Q1.===
Hello,
Can any one who had used Co-60 machine help on this:
For Co-60, how far is the block tray from the patient surface? <16cm, 16cm, 22cm, ...
Khan's book stating has to be more than 15-20cm.
Thanks!

---- Re: Part II question

Guess you answered your own question :) It is 16cm, isn't it?

Q2===
Hi:
For Part II, there is a IMRT question in which the planner can
not define Beams weights or Field sizes?
Thanks,

-----Re: Part II question

Beam Weights

--- Re: Part II question

Since there are so many sub-beams (or beamlets), the planner can not define them. Optimization have to be used to find a optimum solution. The field size usually can be determined automatically based on the target. Please correct me if I am wrong. Xingen

Q3 ==
Hello,
Can you guys please confirm these numbers with me? Thank you, Q.
% attenuation per cm for 6 MV: 3.5%
% attenuation per cm for 10 MV: 2.5%
% attenuation per cm for 18 MV: ~2%

--- Re: Part II question

I supposed you are talking with beam attenuation in water. Open the pdd table,
10x10, 10 cm depth, say you get 67% for 6 MV (PDD), and you roughly get 3.3% per cm. We don't have 10 MV and 18 MV. From Khan's book, I got 10 MV PDD at 10 cm for 10x10=73%, you get 2.7% per cm. For 15 MV, I got from our machine, 76%, about 2.4% per cm. You are right. The numbers are close. Another way is to use the photon mass attenuation coefficients to calculate the
1 cm attenuation.

---- Re:

I agree that your numbers are right I used TMR data to check, I didnt like fooling with the inverse square with the pdd to check. let us hope they are not talking about narrow beam involvement and/or linear attenuation. It is good approximation.

--- Re:

I believe 3.5% in 6MV is common sense. The rest 2 numbers I am not sure. However, more energy will attenuate less percent, this is also a common sense.

Q4 ==
Can someone please help with this part II question?
A linear source has a nonuniform activity. The activity per unit length is:
A (x) = 10 x^2 micro/Ci/cm^3 for 0 _ x _ 10
the activity is zero elsewhere. The centroid of f the activity distribution
occurs at what x? (in cm)
I got 7.2 cm but I am not if that's the right answer.

--- Re:

I am not sure about my approach, but here it is.
Normally, centroid for mass is defined as xc = int(x dm)/int(dm). With similar approach for activity centroid, I will have

xc = int(x dA)/int(dA) [A=10 x^2, dA = 20x dx]

= int(x. 20x dx))/int(20x dx) = (x^3/3)/(x^2/2) = 2x/3 = 2*10/3 = 6.67 cm

---- Re:

check this:
> int x A(x)dx/int A(x)dx for 0_x_10
int x 10x^2dx/ int 10 x^2dx
[10x^4/4]/[x^3/3] 0_x_10
= 7.5

--- Re:

I got centroid @ 7.9cm; see below
A is the activity per unit length = df/dx, where f is the activity (mCi).
Centroid occurs at an Xc such that total activity from 0 to Xc (f(0-to-Xc))is
equivalent to total activity from Xc to 10 (f(Xc-to-10).

Set up the integration equation and solve to get Xc, i.e.

df = 10x^2 dx,
f(0-to-Xc) = f(Xc-to-10)
(10Xc^3)/2 = (10*10^3)/2 - (10Xc^3)/2
Xc = 7.9cm

---Re: Part II question

I got Xc = 7.5 cm by
Integral_{0 to 10} {x^3} divided by
Integral_{0 to 10} {x^2}.

Q5 ===
Part II question
I would liek to ask a help of the group with this question:
Calculate the steradian of a 50cm diameter area on a standard linear
accelerator.

---- RE: Part II question

It seems to me that you are missing important information regarding this problem. Most standard solid angle problems involve small planar areas which can be assumed to lie on the surface of a sphere or at a fixed angle with respect to the sphere's surface. If the area diameter is 50 cm, the distance from the linac must be given. If the distance from the linac is not >> 50 cm, then first principals must be applied to calculate the solid angle using the definition and calculating surface integrals. I would be surprised that this is what was intended for solving this problem. It seems almost certain that the problem is missing important information required for its solution.

----RE: Part II question

The question gave a distance of 100cm with a 50 cm radius.
For some reason I want to say I calculated 0.129??? during the last test?
Anyway, to solve it look in McGinnly.

---Re:

I come up with 0.196 for a 50 cm diameter. Hard to get a 50 cm radius at 100
cm. Anyone else?

Re: Try 50 cm diameter. 25 cm radius. The answer .196 sounds familiar. Anyway I got calculated one of the answers listed on the test following the simple McGinnley equation.

Re: Part II question
steradian is 0.187.
use steradian=2*pi(1-cos theta)
Theta is 14.

Re: Can't it also be obtained by A^2/d^2?
ster=pi*(.25m)^2/1m^2

=.196
4.5%error
Which is more accurate?

Re: Why theta is Â 14? would you please explain? thanks

Re: To me, it should be r^2/(4*R^2). The whole sphere area is 4pi*R^2 (R=1m).
The whole steradian is 2pi (360 degree), therefore:
0.25^2/4 = 0.015625 rad = 0.015625*360/(2*3.14) = 0.9 degree Â
Correct me if I am wrong. Â

Re: Kelin, steradian is dimensionless.

Re: I got the same formula as Robin's but I don't understand why useÂ d = 1m?Â
Calculate the steradian of a 50cm diameter area on a standard linear accelerator?Â Â

Re: Inv tan(.25/1)=14 degrees . You are given 50 cm, and ssd=100cm, a triangle with a base of 50cm and a altitude of a 100cm.You will have a right angle triangle with tan theta =.25/1. I hope this helps. A diagram will clear the confusion.

Re: I think they are talking about standard SSD. The physical picture looks like this: x ray from target confined by jaws(40cmx40cm) project at iso.Â SSD = R = 1m, area = 3.14*0.25^2(not 40x40).
Â

Re: By definition, the steradian is defined as the solid angle subtended at the center of a sphere of radius r by the portion of the surface of the sphere:

The surface area in this regard: A=2*pi*r*h where we have
r=sqrt(100^2+25^2)=103.03, h=103-100=3.03
so the steradian =A/r^2=0.1846, or 2*theta=2*arctan(25/100)=28.086 degrees
[tan(theta)=25/100]

As h is <<SSD=100, A~pi*25^2, r~100, you can get the
steradian~pi*25^2/100^2=0.196

Re: If I remember well the sterradian is calculated as 2*Pi(1-cos theta).
and your theta can be obtained from arctan(25/100)=14

Q5. ==
Can anyone clarify how the speed of sound varies with material density and compressibility.
I have read on Wikipedia that v= sqrt (compressibility/ density). In a college physics book i read it was sqrt (bulk modulus (B) / density) and yet compressibility = is the inverse of B???? Textbook i suppose is correct.

Can I apply some rules of thumb in the event the actual values of B and p are not provided. i.e. overriding determinant: state of matter with the speed being fastest in solids and slowest in gases. Then consider the density- slower in denser materials.
Examples of materials: sound travels faster in water than in air despite having a larger density. sound travels slower in uranium than in iron. these ex were given on the wikipedia site. Can I apply these concepts across the board?

Within a given medium, ie. air, speed of sound will then be modified according to changes in pressure (which affect bulk modulus proportionally) and absolute temp (proportionally).

One question asks if the velocity of sound in air is dependent on wavelength. well of course there is an interrelation v= lambda * f. but it seems changing frequency (sound pitch) will change the wavelength- keeping the velocity constant in the medium.

so...do i dare say speed of sound is independent of wavelength.

----Re: Part I question (bulk modulus-speed of sound)

should have been sqrt(incompressibility/density). the bulk modulus for water is 4 orders of magnitude higher that that of dry air, while the density is only 3 orders higher. so the speed of sound is 3 (sqrt(10)) times higher in water than in air.

yes, speed of sound is independent of wavelength.

Q6. ==

Can anyone please help me understand how to determine the timer error or so called end-effect on linacs?

Say, a 100 MU reading on a linac reads 9.432 nC. 4 readings of 25 MU collectively read 9.501. What is the end effect?

------Re: the equation for end effect is as follows:

end effect = t1*(Reading1-Reading2)/(Reading2-(t1/t2)*Reading1)

For linacs time is MUs.

In your problem, t1=100, t2=25, R1=9.432, R2=9.501.

end effect ends up being 0.173 MU.

---- Re:

I think it's:

9.432/(100+x)=9.501/(100+4x)

x=0.244

---- RE: Part II question

yet another way to find the transit error is to call the average 25 MU readings Av and the 100 MU readings R_100, then:

transit error=[4*(Av) - R_100] / [R_100 - (Av)]

----Re: Part II question

I know two ways to determined the so called timer error. First, by definition

Reading = Conversion-Factor * MU (or beam-on time) + Error

Obviously if you take readings at different MUs, you can derive the Error through linear fitting. This applies to HDR or Co-60 machines as well.

Second (textbook method), you can take readings of one long exposure and multiple (let's say k) short exposures. (Please note - the short exposures do not necessarily have the same MU.) The total MUs of the short exposures should be equal to that of the long exposure. For number (i) short exposure, Ri = CFi * MUi + Error, and for the long exposure, R0 = CF * MU0 + Error. It is easy to see that Sum(Ri) = CFi * Sum(MUi) + k * Error, and because MU0 = Sum(MUi), we have Error = (Sum(Ri) - R0) / (k - 1). Inserting your readings, Error = 0.023 MU.

Q7======================

Does anyone have an idea how to approach this one HDR question? thank you in advance.

Three dwell positions 1, 2 and 3. source # 2 in the middle. Each source is 1 cm apart in a single channel. Dose points A, B and C are 1 cm perpendicular to dwell positions 1, 2 and 3 respectively. What is the ratio of dwell times 1 to 2 to make dose A equal dose B?

------RE: Part II question

use dose=t/r^2, and assume time at 1 and 3 are same.

----- Re: Part II question

for the dose at A and B in fact say at C also to be equal the dwell times at 1 , 2 and 3 positions are in the ratio of 100, 40, 100 respectively.

Q8 ==
Would you please help on following questions

1.AP/PA separation is 20 cm, R/L lateral separation is 38 cm, the dose ratio for a box technique for AP/PA v/s R/L lateral is
1/1 1.5/1.5
1/1 2/2
1.5/1.5 1/1
2/2 1/1

2. A room next to radiation therapy room has use and occupancy factors of .25. 50 patients are treated per day at a dose rate of 400 MU/min. when the machine is operated at 200 MU/min the exposure rate is 250 R/min at isocenter. The distance to the next room is 5 meters, and the wall is designed for 8 HVL's. Does the adjacent room
A. meet NRC requirements
B. requires no additional shielding but a radiation safety shield must be hung on the door
C. 1 additional HVL
D. 2 additional HVL

3. The exposure rate outside a primary wall of linear accelerator is 15mR.hr.The exposure rate at isocenter is 400 R/min. If W= 60,000 R/wk, T= 1, U=1/4 and p=.01/wk, the shielding needs to be supplenmented by -----------additional HVLs

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Q9 ===========================
Here are a few questions.. Can anyone please help? At what energy does a MC (Monte Carlo) calculation stops and bundles everything
into one?
about 200 KeV

What can say about phase space files in Monte Carlo calcs?
they strore the space and time (position and momentum etc) information of particles

If coll rotation is off by 1.2 mm couch is off by 1.4 mm and gantry is off by 1.5 mm what is the overall ncertainty?
sqrt(1.2x1.2+1.4x1.4+1.5x1.5)

---- Re: 10 kev is the cut-off energy for neglecting the contribution of these low energy particles to dose while 200 KeV is a cutoff energy when we do not trace particles as discrete entities but boundles all of them into one continuous distribution in the dose calculation, ie these low energy particles are still having contribution to the dose. 10 kev is the cut-off energy for neglecting the contribution of these low energy particles to dose while 200 KeV is a cutoff energy when we do not trace particles as discrete entities but boundles all of them into one continuous distribution in the dose calculation, ie these low energy particles are still
having contribution to the dose.

--- Re: Thanks for the explanation, but do you have a reference for that? It was my understanding that 10keV was the cutoff to assume the dose is contributed to the voxel in which it exists and was assumed not to travel any farther. The original question seems a bit ambiguous and I can't find a good explanation for it anywhere. I assumed it should be in TG105, but I couldn't find it.

---Re: You may check this article
Int. J. Radiation Oncology Biol. Phys., Vol. 72, No. 1, pp. 220â€“227, 2008 I do not think that it is a cut-offÂ thatÂ everyone mayÂ agree upon. It all depends on a compromise between the speed and acceptable errors, and which Monte-carlo code you are running. So, to be honest, I do not know the answer that ABR wants. It could be 100, 300, 500 KeV, for instance.

Q10 ==========================

1. Definition of EDU?
2. What is the max dose you can prescribe for SRS with a 4 mm cone?
3. When treating lung tumor, what is the dose associated with radiation pnemonitis? that is V20, or V50...
4. Meaning of equivalent uniform dose in context of given non-uniform dose distribution bus asking to find a uniform dose that gives the same BED? I wonder if they mean Quimnby vs PP systems?
5. Also, this question is "killing me" I have seen variations in how people answer it but never with an agreement as to what the right answer is.... A universal wedge with wedge factor of 0.25 is use to deliver a beam with an effective wedge angle of 30 deg. What is the fraction of MUs delivered by the wedged portion of the field? If we use 30= (1-F) 60 it would give us F= 0.5 and if F = open/(open +wedge) then the wedged MU should be 4 times as high, is that right, can someone please help me with this?

--- Re:

EUD: (equivalent uniform dose), a dose when distributed uniformly across the target volume, causes the survival of same number of clonogens as the true dose distribution. It can be calculated from DVH and radiobiological parameters. mean dose<EUD<min tu dose
from Ref. (IMRT summer school 2003) by Ellen Yorke

--- Re: Sorry. Correction EUD mean dose>EUD>min tu dose

----Re:

For > 2. What is the max dose you can prescribe for SRS with a 4 mm cone?

We don't do SRS at our clinic so i'm having a hard time researching an answer for this too. But looking at TG-42 (SRS) I found a curve on page 43 that illustrates dose determination for AVMs. It gives a corelation between beam diameters and max dose that can be used before 1% of a population might experience cerebral necrosis. By extrapolation i got something like ~58 Gy on a 4mm diameter. Maybe a little less for a safety margin? Does anyone know if I am interpreting this correctly? SRS people can you ask your docs.

--Re:

Ignoring for a second that this question seems to be worded pretty ambiguously (not your fault!) let me just say that for the CyberKnife, which uses at smallest a 5mm cone, it is fairly standard to treat a trigeminal neuralgia patient with 5600 - 6000 cGy, signed to as low as the 75% line. This leads to doses around 7500 cGy (yes, in a single fraction). Just a datapoint.

--- Re:

We treated a trigeminal with 8000cGy to 100% line, single fraction , 5mm cone (radionics).

----Re:

For trigeminals at our clinic we routinely prescribe 80Gy to the 90%IDL(88Gy)
with a 4mm cone in 1 fraction.

--- Re:

In SRS the only site that needs 4-5mm cone alone is Trigeminal and the typical prescription is 80 Gy to Max. So max dose for 4mm cone is 80 Gy.

----Re:

I have no idea on the Monte Carlo question. Can anyone help?
The later one should be (1.2^2+1.4^2+1.5^2)^1/2. Correct me if I am wrong.

Q11===

I searched the old post and find some answers for this question but it made me very confused. the questions is one of the ABR sample questions:

1. A 4-MV linac beam, 10 cm x 10 cm with a 45?wedge, is used to deliver 200 cGy to a tumor located at the isocenter (100 cm SAD) at 10-cm depth. Given the following:
1. output at 100 cm SSD at d max 1.2 cm is 1.04 cGy/MU
2. wedge factor 0.70
3. back-scatter-factor 1.03
4. percent depth dose 60%

5. tissue-air-ratio 0.75

What is the number of monitor units (MU) required for this treatment?
1. 206
2. 258
3. 296
4. 366
5. 468

one of the answers is:
The first question is tricky. It's an SAD setup, so you don't use the PDD values given. Also, they gave you the output at dmax, so you don't need the BSF either.200 cGy/(Output * Wedge factor * TAR = 200 cGy/(1.04 * 0.7 * 0.75) = 366 MU. D, which they list as correct.

My confusion is when they say "output at 100 cm SSD at d max 1.2 cm is 1.04 cGy/MU" is it in air or water? Even we don't need to use BSF, we still need to correct the dose rate from 100SSD to 100SAD, right? I still can't get 366 and didn't get the logic in this answer as well. Anyone can explain it again? Thanks.

---- Re:

Here is what I would do....
From Kahn SAD factor = the square of (SCD/SAD) = (101.2/100) squared = 1.02
output at SAD = 1.02*1.04 = 1.06
MU = 200 / (output*wf*tar) = 200 / (1.06*0.7*0.75) = 359
Mike

---Re:

Thanks. I think it really depends on how to interpret "the output at dmax", if it is in air, the way you did is correct to me. However, when it says "output at 100 cm SSD at d max", we probably should look at it as it is in phantom by default, in that way, I think we need to use BSF to get TMR. no matter what the answer can't be 366. I think I understand this question now but it is still very frustrated that ABR post such a unclear question in their web.

Q12==================================
Can anyone please help with this question? thank you
A dose rate in air at 40 inches from a superficial X-ray unit source with 125 KVp is 100 mA.sec. What is the dose rate at 2 cm depth Given; %DD= 0.60 BSF= 1.15 and fmed = 0.9

Q13=======================================
Is there any conversion factor for converting in to cGy from mCi**.**

------Re

cGy and mCi are entirely different units of measure. In many instances for fixed geometries and isotopes, one can sometimes relate cGy/unit time per unit activity or cGy can be related to the time integral of activity (cumulated activity). The relation between these two very different units depends on the circumstances of the situation in question. In nuclear medicine for example, relations between doses and activities are used in MIRD tables for computing cGy/micro-Curie-hour are common and depend on the specific radionuclide. In brachytherapy, doses used to be expressed in terms of cGy/mg-hr when radium analogs were used.
Better than this, there is no firm relation between the units of activity and absorbed dose.

----- Re:

There is the specific gamma ray dose constants at 1 meter table. The constants are a general rule of thumb for use in shielding and health physics calculations. It may be a good idea to know the constants for Ir-192, Cs-137, etc. Keep in mind the table is only for an isotope outside of the body at 1 m and every isotope has a specific Gamma.
I used this to figure out how many TVLs I needed in a container when I shipped out an old Cs-137 source.
http://www.epa.gov/rpdweb00/docs/wipp/08-0442%20attach%203.pdf

--- Re:

mCi x 1.27 = Sk for I-125 and 1.293 is for Pd-103. These are given in TG-43. Ir-192 for HDR I think was mCi x 4.082 = Sk.

Q14==
1. Orthovoltage shielding calculation?
b=p*d*d/wut, am i right?

2. What is the dose rate at 1m from a patient receiving external beam treatment

3. If the high voltage power source is pushing too much, what is the most likely observed result on the accelerator.

4. Multi detector CT, when cone beam increases size, what's true: Collimator decreases, scatter photon increases, etc. (not quite sure about the answers)

5. Morning (daily) QA for a HDR brachytherapy treatment source per TG-40

6. What does Gamma measure? what gamma?

7. Calculate collimator angle for opposite lateral brain fields to match the divergence from a spine field. Field size 27cm, Spine inferior 20cm and spine superior 17cm.

8. Given a graph of ionization current vs polarization voltage with different areas marked select which detector works at specific area? What are they testing? which chapter in khan?

9. What can be said about TBI. (compensators can be used, requires long treatment distance, lateral irradiation brings higher inhomogeneity that AP irradiation, 5% dose homogeneity could be achieved for all distances).

10. Radionuclide and energy emission from Sr-90 eye applicator.

11. An error of 2 mm in MLC opening causes an error of xx % in 2cm radiation field? 2.2/2 or 2.2*2.2/4?

12. For wedge angle qustion, is it tatcher relationship: new Wedge angle = (1-F) Universal wedge angle, and take into account the with a WF, i didn't see a this equation in book? anybody know?

13. How often does barometer need to be calibrate?

14. Kair for IVB source defind at what distance?

15. How does an electron cone cut out affect? output/ pdd/ flatness/depth at 50%/ dpeth at 90%

16. Which is used for palliative treatment of bone mets? Sr-89, I125, p32

17. NRC required HDR shielding to be survery? daily, weekly, mothly, annually, after source change.
I choose after source change

18. what is range of SR90 beta in air

------- Re:

7. ASSUMING SSD = 100cm...THETA = 9.5 degrees THETA = arctan(17/100).
10. strontium is abeta emitter with decay energy of 0.546 MeV
15. if cutout dimensions are smaller than range of electrons then: output & pdd decrease, flatness gets worse, depth of 50 & 90 % shallower
16. Which is used for palliative treatment of bone mets? Sr-89...also a beta emitter
18. what is range of SR90 beta in air: I found range to be 10.62 m in air (not 100%)

----- Re:

> 1. Orthovoltage shielding calculation?
> > b=p*d*d/wut, am i right?
for the primary barrier, yes.
> > 2. What is the dose rate at 1m from a patient receiving external beam treatment 0.1% of primary (not

100% on this on)
agree.
> > 3. If the high voltage power source is pushing too much, what is the most likely observed result on the accelerator.
your beams will be overpeaked.
> > 4. Multi detector CT, when cone beam increases size, what's true: Collimator decreases, scatter photon increases, etc. (not quite sure about the answers)
not too sure about this but would guess, scatter photon increase.
> > 5. Morning (daily) QA for a HDR brachytherapy treatment source per TG-40
door interlocks, lights, alarms, console functions, switche, batteries, printer, visual inspection of source guides, verify accuracy of ribbon preparation.
> >> > 6. What does Gamma measure? what gamma? Exposure Rate Constate (R cm^2/mCi hr)
exposure rate at 1 cm from a 1 mCi source, or if talking about film, it’s the linear portion of the H&D graph and describes the contrast.
> > 7. Calculate collimator angle for opposite lateral brain fields to match the divergence from a spine field. Field size 27cm, Spine > > inferior 20cm and spine superior 17cm. ASSUMING SSD = 100cm...THETA = 9.5 degrees THETA = arctan(17/100).
theta=arctan(8.5/100), refer to Khan 13.17B, i'm assuming that we have two adjacent spine fields and will use superior field.
> > 8. Given a graph of ionization current vs polarization voltage with different areas marked select which detector works at specific area?What are they testing? which chapter in khan?
ion chambers are to be used in the near-saturation or saturation region.
> > 9. What can be said about TBI. (compensators can be used, requires long treatment distance, lateral irradiation brings higher inhomogeneity that AP irradiation, 5% dose homogeneity could be achieved for all distances).
all except 5% dose homogeneity, i think its more like 10%.
> > 10. Radionuclide and energy emission from Sr-90 eye applicator.
> strontium is a beta emitter with decay energy of 0.546 MeV
yes but remember that practically speaking, the 0.546 MeV beta is shielded by the encapsulation and its the 2.27 MeV beta from Sr-90's daughter Yttrium that does the work (T1/2=64 hours).
> > 11. An error of 2 mm in MLC opening causes an error of xx % in 2cm radiation field?
> > 2.2/2 or 2.2*2.2/4?
if you assume your MLC is at 20cm and your SSD=100cm, then you would have an error of 50%.
> > 12. For wedge angle qustion, is it tatcher relationship: new Wedge angle = (1-F) Universal wedge angle, and take into account the with a WF, i didn't see a this equation in book? anybody know?
there seem to be two ways to do this,
first is ratio of tangents of angles, then take into account the WF, this gives a ratio of wedged MU's to open of 1:1.
tatchers equation results in a ratio of 2:1 which using the ratio of the angles,not the tangents. there is a paper out there that states that the tangent method more closely matches measured data though i'm still not sure which method i'll use.
> > 13. How often does barometer need to be calibrate?
every 3 months, tolerance: +/- 1 mmHg
> > 14. Kair for IVB source defind at what distance?
2mm from source center
> > 15. How does an electron cone cut out affect? output/ pdd/ flatness/depth at 50%/ dpeth at 90%
> > if cutout dimensions are smaller than range of electrons then: output & pdd decrease, flatness gets worse, depth of 50 & 90 % shallower
agree.
> > 16. Which is used for palliative treatment of bone mets? Sr-89...also a beta emitter
agree.
> > 17. NRC required HDR shielding to be survery? daily, weekly, mothly, annually, after source change.
> > I choose after source change...I agree
if we are talking about source housing then yes, as for room shielding i want to say that this is only done at installation or when you make a major change.
> >18. what is range of SR90 beta in air
> > I found range to be 10.62 m in air (not 100%)
if you use the energy of the pure beta of Sr-90, E=0.54 MeV then I get something like 1.5 m, but if you use energy of its daughter product yttrium E=2.27 MeV, then you get 9.7 m.

Q15=-=================================
More questions, hope anybody can help.
1. For a xray tube with 100ma and 100kVp, the HU has sigma of 1.5, if the current is raised to 400 mA, what is the new sigma of HU?
2. A point 2cm outside of 10*10 treatment field at 10cm depth, what % of dose does it get?
3. 18MV photon linac, what is the biggest contribution to exposure behind the gantry stand? Is it patient scatter, wall scatter, col scatter, head leakage...etc?
I choose head leakage
4. Counts given (cpm) for reference source with known activity (mCi). How many counts allowed to stay below wipe test leakage limit – limit not given (5nCi?).

5. Dual scattering foil in linac, when change to electron mode (from photon) what happens. A. gun current reduces substantially, B. Both scattering foils are in place C. other options that were way off.

6. TG40 how often do you check well chamber leakage.A. 2 years, B. Every use, C.…

7. Biggest impact on fetal dose according to TG36. A. Distance to fetus, B. energy C. Blocking, D. Depth below abdomen surface.

8. HDR 192Ir. Patient treated with time XXX with Activity YYY on Aug 15th. Source replaced with activity ZZZ on Aug 17th. Treatment time on Aug 22nd is ? No 192Ir half life given.

9. Electron cutout changed from 6x6 to 4x4. What doesn't change, A. Bremstrahlung B. Output Factor, C. Depth of 80%, D. Surface Dose.

10. A survey points a linac beam at a primary wall and measures 2mR/hr. Is this OK?

11. An ion chamber is used to perform a survey. You also need all of the following except: A. Dose rate of linac B. Sufficient buildup around the survey meter

12. What happens when you change from 15cm field size to 20cm field size for electrons. No energy given. Various combinations of change in surface dose (increase / decrease) and change in dmax (increase/decrease). Only one option had no change in surface dose (which I chose)

13. Four field prostate treatment to 200cGy. What is the dose to anterior rectum. No other information was given, anterior was in bold. I answered 200cGy.

14. What should you check with each use of an ionization chamber / electrometer.

15. A 60Co single field calc 100SSD, cGy/min at dmax given. PDD table given, BSF table given, TAR table given. Prescribed dose was 300cGy to 10cm deep. Had to use 4A/P to convert to square field (had to use 4A/P on numerous rectangular field questions.

16. Dose 10cm deep 5cm outside field is A. 1% B. 2% C. 3% D. 4% E. 5%

---- Re:

Numbers 2 and 16
For 6 MV photons 2cm outside of a 10x10 field 7% the CAX dose at 10cm
For 6 MV photons 5cm outside of a 10x10 field 3% the CAX dose at 10cm

For 18 MV photons 2cm outside of a 10x10 field 5% the CAX dose at 10cm
For 18 MV photons 5cm outside of a 10x10 field 2% the CAX dose at 10cm

#5 (A) The gun current will go way down factor of 1000

#12 The output will decrease but the shape fo the depth dose curve will be the same provided the electron enery is less than 30 MeV

----- Re:

where did you get these values for the doses at points outside the field. I found similar results from scans that i had done but when i tried to do a negative field method calculation using TMRs i get values very low. Thanks

---- Re:

I have different values that were given at the ACR review course. The are all within a percent or two. Hopefully if you know a close approximation it will get you close to the answer they are looking for. I know RAPHEX uses 5% at 2cm from a block. That becomes a problem when they give answers that are very close.

--- Re:

It is from a Pinnaclecalculation! I placed points at a depth of 10 for a 10x10 field. I verified the accuracy of the point calculation with a Wash U paper (I am @ home and don't have reference with me) for doses out of field used for pacemakers at distances of 5 cm.

--- Re:

Also Peripheral dose from megavolt beams , Fraass BA, van de Geijn J
Med Phys. 1983 Nov-Dec;10(6):809-18

--- Re:

> 1. For a xray tube with 100ma and 100kVp, the HU has sigma of 1.5, if the current is raised to 400 mA, what is the new sigma of HU?

raising the mA results in more signal => 1.5/sqrt(4)=1.5/2=0.75

> 3. 18MV photon linac, what is the biggest contribution to exposure behind the gantry stand? Is it patient scatter, wall scatter, col scatter, head leakage...etc? I choose head leakage

agree.

> 4. Counts given (cpm) for reference source with known activity (mCi). How many counts allowed to stay below wipe test leakage limit – limit not given (5nCi?).

leak test limit is 5 nCi which is 1.1*10^4 dpm

> 6. TG40 how often do you check well chamber leakage.A. 2 years, B. Every use, C….

each use

> 7. Biggest impact on fetal dose according to TG36. A. Distance to > fetus, B. energy C. Blocking, D. Depth below abdomen surface.

distance to fetus

> 8. HDR 192Ir. Patient treated with time XXX with Activity YYY on Aug 15th. Source replaced with activity ZZZ on Aug 17th. Treatment time on Aug 22nd is ? No 192Ir half life given.

time(aug22)=time(aug15)*A(aug15)/A(aug22)

Another reply: For this problem, you need to find out dose delivered (D = dose rate constant * activity*time). Then determine amount of time (To)needed to deliver dose with new source on Aug 17th. Finally, determine new time T = To/(exp^(0.693/74)*t...where t is days elapsed from Aud 17 to the 22nd.

>> 9. Electron cutout changed from 6x6 to 4x4. What doesn't change, A. Bremstrahlung B. Output Factor, C. Depth of 80%, D. Surface Dose.

bremstrahlung

>> 10. A survey points a linac beam at a primary wall and measures 2mR/hr. Is this OK?

2mR/hr is approx 42mSv/yr (assuming 2088 hrs/yr) which is less than 50 mSv/yr, so yes

>> 11. An ion chamber is used to perform a survey. You also need all of > the following except: A. Dose rate of linac B. Sufficient buildup around the survey meter dose rate of linac

> 13. Four field prostate treatment to 200cGy. What is the dose to anterior rectum. No other information was given, anterior was in bold. I answered 200cGy.

anterior rectum is right next to prostate so i'd say 200 cGy also

>> 14. What should you check with each use of an ionization chamber / electrometer.

leakage, collecting potential (TG-40)

>> 15. A 60Co single field calc 100SSD, cGy/min at dmax given. PDD table given, BSF table given, TAR table given. Prescribed dose was 300cGy to 10cm deep. Had to use 4A/P to convert to square field (had to use 4A/P
on numerous rectangular field questions.

time=300cGy/[# cGy/min @dmax in air]*[BSF]*[PDD]*[ROF]

Q16===

I am having trouble with ratio of air density to mercury in order to calculate barometric pressure at a given altitude. Initially I thought i could just ratio 1.29kg/m^3 / 13.6 E3 kg/m^3. however I realize that density changes with altitude. I then came across this prior asked question in the posts. Can anyone explain the ratios or direct me as to where I can find a good explanation. Is it some sort of mb??

The air pressure at Denver has been puzzling me. The elevation is roughly 1700m. If we convert this height in air to that in mercury simply by the ratios of densities, it is equivalent to:

1700mAir*(1mHg/10000mAir)*(1000mm/1m)=170 mmHg, which means the air pressure at Denver is 760-170=590 mmHg. However, data from www.weather.com indicates about 755 mmHg at Denver. Why?

---- Re:

P=P0*Exp(-h/H), where H is about 8500m, h is the altitude of interest, P0 is the pressure at sea level. Actually, even if you ignore the exponential and just scale the density linearly, you will only be off by a few percent as long as you are not on Mt. Everest.

The reported pressure from a weather station has been corrected for altitude to sea level.

---- Re:

I hope everyone here realizes that barometric pressure should not be used for calculation of the temperature pressure correction factor. Barometric pressure is used by meteorologists to predict weather patterns. In order to compare pressures, station pressure (absolute pressure) is normalized to sea level.

This corrected value is what we call Barometric pressure. Unless your machine is at sea level, using barometric pressure in the TPC will be wrong.

There is a classic radiation accident that occurred when a locum physicist asked for station pressure in Colorado. I am trying to remember this from a short presentation, so my recollection may not be 100 percent accurate. Anyway, here are the basics of what happened: The airport gave him the barometric pressure and because he was a locum he was not familiar with the usual TPC values. The machine was calibrated at 8% or so hot. No MD Anderson TLDs were done and the machine was used on many patients. Several patients had significant complications.

If you have the altitude of the weather station/airport, you can back calculate to the real pressure.

http://www.csgnetwork.com/stationpressurecalc.html

I remember seeing a question related to this on Part 2 last year.

Q17===

but I was wondering if someone could help me on the following:

for wht type of external beam treatment would it be important to have the linearity accurate for small numbers of MU?

-- Re: IMRT yes, but specifically "step and shoot" IMRT, where there can be many segments with small mu's....

---Re: This is why I set our min MUs to 4 (I've checked it to 3 but trust 4 more) for step n shoot IMRT (and also for forward plan control point treatments). Below 3...

----Re: I also set 4MU as minimum. The major reason why the linearity fall apart is the end effect causes bigger uncertainty for small MUs.

Q18==

The dose to pacemaker will be kept below 2.0 Gy. In a lung treatment of 40Gy with 10MV photon, the field should be no closer than ______ to the pacemaker. The answe is 2 cm. How ?

--- Re: You can check the dose profile of 10 MV. 1 cm outside the field edge is about 20%, and 2 cm is about 5% (Inverse square law). So 5%x 40 Gy is about 2 Gy. Today's maximum allowable dose of pacemaker is usually larger than this limit. You need check with the vendor. Good luck.

--- Re: I would suggest to take a look at TG report on dose to fetus. It has plots of dose vs distance from the field edge

--- Re: Scatter radiation is directly related to the output (x-ray intensity) of the primary x-ray beam and is about 0.1 percent of the primary beam if measured 90 degrees from the primary beam at 1 meter away (see Health physics society http://www.hps.org): 2gy/40gy = 0.05 or 5% 0.1% at 100 cm or 10% at 1 cm, 5% at 2 cm, etc.

Q19==

I have a quick question regarding the 2mrem/hour tolerance level. As far as I understand that tolerance level (2mrem/hr) is only applicable to uncontrolled area and that too only if we take the Occupancy factor as 1 (as mentioned by Mcgingly). Other than that at least for the LINAC the 1msv/year is applicable. So being that i were to read 4 mrem/hr in a room which i have considered a uncontrolled are having a occupancy factor of 1/5, it would be ok. Please correct me if i am wrong.

----Re: There is a different between 2 mrem/hr and 2 mrem in an hour. I think the regualtion state 2 mrem in an hour. I hope this helps

----Re: Yes. The regulation specify 2mrem "in any one hour". Tejas858 is wrong about using T factor here. The 20microSv "in any one hour" can consider the U factor but not T.
And more important, you have to use the W (workload) corrected by the maximum number of patient that can be exposed in any one hour.
So you can have a reading such as 200 mrem/h and be ok with the "dose rate" constraint for uncontrolled area. (for instance, with Cyberknife). You should use T to show compliance with the weekly limit of 0.02mSv. H <= Rw xT.

----Re: There is a difference between the two and if you read NCRP-151 it is clear what they want. The instantaneous rate cannot be more than 2mrem/hr and one cannot get a total of 2mrem in any hour. I hope this is clear

Q20==

Oral questions:

1. Rational for image fusion, How do you carry out an image fusion? Are you familiar with any image fusion algorithms? What are the five imaging modalities that can be fused?
2. What is scanned beam, continuous beam, pulsed beam.
3. Are the 12 MeV beams generated by two linacs equal? why
4. How/what would you estimate ganadal/ fetal dose for a woman with breast cancer receiving tangents and e-boost to a dose up to 60 Gy? Where do you find guidance on this? What can you do about it? What dose levels would cause you to be concerned about fetal risk? What are
the magnitudes of the risks?
5. What QA tests do you do for your MLC?

--- Re:

Image Fusion:

Rationale: To get the best of both worlds. Different imaging modalities give different information and each one has its own advantages. CT gives anatomical information and electron density information, MRI has good soft tissue contrast and PET gives metabolic information. You could even fuse data sets from same imaging modalities, like pre implant and post implant CT's.

Image fusion is combination of two processes.
Image registration + Data fusion.

Image registration:
Manual techniques and Automatic techniques
Manual Techniques:
1) interactively superimposing two data sets—translation (3 degrees of freedom—X,Y, Z), rotation (2 degrees of freedom—CC and CCW), tilt, scale and may be warp (no software's have this option yet)
2) Point to point fitting – anatomical points or fiducial markers
3) Surface or topography matching

Automatic Techniques:
1) Point to point fitting --- reduce the root mean square between the points
2) Surface or topography matching --- Chamfer algorithm – reduce the square of the minimum distance
3) Edge detection algorithm
4) Minimize mutual information: This is the most accurate and widely used algorithm out there.
Voxel intensity histograms from each data set are generated and a joint voxel intensity histogram is computed. Mutual Information is similar to cost function in the IMRT algorithm. It's a probability function and is an indicator of the likeness or similarity of the two voxel intensities from each data set. The MI is maximum when the two data sets are perfectly registered.
(another reply: I just have a comment on your comments about the Minimize Mutual Information it should be MAXIMIZE MUTUAL INFORMATION to get the best Intensity Histogram.)

Data Fusion:
1) Integrate the voxel intensities by simple addition, multiplication or subtraction.
2) Display on adjacent windows with linked cursors

3) Display on single window as color wash display
4) Display on a single window with the primary data set in grey scale and the secondary data set in pseudo color wash
5) Checker Board display

---Re;

2. What is scanned beam, continuous beam, pulsed beam.
A- ELECTRONS ARE SCANNED USING MAGNETS AND A BEAM IS MADE USING RASTER SCANS.
B- CO-60. C-LINACS. IF YOU DO NO UNDERSTAND THE LAST ONE YOU ARE IN DEEP TROUBLE. GO TO VAN DYKE'S BOOK.
3. Are the 12 MeV beams generated by two linacs equal? why
SIMILAR BUT NEVER EQUAL. WHY? FOR THE SAME REASON NO TWO CARS OF THE SAME MAKE, MODEL AND YEAR ARE EQUAL--MANUFACTURING PECULIARITIES.
4. How/what would you estimate ganadal/ fetal dose for a woman with breast cancer receiving tangents and e-boost to a dose up to 60 Gy? Where do you find guidance on this? What can you do about it? What dose levels would cause you to be concerned about fetal risk? What are the magnitudes of the risks?
HOW? TPS, IN VIVO MEASUREMENTS, HAND CALCULATIONS. GUIDANCE: SEE AAPM REPORT ON FETAL DOSE/PREGNANT. YOU CAN SHIELD AS MUCH AS POSSIBLE, YOU CAN MINIMIZE THE SIZE OF THE BEAMS TO MINIMIZE SCATTER, YOU CAN SPEND MORE TIME PLANNING/SEEKING FOR THE MOST FAVORABLE PLAN TO THE FETUS. IDEALLY WANT TO KEEP
THE DOSE LOWER THAN 10 CGY. DOSE-FETUS> 100CGY = SIGNIFICANT RISK FOR RADIATION EFFECTS.
5. What QA tests do you do for your MLC?
REPRODUCIBILITY OF PATTERNS.

Q21===
Oral : Air Kerma Strength
1. Why do we use air kerma strength? Is it because it is traceable to Nist. Are the other source strength specifications quantities such as activity, apparent activity, exposure rate traceable to NIST. What is the difference between activity and apparent activity.
2- What is the overall acceptable uncertainty in the delivery of brachytherapy dose. TG40 mentions 15% in certain cases. Is there a similar number like the 5% we aim for in external beam?
-- Re:

Air kerma strength is a measure of the actual radiation output. Activity is the number of atoms which decay per unit time. As each radionuclide has its own emission spectrum and probabilities with widely varying degrees of output. Air kerma strength gives a measure of the energy transferred to a unit mass of air at 1 cm from the source. Air kerma strength is also not restricted to radionuclides. As silly as this sounds, linac output could be expressed in terms of air kerma strength. Try expressing linac output in terms of apparent activity. A good way to see the benefits of using air kerma strength is to visit www.standardimaging.com. If you go to the online manual for the HDR-1000 Plus well chamber, you will see that typical charge/air kerma strength values are very nearly equal to one another. The charge/activity values vary greatly depending on the radionuclide. The only outlier value for charge/air kerma strength being different from the other radionuclides is I-125 (I believe because of it very low energy photons detected by the well chamber but removed by NIST). In short, air kerma strength gives an immediate feel for the true strength of the source, irrespective of whether it is a radionuclide, an x-ray tube or a linac for that matter.

---Re:

We have to Use AKS to shift to SI units. Years back NCRP has recommended shifting to Exposure strength and so when SI units wsa introduced we shifted to AKS.
The reason for recommending Exposure Strength (which later become AKS) :
What we need is the tissue dose at a certain distance from the source when it is embedded in a medium. This was traditionally obtained by determining the exposure at a certain distance from the source in air and correcting for the perturbation when the whole configuration was embedded in a medium, which was the traditional Meisberger correction.
The funny thing was, before the recommendaion of ES - Exposure Stength - Exposure measured at a distance 'd' was used to define an apaparent activity using the realtion - Apparaent activity x Gamma factor - Exposure at 1 meter - / d x d = Exposure measured at d, and the user used the same realtion again to get back Exposure at 'd'. This was an unnecesary exercise. ES could have been used directly by the user to determine Exposure at any distance 'd' using the ISL. This roundabout method was unnecessary and hence ES was recommended.

The
problem became serious with HDR Ir because there was large uncertainty in the gamma factor and the calibration lab used one factor and the user used a different factor and hence they were not getting cancelled and causing addional uncertainty.

When this recommendation came the TPS was not accepting Apparent activity and only much later it started accepting AKS. Unfortunately for a long time and perhaps even now the TPS accepts App. activity which is wrong. As long as you use the App. activity route you rae still likely to commit this error though the CAl. lab. started mentioning explicitly in the certificate what App. activity they were using so that you could use the same fcator.

Forget about Activity. It tells you the actual disintegrations occuring in the source which is not possible to determine because of self absorption. What we get is only App. activity from the above equation. I.e. if the source were apoint source of activity = app. activity it would give the measured exp. at the measured distance.

Reg. TG 43 rec., about 5 % is what we recommend in Ext. Beam therapy and it can not be achieved in complex cases where the uncertainty could be more. Because of the ISL effect and other uncertainties, about 15 % in complex cases seems to be resaonable in brachytherapy.

Q22==

What is difference between Ppol and Pion

-- Re

Ppol is dependant on more than just beam quality. It can be affected by the position of the cable...etc. This is why Ppol should be measured each time clinical dosimetry is determined (i.e. during an annual).

Pion is a correction factor for a particular chambers inability to collect all of the charge created in the chamber before the charges are able to recombine (the lower the Pion value the more efficient the chamber's collection ability). Pion is a function of both the chamber AND a function of the dose per pulse in an accelerators beam. Pion values can change if there is a difference in dose-rate and/or if there is a change in the pulse rate for a fixed dose-rate.

Therefore it is important to measure Pion for all beams and dose-rates used clinically. Pion for a chamber should be < 1.05, or the chamber should not be used.

Q23==

I know there is a simple way to solve this problem, but I can not get my head wrapped around it right now. Any sugjestions on how to solve it?

• 13.05 nC exposure, W/e = 33.3J/c 2.58 x 10 R/C What is the volume of gas in the chamber?

--- Re:

From the definition of exposure:

X = Q/m, X: exposure, Q is charge in C and m mass of air in kg. (1) [Units in C/kg]

Take into account that 1 R = 2.58E-04 C/kg

And from the definition of density:

ro= m/V, ro air density in kg/m**3, m mass in kg and V volume of the chamber in m**3 (Volume generated by the electric field inside the chamber).

m = ro * V (2)

From (1): m = Q/X

From (2): V = Q/(X*ro)

Exposure in the chamber: Calib factor * Q in R to convert it to C//kg multiply by 2.58E-4 C/kg/R, all together in one equation follows):

V = Q / (CalibFactor*Q*ro*2.58E-04 C/kg/R) [m**3]

V= 13.05E-09 C /(2.58E+0X R/C * 13.05E-09C *1.025 kg/m**3 * 2.58E-04 C/kg/R)

[units en m**3, convert o cc]

E+0X is because in your question you didn't specify this value. It has to be high enough so the camber volume is reasonably small enough.

Q24==

200 keV beam. The density of copper is given in g/cm3, and the ì/î/ñ for copper is given in cm3/g. If 3 cm of copper attenuates the beam to 63% of its original intensity, what is the TVL for copper? Seems to me the energy, depth, and 63% are extra information.

Here is how I solved it: I/Io = (1/10) = e^-(ì tvl)

thus: tvl = 2.3/ì

ì can be calculated from the density and the linear mass density.

ì = ñ(ì/ñ)

Am I wrong? Do any of you have any other solutions? According to Johns & Cunningham: ì/ñ = .0157 m^2/kg & ì/ñ = 8960 kg/m^3 Using these figures the tvl for a 200 keV beam in copper is 1.63 cm.

-----Re

Are you sure the problem says that is 3 cm and not 3 mm? In KV the HVL are in the mm range of Copper and Aluminum.

First, no matter what there is an easy way also to check that your answer is wrong (assuming 3 cm or 3 mm the result is the same):

If 3 cm of coppper attenuates the beam by 63 % only, then your HVL has to be thicker than 3 cm and your TVL way thicker...

Here is the fast solution:

I/Io = exp(- ln2/HVL * Thickness)

ln 0.63 = - ln2/HVL * Thickness

HVL = -ln2 /ln 0.63 * Thikness (in yor problem HVL = [-0.693 / -0.46] * 3 mm = 4.52 cm)

TVL = ln 10/ln 2 * HVL (in your problem TVL = * 4.52 cm = 15.01 cm)

The end (off course I still think the problem states that 63 % of the beam is attenuated by 3 mm of Copper).

In general:

ln 2/HVL = ln 10/TVL = ln 5 / FithValue Layer = ln 20 /Twentieth Value layer and so on. This expedites a lot calcs. It can be easily shown that it is correct.

--- Re:

The question was copied an pasted from the 2008 recalls. I agree 3 cm seems to be a bt much and may just be due to the recaller getting the units a bit mixed up.

--- Re:

I still think the information in the question regarding thickness and % attenuation is irrelevant since the TVL and HVL can both be calculated from other information in the question. Namely the density (p) and linear mass density (u) – u = (u/p)/p.

Johns and Cunningham list the following values in their book.

Density of copper 8960 kg/m^3

Linear mass density 0.0157 m^2/Kg

And the linear attenuation coefficient is (8960 kg/m^3)(0.0157 m^2/Kg) = 140.8m^-1

HVL = ln(2)/u = 0.693/140.8 m^-1 = 0.0049 m

TVL = HVL*3.2 = 0.0049 m*3.2 = 0.0158 m

Alternately:

TVL = ln(10)/u = 2.3026/140.8 m^-1 = 0.0164 m

While not identical I believe these 2 results support each other – a difference of only 0.0006 m.

My assumption is that the information in the question regarding thickness and attenuation is there to through you off.

--- Re:

Fine, but the way I solved it does not require the use of any table. You are not going to be given any table on the exam.

From the attenuation, and the thickness one can get the HVL, TVL without the need of tables if the assumption is made,as in my calc that it is not a broad beam. In the real world you have a buildup factor B(E,d) on the expression too.

One take home tip:

ln2/HVL = ln 10/ TVL = ln N/Nth value layer. This is the best rule of 3 for exponential decay type of problems.

Remember that in the exam you need speed, and as I recall, no tables were given for part I, and in part II you have only TMR and PDD tables.

--- Re:

Well if you read the question the person recalling states the density and linear mass density were given in the question.Â I can only assume they could not recall the values and is most likely why the units in the thickness are cm and not mm.Â I took part 2 last year and there were many questions that included a few pieces of data from tables just not the whole table.

Q25=======================================

On Khen book, it said: " wedge transmission factor (or simply wedge factor), defined as the ratio of doses with and without the wedge, at a point in phantom along the central axis of the beam. This factor should be measured in phantom at a suitable depth beyond the depth of maximum dose (e.g., 10 cm)."

Q1: Will the wedge factor be same when it is measured at different depth? I think it should be same if depth>=dmax.

Q2: Can we measure wedge factor at dmax? If not, why?
Q3: 10cm is recommandation depth. any physical or clinical resaon?
----- Re:

Dmax is the position with the most amount of contamination in the beam (from head scatter and also scatter from the wedge). One of the reasons that the wedge factors are measured at 10cm depth is that the beam is contamination free for the most part and also most beams are defined "flat" at 10cm depth also. There maybe other reasons that I am not thinking of right now and hope someone else will post :)

Q26==
Hi, can somebody please tell me the tolerance for a pacemaker under radiation treatment

---Re: AAPM TG-34 recommends 2-10 Gy with heavy emphasis on the 2Gy value

---Re: Newer pacemakers can tolerate around 500cGy and older ones about 200cGy. The TG report on pacemakers says 200cGy is the limit. What I do usually is to get the serial number and manufacturer name from the patient and call up the manufacturer and tell them to fax you a sheet of paper that gives you the radiation limit. I put this in the chart so that it is documented along with the dose that we calculate it to receive during the course of treatment.

Q27==
Just want to be 100% on what the specs are for flatness and symmetry
for photon and electrons, according to TG-40. I understand it as:
Flatness (photons): +/-2%
Flatness (electrons): +/-3%
Symmetry (photons & electrons): +/-3%
Is this correct?

---- Re:
I think that is for the monthly QA spec. If i were asked the flatness spec i would say 3% and the symmetry as 2%. Obviously, it's not really related to TG protocol, but Varian engineers quoted their specs as flatness 5% electron 3% photons symmetry 2%, @80% field size 50% of beam power depth
---Re:
khan references NCRP 69 and states that flatness for photons should be less than 3% (that is w/in the central 80% of the field)
TG-25 states that electrons should not exceed 5% (optimally 3%) over an area within lines 2 cm inside the geometric edge of fields equal to or greater than 10x10cm.
If they ask me what TG-40 states, which is constancy, obviously i'll regurgitate
what TG- 40 states.
--Re:
> Table II of TG40 doesn't have tolerance for flatness. 2% and 3% are the flatness constancy. I understand it as relative (to the baseline). Could someone point out where the absolute flatness is specified?
-- Re: Radiation Therapy Physics book by Hendee et al pages 377 to 380: photon beam and electron beam characterization.
--Re:
Electrons are discussed in TG-25. 3% for flatness and 2% for symmetry.
--Re:
There is a different between Flatness and Symmetry intial commissioning values and constancy (monthly qa) value.
Typical flatness at a 10-cm depth within the region extending up to 2 cm from the field edge is +3% to -5% (21). Khan's book
In the light of the above discussion, there is a need for a national or international group to examine the prevailing definitions of field flatness and recommend a criterion that checks the effectiveness of the flattening filter, excluding the penumbra. In the meantime, the flatness definition given by Equation (17.1) may be used with the acceptable limit being within Â±3%. For acceptance testing, flatness should be checked for the maximum field size at least at two depths: 10 cm and dmax. Whereas the flatness criteria is applied to the profile at a (P.441) 10-cm depth, the profile at dmax should be examined for the extent of peripheral hot spots, or â¤½horns.â¤ These horns should not exceed 105%. For bigger horns, an accessory filter may have to be designed to reduce them when using large fields (22). In addition to the profiles along the principal axes of the field, diagonal scans should be obtained to check field flatness . Typically, the diagonal flatness is +4% to -6% in the reference region, extending up to 2.8 cm from the 50% isodose curve in a plane perpendicular to the central axis and at a 10-cm depth (21).
The flatness and symmetry specifications of electron beams are given in the AAPM TG-25 report

Q28======================
Prescription point for intravascular brachytherapy?
Re: 2mm from the source center

Q29=========================
1. For what isotope is the ratio of dose at 5 cm to the dose at 1 cm the lowest? Cs, Co, I, Pd
33. IMRT dose verification using small volume chamber (0.1 cc). What should its resolution (or measured error) be in order to be able to use if for dose verification (0.1%, 0.5%,1%, 3%, 10%)?
28. What would cause the biggest change of depth of 80% IDL for 9 MeV electron? add 1 cm bolus, change to 18 MeV, increase FS
---- Re:
q1 what energy Cs=667, Co 1250, which Iodine? 125=?, 131=?, 123=?, and Pd = 23 kev
pentration .. etc. The asnwer is Pd
q33 = not 100% but I would say 0.5%
q28 18 Mev
-- Re:
I found the answer for #1. It's I-125 per the plot on pg 374 of Kahn.
-- Re:
The answer is pd-103. because of the lower energy of pd-103 compared to i-125

Q30==============================
In 2005 part2 q20, Stereotactic radiosurgery scenario: Given a CT image with the rest of the info as given in the picture that follows. How much and it what direction (either one of four choices AP-PA, PA-AP or RT-LT LT to RT) will move if the patient head (or AP beam I don´t recall it) is tilted 1 degree.
--- Re:
For small angles, the shift will be approximately the arc length:
x = (tilt angle / 360 degree) . 2 pi R
~ 2% R for each degree.
R is the distance from axis of rotation to the point of interest. If the point is 10 cm away from the axis then you can expect 2 mm shift for each degree of tilt, which is unacceptable in SRS. If the point of interest is on the rotation axis, then there is no shift. That's why it is preferable to put your target close to the isocenter.

Q31==
1. HDR scenario: Given activity of Ir-192 source 10 Ci (quickly convert it to mCi´s) , the exposure rate constant of Ir-192 was not given here, I used 4.6 R-cm2/(mCi –hr), then you had to know the f factor also for Ir-192. Balloon with 4 cm diameter. Calculate the approx. time to deliver 340 cGy´s at 1 cm from the surface of balloon.

D=D0*1.44*D(1/2)
D0=gamma*A*F/d^^2
=4.69*10^4*0.965/9=5029 cGy/hr

D=5028*1.44*74*24=12860655 cGy
1-e^(-t/1.44*T(1/2))=2.64*e^(-5)
t= 4 mins
is it right?

2. timmer error =0.02 min, dose rate 150cGy/min, what is minimum dose at 2cm (pdd=60%) so that time error to dose is <2%?
0.02*150*0.6/2%
is it right?
---- Re:
D = gamma*activity*(time)^2/d^2
solve for time [340*3^2]/[4.6*10^4] and convert to need time unit = approx 4 min

---- RE:
For the HDR question, the equation of dose you are using is for permament implants!
For t<< T1/2 (192 Ir) use simply D = Dose rate * t and Dose rate from:
Dose rate = Lambda * Sk * g(r) * (phi)an / r2

For 192Ir g(r) and (phi)an are aprox equal to 1 and memorize lambda for 192 Ir in case is not given.

For the timer error question I calculte the max treatment time that can be used for the 2% error (dose is proportional to treatment time) and then I calculate the dose based on this treatment time, dose rate and PDD given.
Any other solutions, anyone?

Q32==
> This question is from ABR website. I got D, but the website lists C as the right answer, any input? Thanks.
> 3. A lesion at 1-cm depth in tissue is to be treated with 6-MeV electron beam with bolus. A dose of 1.5 Gy to 80% is prescribed. If output is 1cGy/MU, SSD is 104 cm and cone factor is 0.8, what should the thickness of the bolus be, and how many MU should be delivered?
> 1. 0 cm, 153 MU
> 2. 0 cm, 170 MU
> 3. 1 cm, 209 MU
> 4. 1 cm, 270 MU
> 5. 2 cm, 302 MU

Re: Part II: Answer is not right?
this question has been discussed many times on this group, just search for it in the messages and draw your own conclusions. don't feel bad though, i don't thnk anyone has gotten the answer from ABR.

Q33==
> 1. if the TVL is 1 mm of Pb, the fifth value layer is ____ mm of Pb
> 2. the TVL of concrete is 18 cm and the TVL of Pb is 1.2 mm. WHat is the amount of transmission for 30 cm of concrete plus 5 mm of Pb?

-------Re:
1. 5VL = TVL * ln(5)/ln(10) = 0.7 mm
2. exp(-ln(10)/18*30) * exp(-ln(10)/1.2*5) = 0.02 * 7x10-5 = 1.3x10-6 (good shielding)

Q34===
1. Multi detector CT, when cone beam increases size, what's true: Collimator decreases, scatter photon increases, etc. (not quite sure about the answers)
2. Decay rate of 192Ir Per day?
3. Tolerance for deviation in a ight field for a CT sim? 2mm?
4. If the high voltage power source is pushing too much, what is the most likely observed result on the accelerator.
5. AP/PA doses given from each field to cord for 200 cGy to tumor (62cGy, 150cGy respectively). Cord block put in PA, new cord dose is 18% of original. How many fractions need cord block to limit cord dose to 40Gy?
6. TBI, diode reading 450cGy on surface, prescribed midline 600cGy POP laterals, 30cm separation. TMRs were given with 350cmSSD. What is error in midline dose? A. 2.6% higher, etc.
7. Field size is measured 56 cm on patient skin and collimator 40 cm with table at its lowest position 167 cm from the source. What's patient size (including setup bag etc.)?
8. Orthovoltage shielding calculation given the workload.
9. Minimum parameter for daily QA check for HDR machine?

---- Re:
#2 1% per day
#7. 27cm
I workded it this way: 100cm/40cm * x/56cm = x=140cm
167cm - 140 cm is 27cm patient thickness.....correct?

-----Re:
for #4: this is what Varian egineer told me:
I assume you mean that the voltage from the PFN has increased. If this happens it will increase the power level of the RF, and without a subsequent increase in Gun emmision your output dose rate will drop off. You do actually change the energy of the electron bunches exiting the accelerator, but because of the 3% energy slit the energy of the electron bunches exiting the Bend Magnet does not change. There are just less of the correct energy, so your dose rate drops
off.

Q35===

On page 126 in McGinley, problem #2 it gives 4 in the numerator, which, I thought was suppose to be I= mA, which was given to be 400. Where did the number 4 come from?
B = 0.002(4.5)^2 * 600(4) / 400(1/4)
----Re:
The number 400 is MA MIN/week. the number 4 is just the max tube current. Thats why in the leakage calculations one has to use 4 (max tube current)

Q36=======================
" Exposure rate at 1 m was given= 0.01 R/ mAs at 1 m. Workload = 600 mA-hour / week. U = 1/4, d = 3 meters. Xp = 0.01 R/week. Determine how many TVL´s given the exposure rate limit." The answer I get is 1.22 TVL.

---Re:
this one has confused me a bit also,
B=[Xp*d^2]/[WUT}
Xp=0.01 R/wk
d=3m
W=600mAhr/wk
U=1/4
T=(assume)1
thus,
B=[0.01R/wk*(3m)^2]/[600mAhr/wk*60min/hr*1/4*1]
=1*10^-5
Mcginley says that the thickness must be determined graphically, using figure
8-2 this results in about 3.5mm lead which for a 125 kV simulator is about 3.8 TVLs.
if you use #TVLs=log(1/B) this gives, 5 TVLs
thats my 2 cents worth.

--- Re:
Then why is the exposure rate given? that is what confused me too. Also if you look at the graph form fig 8.2 in mcgingly it says the exposure rate @ 1m. now according to me that is not right, as the exposure rate one would get by doing what you just did would be at 3m. So why does he back project it to 1m.
--Re:
maybe just to confuse us. as for the exposure rate at 1m, none of the transmission graphs specify that they are @ 1m. besides we are correcting for not being at 1m with the (3m)^2.
also, remember that this is what someone remembered after taking a 4 hour exam
so I wouldnt take the question as being exactly accurate.

--Re:
Thanks... one thing thought, the graph on mcgingly text book on page 125 does say that the y axis is "R per ma min at 1m". Dont know if that makes a difference

--Re:
I agree that if you were NOT given the exposure rate and that if you were given a figure like 8.2 in McGinley's book, the answer would be 3.5 mm lead. However, you cannot calculate the TVL from this, since the unit in your equation do not cancel out. Since they do provide the exposure rate and they ask to calculate the TVL, I would solve the question as following:
0.01 R/week = 600 mAh/week * 0.01 R/mAs * 1/4 * 1/9 *B
then by converting 1 h = 3600 s, B=0.06 with corresponds to 1.22 TVL
--Re:
ok, i agree with the point about the units but i think you forgot to convert the 1 hour to 3600 seconds,
B=[0.01R/wk*(3m)^2]/[600mAhr/wk*0.01R/mAs*3600s/hr*1/4*1]
=1.7*10^-5
and, n=log(1/B)=4.8 TVLs
and from hendee TVL(lead for 125 kV)=0.93mm,
so, we have 4.4 mm which is slightly larger than what our calculation using mcginley's method gives us (3.5mm), so this method overestimates the shielding compared to using broadbeam data.
---Re:

I agree i think i forgot to check the unit.

On the same note, as the graph in mcgingly is give @ 1m. do we ahve to project back to 1m or not. As the transmission value is at the point protected. Because if one looks at the problem in mcginly book he "does not" project back @ 1m.

Q37===

I find this in the 2006 part2: Mammosite balloon w/ diameter = 4 cm and Rx point at 1 cm from surface of balloon. What is the minimum balloon to skin distance to minimize the hot spot to 150%?

Could someone explain how balloon to skin distance affects hot spot? And where is the 100% IDL defined, at the balloon surface or 1cm away? Any good reference for this topic?

---Re:

"Hot spot" is not a good term, in this context -- unless you contour the skin as a region of interest, that is. You are trying to make sure the 150% line does not hit the skin at any point. Just as you want to make sure that air/seroma is less than 10% of the PTV and that 90% of your PTV (minus air) gets 90% of the Rx dose (340 cGy per day). Therefore, your Rx point is 1 cm from the balloon. A 4 cm diameter means a 2 cm radius so your Rx point will be 3 cm from the source.

You have a dose distribution that falls off as inverse square and hits 100% 1 cm from the balloon surface and 3 cm from the source. If you have seen a few cases beforehand, you know that the 200% line fits pretty neatly along the surface of the balloon. Therefore you expect something near 5 mm balloon-to-skin distance (2.5 cm from the source). If I recall, this was the end of my problem-solving because there was only one reasonable answer. However, you can go further.

We assume that the dose falls off as r^2. As a quick check 100/((2/3)^2) = 225 so the surface of the balloon (2 cm) gets about twice the dose as the Rx point (3 cm). 100/x^2 = 150 gives us x = .817. But, x is just (r/3), where r is the distance to the 150 line and 3 is the distance to the 100 line. So, r is .817 x 3 = 2.45 cm. Or, 0.45 cm from the balloon surface.

Can someone check my math/logic, please? Really, there is no substitute for experience. Preferable sitting in on a case or 5 but just talking with someone who is comfortable with the process can help, too.

Oh, and they teach you not to accept three consecutive 5 mm slices because of skin dose, that also helped me come to a quick decision (RTOG limit is 145% to skin).

---Re:

Sorry, I answered earlier as rule of thumb. usually 140%. anyway to calc as a physicist, I was told that 340 cGy for balloon diam 4 cm, and the calc at 1 cm. So, if we use point source principle 1/r sq, the distance is 2+1 =3, and the 150% = 510 cGy 340 x 9 = 510 x^2

x= 2.449 cm

Q38===

I need some help with the following questions. Thanks in advance, everybody.

1. Ratio of Maximum Dose between 25MV and 4MV for same dose to midline using POP setup with SSD =100cm. PDD's given. Dmid/PDD(25) / Dmid/PDD(4) ???

25 MV has a lower ratio because 4 MV has a higher dose at dmax or (dmax25/dmid25) < (dmax4/dmid4)

2. Given Kersey's formula and the distances and ratio of maze areas, neutron dose at isocenter (mSv) per photon cGy at isocenter, what is neutron dose (mSv) at door per photon cGy at iso. Told TVL of maze for neutrons is 5m.

3. Superficial X-ray, measurement at end of cone gives a reading of 150. Measurement at 10cm from the end of the cone gives a reading of 52.3. What is the effective SSD at the end of the cone?

150(ssd / ssd+10)^2 = 52.3 solve for ssd. I get 14.4 cm

4. Dose to cord from AP/PA 100 SAD setup. Given 22cm separation, cord 4cm deep, and 200cGy to isocenter.

cord d=18 ap and d=4 pa 100cGy(100/107)^2(TMR18/TMR11)=dose @ cord ap

100cGy(100/93)^2(TMR4/TMR11)=dose @ cord pa

5. Point A and B are candidates for machine isocenter. Point C is outside the primary shielding and distances AC(=7m) and BC(=5m) are given. If isocenter is set at A, measurement at C is within the MPD specification. If isocenter is changed to B, how much more shielding (TVL) is needed for the wall to maintain same reading at C, given TVL.

6. If dose to point A (depth 10 cm) is 200 cGy, calculate dose to point B ignore beam divergence. %DD(10)=65%, %DD(12.5)=56% , 100 SSD alone CAX.

200(%dd12.5/%dd10)=200(.56/.65)=172cGy

7. Lung correction given dose with no correction - the corrected dose has 2 cm of lung and 4 cm of dense medium (4x tissue) - what is the dose at that second point?

8. Orthovoltage shielding calculation given the workload.

9. AP/PA doses given from each field to cord for 200 cGy to tumor (62cGy, 150cGy respectively) . Cord block put in PA, new cord dose is 18% of original. How many fractions need cord block to limit cord dose to 40Gy?

10. Scatter and leakage shielding thickness calculations are equal. The shielding that should then be used is: A TL + 1HVL, B other options including Ts + TL, Ts + 1TVL. How to cal?
since scatter and leakage are the same, you use the leakage TVL+1 HVL (from, McGinley's book)

11. TBI, diode reading 450cGy on surface, prescribed midline 600cGy POP laterals, 30cm separation. TMRs were given with 350cmSSD. What is error in midline dose? A. 2.6% higher, etc.

12. How do you convert ionization curve to %dd curve? normalize to dmax
13. 9MeV electron beam. At 4 cm depth, how much lead should be used to shield deeper structure? No other information.
Rp=9/2=4.5 Ez=E0(1- z/Rp)=9(1-4/4.5)=0.99 since this is almost a linear
relationship (from Kahn) 0.99/2=0.5 mm Pb shielding

14. Treat 4.3 cm depth with 12 MeV and 200 cGy, dose at dmax.
d80=E/2.8=12/2.8=4.3 so dose at dmax=200/.80=250cGy

15. Multi detector CT, when cone beam increases size, what's true : Collimator decreases, scatter photon increases, etc. (not quite sure about the answers)
16. Difference between Acceptance Test and Commission of Linac.
17. Tolerance for deviation in a light field for a CT sim
18. If the high voltage power source is pushing too much, what is the most likely observed result on the accelerator. waveguide?

--- Re:

For question #3, because the question is asking for effective SSD, shouldn't the following equation be used:
sqrt(Io/Ig) = g/(f+dmax) + 1 where the effective SSD is is equalt to the slope of this equation (ie 1/(f+dmax))?

--- Re;

in problem 2 with Kersey's formula, what do you think we're suppose to know that's not given? H0? And how does it help to know that Kersey says the TVD of a maze is 5
m?

---Re:

Partially found the answer to my own question. The exponent has TVD in the denominator.

Q39==
1. HDR, three dwell positions (1, 2 and 3 – 2 in middle) 1cm apart in single channel. Dose points A, B and C 1cm perpendicular to dwell positions 1, 2 and 3 respectively. What is the ratio of dwell times 1 to 2 to make dose A equal dose B?
---Re:

Assume that each point is located 1cm perpendicular to the center of each source and that the distance between the center of each source is 1cm. The one piece missing is that I would assume that
R (R * cm^2/mCi * hr) = Exposure Rate Constant = constant
Activity = A = constant
Dwell time = t1, t2, t3 The one piece missing is that I would assume that t1=t3 - want a uniform dose along the axis of the sources.
Distance = d1-a (distance of source 1 to pt a), d2-a (distance of source
1 to pt a...)
Dose= (R * A * t)/ d^2
So the Dose at a = Da= R * A * t1/(d1-a)^2 + R*A*t2/(d1-b)^2 + R*A*t3/(d1-c)^2
The same will apply to each dose point.
We want to have Da = Db

you can cancel out R and A on both sides of the equation, all of the

distances are easy to calc and t1=t3 so eliminate t3 and solve for t1 as
a fraction of t2
t1 = 2.5 * t2

--- Re: Sorry, brain fart. d2-a = distance of source 2 to pt a

Q======================================

In the three linear source problem I've noticed in solutions that many people do not apply the rule that dose is proportional to 1/r if the distance is less then 2X the source size; dose is proportional to 1/r^2 if the distance is greater than 2X the source size (Khan p 371). Many solutions from last year had the answer as 2.5 when it should be 1.7 if you apply this rule. Are people in agreement or am I missing something?

--Re:
If I recall this question correctly it refers to dwell locations and as shuch is an HDR question. The 1cm distance is greater than 2x the source size.

---Re:
The question is #1 of the complex section of 2007 exam.
Can someone elaborate for me on the geometry of the set-up? I cannot visualize it clearly.
HDR, 3 dwell positions 1,2,3--2 in the middle) 1 cm apart in single channel. Dose points A,B,C, 1 cm perpendicular to dwell positions 1,2,3 respectively. What is the ratio of dwell times 1 to 2 to make dose A equal to dose B?
Should I visualize 2 rows? One with the 3 source positions, parallel to the row of dose points?

---Re:
Yes, you can visualized this geometry in two rows. Using Inv. square law, you can readily get dwell time t1 : t2 = 3: 2.

Q==

Anyone shipping RM MUST have DOT training once every 3 years. Must have an approved container for type of RM Transport Index (TI) is based on mR/hr level 1 meter from the container Type and activity of RM must be written on the transport Label (activity
in GBq only)
Transport labels:
White I = < 0.5mR/hr on surface
Yellow I = < 50mR/hr on surface and a TI <=
Yellow II = < 200 mR/hr on surface or a TI <= 10 (not sure about
<200 OR TI=<10
Must have a current wipe test of the source (within last 6 months).

49CFR173.400 for most things.
http://www.access.gpo.gov/nara/cfr/waisidx_06/49cfrv2_06.html

Q==

I have the following part II questions. Thanks for your help.
1. IMRT: difference between simulated annealing and gradient reduction in IMRT
simulated annealing is stochastic algorithm but gradient is deterministic.
2. If the high voltage of power source is pushing too much, what is the most likely observed result on the accerlerator?
3. Tolerance for deviation in light filed for a CT sim there are many tests for laser alignment, I don't know of any for CT Sim light field, If I had to guess, 2 mm would probably be a safe answer
4. Detector resolution required for SRS field profile is (less than 1mm, 2mm, 3mm, etc)
is it 3mm? for linac: profiles 2 mm or less(TG-42), tmr and output factors 3 mm or less
5. Measurement of the crack in a LINAC vault with high volume IC. Chamber over the crack measures 1mR/h and far from the crack 0.5mR/h. Estimate what would be the actual exposure rate (less that 0.5, more than 1, etc)
6. The only factor less than 1 in TG51, select from Ptp, Pele, Ppol, Pgrad P(Q gr) for electrons is less than 1 when dref > (dmax+0.5rcav)
7. Electron virtual source for lina with end of application at 100cm. Given chamber readings at several distances, the virtual suorce position is _ cm At 100cm, 100, at 120cm, 44, at 140cm, 25
plot sq. rt.(I0/Ig) vs g, g is gap between end of cone and surface (here 20 and 40), I0 is reading without gap (100 cm), Ig reading with gap. The virtual distance f = 1/slope - dmax. In this example, I get 40 - dmax.

8. Does 10cm deep 5cm outside filed is A. 1%, B 2%, C 3%, D 4%, E 5%
A
9. What should you check each time when you use an ionization chamber/electromete r? leakage?
I agree
10. Sim film taken at 102cm SSD, SFD 140cm. Want to treat at 120cm SSD. What distance to film should be used when cutting blocks.
mag = 140/102=1.37 and 120/140=0.86 then=> 1.37*.86=118 cm
11. g(r) for I125 and Pd103. A. same at all depth, B Pd exceeds I beyond 1cm, C Pd exceeds I beyond 4cm, D. I exceeds Pd byond 1cm. E same at all depth since the gamma values are almost the same, I'd say the same at all depths
12. What is the device for IVBT source calibration?
well chamber
13. What is the dose to a kidney that will cause irreparable damage?
3000cGy??
14. What do you use caps on ovoids?
to increase dose to vaginal tissues
15. Average expose around a Co-60 head taht a therapist can receive?
16. Most common late effects of hodgkins?
acute non-lymphocytic leukemia
17. Average E of photonuclear particles in a LINAC?
0.4 MeV
18. TD 5/5 of kidney and liver
2000 and 2500 respectfully

Q==
Given the frequency (MHz), calculate the size of each microwave cavity.
c= wavelength* frequency?
That seems to trival. Please help.

---Re:

It's a pretty easy problem. The only thing that you're missing is that in order to be a resonant cavity, it must have a dimension that is an integral number of half wavelengths. In other words, cavity length = n * lambda/2, where n is an integer and lambda is wavelength (c/frequency).
(Refer to Pg 60 in Hendee Book Radiation therapy Physics)

Q===
1. How often are electron energies checked according to TG-40? Once a week, Once a week if they are used, twice a week, etc.?
Twice per week (TG-40)

2. What measurement device is best for a simulation room survey? Ion chamber, ion chamber w/ electrometer, GM, scintillation counter?
survey meter (ion chamber calibrated by ADCL)

3. With 6 MV incident on x1 mm tissue then x2 mm bone then x3 mm lung, what is the dose to the proximal (or distal, I forget) part of the lung?

4. Mammosite balloon w/ diameter = 4 cm and Rx point at 1 cm from surface of balloon. What is the minimum balloon to skin distance to minimize the hot spot to 150%?
since dose in tissue for brachytherapy follows inverse sq law up to 5 cm, 100% of the dose is at 3 cm (1 cm from balloon surface), then by inverse square (1/.8)^2 = 1.56 or 156% so the minimum skin distance is 8 mm

5. What does Gamma measure?

6. Calculate collimator angle for opposite lateral brain fields to match the divergence from a spine field. Field size 27cm, Spine inferior 20cm and spine superior 17cm. calculate the divergence of the spine field assuming 100 SSD, sotheta=arctan(17/100)=9.6 deg for coll rotation.

7. what is Skyshine steradian?

8. Given the dose at A, find the dose under the block at the same depth at B. 2006 part2, q24, how to solve dose

calculation with block?

9. When to check the wedge interlock
monthly (TG-40)

10. what is Gamma strength related to HDR treatment.
Exposure rate constant (R m^2 / Ci hr)

11. Beam abutment question. Patient treated with 10MV photons and 16MeV electrons. Field size given. At 5cm depth what would be the case (photon side hot spot:electron side cold spot, photon side cold spot:electron side hot spot, both sides hot spots, both sides cold
spots or no hot spots)
I think it's photon side.
I agree, hot spot on photon side cold spot on electron side (electrons scatter out)

12. Question on backscattering using block for electron beams. How does it change with energy E and Z. (increase when E and Z increases, decreases when E and Z decreases, Increases when E increases and decreases when Z increases and vice versa)
my ans: Decrease with E increase + Increase with Z increase
I agree

13. what's the formula for HDR shielding calculation?
same as that for linac except that U=1 do to isotropic photon emission B=Pd^2 /
WT

14. Shielding calculation. the thickness was calculated as per the 6 MV beam and the Exposure level was given at particular point. Question was to calculate the exposure level if 18 MV beam is used for the same thickness. TVLs were given.
I would calculate the #of TVL's needed based upon the B value given using n=log10(1/B) then find the thickness need for both the 6 and 18 MV beams take a ratio of those values and determine the #TVL's for the 18 MV beam and then solve for B.
for ex. assume we solve for n with the given B value and n=5. TVL thickness of concrete for 6 MV = 0.35m and 18 MV = 0.47m then we have 5*0.35m = 1.75m of concrete and we need 5*0.47m = 2.35m for 18 MV. 1.75/2.35=0.74 so....we actually have 0.74*5=3.7 TVL's for 18 MV beam. Then solve n=log10(1/B) for B (n=3.7).

---Re:
#4 - Shouldn't we inverse square from 3cm not from 1 cm (3/(2+x))**2 = 1.5 giving x = 0.45 cm
---Re:
You are correct! Mammosite specifies an absolute minimum balloon-to-skin distance of 5 mm.
---Re:
In regards to question #6, shouldn't the collimator angle be the arctan((17cm/2)/100cm) = 4.9 degrees?
--Re:
I read the question as the total spine field length is 37 cm (inferior jaw setting being 20 cm and the superior jaw setting being 17 cm).
--Re:
TG40, under II B. Test Frequency says - "there are no recommended weekly tests" (unless its a Cobalt unit for source positioning). No weekly tests are listed in the table for QA of medical Accelerators. Where did you find weekly?
--Re:
Footnote b to Table II, on page 598 states" All electron energies need not be checked daily, but all electron energies are to be checked at least twice weekly."
In practice, though, most places I've worked have checked all energies every day as part of the routine morning QA.
--Re:
TG-40 Table II b (at the bottom of the Table) says: "All electron energies need not be checked daily, but all electron energies are to be checked at least twice weekly." This means that if you have 6, 9, 12, 14 MeV electrons that you can check 6 and 9 on Mon., 6 and 12 on Tue., 9 and 12 on Wed., any and 14 on Thur., and any and 14 on Fri.. You would have then satisfied the recommendation to check electron output constancy daily and each energy "at least twice per week."
In the real world, you check all electron energies daily. That way you don't have to worry about missing any. However, for exam purposes, you would check each energy at least twice weekly.

Q==
Khan page 420:" the licensee must conduct a quarterly physical inventory of all sources in possession.
TG 40, Table XIII, verify source inventory is an annual check.
Can someone help me out please?
---Re:
quarterly for used SOURCES and in lab.   examples: point sources, flood. references , ...etc
Annual for stored sources (not used), either for decay or not in use for what ever reason.

Q===
On Page 411 of Khan, Eq. 16.9 shows
> B_leakage = P*d^2*60*I/WT
>> On Page 123 of McGinley, Eq. 8-2, the same equation is given w/ 600 instead of 60.
>> Which is correct?
>> Also, for W, do you plug in the full isocenter workload into the equation (for e.g., 400 mA-min per week)
> Since this is calc. for leakage, shouldn't there be some correction? (for e.g., for megavoltage beam, there is W is corrected by 0.001 in the calculation.

----Re
The 60 or the 600 is the correction that you speak of.
Also from what i understand the equation in KHAN is for a therapy machine (for which the leakage has to be below 1R/hr), this is where you get the value of 60 from)
but for the simulator the leakage requirements are 0.1R/min (thus you get the value of 600 in that equation.
Please correct me if i am wrong.

Q===
Can someone please tell the best way to solve problems with dose under a block ?
---Re
Dose(open field) - (1-0.05)Dose(size of block)
(1-0.05) assumes 5% transmission through block so you are subtracting 95% of the dose from the blocked area.
For example, if you have a 10x10 jaw settings and a 2x10 block, Dose(10x10) - 0.95Dose(2x10) equals dose to a point under the block (the assumption that the point is in the center of the block in the center of the 10x10 field).

Q==
1. An isocentric 10-MV oblique photon beam has depth of 12 cm, of which 6 cm is muscle tissue and 6 cm is lung. Without lung correction, the actual delivered dose at the isocenter compared to the calculated dose at the same point would be how much percent higher?
how calculate

2. guard ring in a plane parallel chamber is to ?? define the collection volume??
yes and create field homogeneitybetween electrodes which avoids secondary e-scattered from the wall being counted.

3. Electrons at extended SSD, which is true? A??
A. Width of the 90% extends proportionately B. Penumbra increases C. Output follows ISL with 100 to source …
penumbra increases

4.. TG51: What's energy specification for electron beams?
R50

5 Linac's outputs are off the same way for all the beams, what is the problem?
klystron, bending magnet, RF waveguide, monitor chamber - I said monitor chamber because it would be the most consistent
I agree

6. Which organ shows partial volume effect? Brachial Plexus, Kidney, Optic nerve, etc.
Of these three, Brachial plexus

7 Gas pressure low fault is related to which part in Linac? Gun, Waveguide, Magnetron,

Accelerating tube, etc.
waaveguide

8. To compare light field vs. radiation field, film is used. Ask distances for SSD and film SAD. SSD=100, SAD=100; SSD=100-dmax, SAD=100; etc.
SSD=100, SAD=100

9. Photon field abuts electron field, where is the hot spot?
on the photon side (e- scatter out)

10. The Transport Index represents the exposure rate…. (choices included "on the surface" and "at one meter")
T.I. = exposure rate @1 m / 10

11. Mayneord's Factor is more accurate for: 6MV, 6x6, 110 SSD; 6MV, 30x30, 150SSD; 15MV, 6x6, 110 SSD; 15MV, 6x6, 150 SSD; etc.
higher energy, small fields and small ssd changes

12. Tolerance for simulator laser vs. gantry center (or some other mechanical center)?
1mm?
2mm (safe answer for QA)

13. Amount of X-ray contamination of 18 MeV electron beam? 1%, 4%, 10%, etc.
4%
14. IMRT shielding: how much more shielding needed? All wall + TVL; Primary +TVL; Secondary + HVL; Secondary + TVL; etc.
secondary + TVL (NCRP-151)

15. If you were going to use a thimble chamber to calibrate an Ir192 source what type of beam would need to be used in determining the calibration factor? Calibrate with 192Ir; Calibrate with 380 keV X-ray, Cobolt-60 etc.
use Ir-192

16. Shielding: What's peak energy of photons near door? 200 keV, 500 keV, etc.

17. Shielding: Electron only machine has 4 electron energies, each with 3.5%, 2%, 1.5%, and 1% X-ray contamination. Workload 200 Gy/week, what is weekly workload for photon contamination?

18. Weekly dose limit for unrestricted area.
5 mSv/yr / 50 wk =0.1 mSv / wk

----Re:

The only one I disagree on is #6:Which organ shows partial volume effect?
Brachial Plexus, Kidney, Optic nerve, etc. Of these three, Brachial plexus

I believe that kidney is the correct answer. It is the only site listed that will still function if part of the kidney is destroyed. I refer to these as "parallel" organs such as liver, parotids and kidney. These organs can still function if partially destroyed. This is where the information on a DVH is important. For example, if 30% of the liver receives >~5000 and the patient
will still have a functioning liver.

The other organs I refer to as "serial" - where destruction of part of the organ will disable the function of the entire organ. This is why a DVH for the cord, optic nerve or chiasm is really meaningless - you are only concerned with the max dose.

--Re

I believe the right answer for the question 13 is close to 1% (see table 14..2, p318, red edition of Khan).

--Re:

No, the x ray contamination should be 4% instead of 1% in table 14.2, which is in theory.

--Re:

Question 13: According to John Antolak in his AAPM review course at the annual meeting the x-ray contamination of new machines for 18 MeV electrons is 1 or 2 % cut down for the older machines which were 4 or 5%. So you are both right!
Question 16: 511KeV assuming a mazeless design of the vault.

--Re:
What if with maze? 200KeV? If the problem didn't say if the room has a maze or not, what should we assume?

--Re:
The problem is simply the maximum energy photon energy from a compton event scattered at 90 degrees or pair production. Regardless of how high the accelerator energy, the answer is 511 KeV. If the vault has a maze, it might require 2 scattering events for a photon to be incident on the door. We would require some knowledge of the geometry to answer that question correctly.

--Re;
I remember seeing some comment in NCRP 151 that when calculate the dose for the door with maze, it is safe to use 200KeV, so I assume with maze, maybe the maximum energy is 200KeV.

--Re:
Shielding: What's peak energy of photons near door? 200 keV, 500 keV, etc.
Is it 200kev for energy less than 10MV and 500 for energy more than 10MV?

Q===

"According to the report by Kersey (sp?), what is the attenuation TVL of linac neutrons in a maze?" This is an ABR II practice question.
Do you think that they mean TVD (tenth value distance)?
In McGinley he talks about Kersey's value as 5 m as a distance in a maze and refers to it as a TVD. Think the problem is worded badly? Particularly as it does not specify material.

---Re:
It is one and the same.. 5m is the answer

--Re:
Yeah it is difficult to know if they meant Tenth Value Distance or TVL. Peoples memories of test questions can be questionable, but it's amazing they do as good of a job as they do.

--Re:
Right, that is good data, but if they did not specify the material, then----it could not be TVL

Q==

The current in Linac for photons and electrons? Is it 100:1 or 1000:1?
--Re::1000:1

Q===

door shielding debate: In any event NCRP 151 (which I also don't have) says the arrangement lead, BPE, lead is good.
Others say the BPE should be on the linac side of the door.
The BPE attenuates the neutrons and the lead attenuates the neutron capture gammas.
The question is, what really is in your linac door? Which is best?

---Re:
NCRP 151:
"lead, BPE, lead. The lead on the source side of the BPE is to reduce the energy of the neutrons by nonelastic scattering, and hence make the BPE more effective in neutron shielding. The lead on the outside of the BPE will serve to attenuate the neutron capture gamma rays from the BPE... Often, the outside lead will not be necessary when the maze is long enough to attenuate the neutrons sufficiently before they encounter the door."
BPE then lead sounds reasonable if your average neutron energy is low enough, though how low is a good question.

Q==

The dose limit for a radiation worker is 50msv a year. which would equate to 1msv/week. but according to the McGinley book they say that the dose limit for (controlled area is 0.1msv/week). is this just because they are using a value 1/10 of the recommended. or is there something i am missing.

---Re;

They are using 1/10 the recommended value as per ALARA. you try to keep the dose limited as resonably acheivable. you can even try to limit less than that if u want..The shielding cost is going to go up. you try to balance out the shielding cost and benefits. There is actually a curve sheilding vs cost curve. The curve is in Hendee's book

Q=================================

When thyratron is fired, what are the 2 components that are also pulsed for linac?

---Re:

the thyratron is a "switch" in what is called the modulator, when the "switch" is thrown a high voltage pulse is delivered into the klystron (or magnetron depending on your machine). the klystron then injects the pulse into the accelerator tube. The klystron provides the RF which accelerates the elctrons in the LINAC. thus the second component that would be "pulsed" after the thyratron is fired would be the elctron gun so as to provide electrons to be accelerated.

Be sure to be absolutely clear that the klystron merely amplifies the RF, which is provided by the RF driver. It's not that you don't know that, it's just that if you aren't clear, they will question you further, which can lead you into trouble.

---Re:

I'm thinking electron gun and RF driver.

--Re;

The thyratron is part of the modulator. The pulses are sent to the electron gun and the magnatron/klystron.

Q=====================================

TBI, diode reading 450cGy on surface, prescribed midline 600cGy POP laterals, 30cm separation. TMRs were given with 350cmSSD. What is error in midline dose? A. 2.6% higher, etc.

I am not shure about this one. Thinking about using TMRs and inverse square to change perscribed 600 cGy at midline to a surface dose and compar with the 450 cGy surface dose from the diode. Must also remember to cut the prescribed dose by half for one beam.

--Re:

It seems that 450 cGy on surface may be considered as the dose at dmax at 350cm SSD.

Therefore,

Dose at midline (each field) = 450 x TMR x (350/365)^2

Error = [600 - 2 x 450 x TMR x (350/365)^2]/600

I hope this works in correct manner...

--Re:

General Notes on TBI from AAPM-TG29

1. The Higher the energy, the lower the dose variation (excluding the effects of the build up region and tissue inhomogeneities).

2. The larger the treatment distance, the lower the dose variation.

3. the larger the patient diameter, the larger the dose variation.

4. AP/PA treatments will yield a variation not larger than 15% for most megavoltage nergies and distances.

5. lateral opposed beams will usually give a greater dose variation compared to AP/PA treatments especially for adult patients. For pediatric cases or higher energy x-ray beams, a +/- 15 % uniformity might be achievable with bilateral fields.

This is a summary to an excellent graph on page 8 of the task group of Dpeak/Dmid Vs patient thickness. I think most of answers to the TBI questions could be approximated from this graph.

Q====================

Please help clarify Pion upper limit. In TG51, it says that Pion can be greater 1.05. But in part II question, the close answer is 1%.

---Re:

Pion is usually observed to be around a 1%. But TG51 recommends that if Pion is greater than 5% then the ion recombination efficiency of the chamber is bad and the chamber should not be used. But I would be definitely be concerned with the chamber is I see something around 2%.

I must clarify with my above statement that the ions and electrons combine more and hence the charge cannot be collected fully by the chamber. hence the Pion correction is needed for the chamber being not efficient.

--Re:

TG51 says that for chamber whose pion is greater than 1.05 as calculated by the standard two voltage technique, the accuracy of pion is not fit for clinical use. However, if one can determine pion with more accuracy using

published values or other medthod, it can be used
clinically (< 0.5%).

Q====================
What percent higher/lower difference is expected when going from TG-21 to TG-51?
TG-51 states in the preface that it will not change the results by more than roughly 1% from TG-21. I've found various references all basically confirming that statement but depending on what chamber is used with what energy the results can be higher or lower.
---Re:
There was a published paper from JOURNAL OF APPLIED CLINICAL MEDICAL PHYSICS " comparison between TG51 and TG21 calibation of photon and electron beams in water using clindrical chambers". In this study, Dose at depth of 10cm from TG51 calibration method is 1% higher than dose at depth of 10cm from TG21 method. Electron is about 2%.
--Re:
yes, i found a couple other papers in "medical physics", not TG-51, also that agree with that, ~1% higher for photons and ~2% higher for electrons.
---Re:
A good quick source by one of the authors: http://www.aapm.org/meetings/03AM/pdf/9802-71112.pdf This is also a good read for the oral when you are ready.

Q==================================
How much additionion shielding do we require for IMRT.
All wall +1 TVL
Primary + 1 TVL
Secondary +1 TVL
---Re:
For IMRT, primary radiation no increase, scatter raditation no increase, leakage radiation, increase by a factor of 5-10 according to NCRP 151. Conservatively, secondary + 1 TVL

Q====================================
Can someone tell me how many TVLs in linac head and second question
Wedge Pdd increase over open field due to ?
---Re:
(1). There are 3 TVL to take the leakage down to 0.1%.
(2). The same reason as for open friend. The head & patient scattering increases with the increase of the field size.
--Re:
I have to disagree about Beam Hardening in the MV range. If you neglect the ISF and scattering the PDD is governed by attenuation. Beam hardening is prominent in the diagnostic range due to the increase in attenuation (photoelectric effect mostly).
As you increase in energy pair production becomes a factor, reducing some of that 6/15 MV beam into annihiliation photons (0.511 MV), which will "flatten" your attenuation, particularly in higher Z material. PP varies by Z^3/E^3.
For reference look at appendix A.7 for the mass attenuation coefficients - see the trend of increasing energy vs. lead where it becomes it's lowest value (thus least attenuating) @ 4 MV then starts to increase again - note HVL = ln2/u.
Thus for a high Z wedge in an MV field (for lead > 4 MV) the linear attenuation coefficient will "flatten out" (actually slightly increases) - hence when you look at HVL/TVL values in KAHN (table 13.1), NCRP 29 ect. you won't see in increase in HVL layers as energy
and Z increase simultaneously.
It does attenuate the scatter from the linac head, which will increase PDD.
It also starts to produce neutrons.
-Re:
And definitely not as clear-cut as I laid out below. Using the argument about HVL increase/decrease and Z dependence, I would postulate that we are really only discussing PDD in water. Still, PP contribution is a factor, and would compete with preferential hardening due to the wedge.
Also, I realize that I was wrong about the Field Size effect. PDD increases with increase in FS. For small FS, Primary beam dominates the PRI + Scatter dose absorption. For larger FS, Scatter plays a larger role, but Primary does not decrease.

Q===

What is the neutron dose equivalent (mSv) outside field per photon Gy at isocenter for 20MV beam? Is there a rule of thumb for determining the neutron dose per photon beam energy?
Also, on average, how much more shielding is needed for IMRT? Some example answers include: All wall + TVL, Primary + TVL, Secondary + HVL, etc...

RE--------------------
For your first question, there are tables that have these values in McGinley and NCRP 151. It depends on what the manufacturer is, and the nominal energy. In NCRP p 172, and McGinley p 70. I am taking part 2 also in three weeks, so I am just going with a value of about 1 mSv/Gy. Note also that this is defined at 1.41 m from the target.
For your second question, you need to add 1 HVL to the secondary shielding. I was also looking into this question, and found in answers in NCRP 151, pages 114-116, where they go through an example of a 6/18 machine, and after all of the 2 source rule, it is the difference of 66.4 cm (non-IMRT), and 73 cm (IMRT)--The workload does not change for patient scatter, only leakage.—J

Q==
1. TBI treatment: Head thickness =16 cm,TMR =0.858 Midline thickness = 40 cm TMR = 0.56
Each layer of compensator thickness transmits 0.9 How many layer of compensator thickness required to decrease head dose.

2. Patient thickness is 24 cm thick. Distance from source to floor = 2.3 m = patient treated on floor at 100 cm SAD, the field sizes are 35 cm and 40 cm respectively. If the field match at the surface of the patient, find the amount of overlap at the midline.

Re-------------
1. Assuming the head midline is the same distance as the "midline"
being treated; i.e. no inverse square correction.
100 cGy for example / 0.56 = 178.6 MU for body
178.6 MU x 0.858 = 153.2 cGy at head.
Ratio is 1.53 head to body.
0.9^n = 1.53
Take log of both sides and solve for n = 4.05
So it would require 4.05 layers of compensator material to make the head dose at midline the same.
2. PT separation is 24 cm so mid-depth is 12 cm, d = 12 cm
230 cm to floor minus 24 cm PT gives 206 cm to surface of PT SSD.
206/100 * 35 = 72.1 cm at surface for 35 cm at 100 SAD b = 36.05
206/100 * 40 = 82.4 cm at surface for 40 cm at 100 SAD, b = 41.2
GAP (Overlap) = (12 x 36.05)/206 + (12 x 41.2)/206 = 2.1 + 2.4 = 4.5 cm overlap
Re----------------
I agree with you on question one. I got the same. But for question 2, I get twcie the distance of overlap. Can you please tell me where you get the 36.05 and 41.2?
Re---------
The b value is ½ of the triangle base. So at 206 cm SSD, a 35 cm field at
100 cm SAD would be 72.1 cm. ½ of this value is used for GAP calcs or 36.05
cm. (b x d) / SSD = GAP
Re:---------------
Now I have a Gap question with a non-conventional set-up.
If the original setup was with SAD of 90 cm and FS at 10 cm depth is 24 cm^2 but now treating at SAD of 100 and FS 32. What is the Gap needed on the skin?
Do we need to always calculate gap (conversion of FS, that is) such that we are at the surface of the patient not not at depth of interest?
If so, FS for the first case is (80/90)* 24 = 21.3 on the skin and for the second case is (90/100)*34= 29
Gap= 10/2[(21.3/80)+(29/90)) = 2.9 cm
Can you please comment is this is right?
Re:------------
You can do this problem 1 of 2 ways for your first gap calc:
SAD way:
s1 = 0.5(24)(10/100) = 1.2 OR
SSD way, using corrected field length & SSD:
s1 = (0.5)(24*(100-10)/100))*(10/90) = 1.2
Reference = Bentel, Rad Therapy planning 2nd edition, pgs 145-146

Re:-------------
Actually, we do not need 2.3 m at all
100/(35/2)=12/x1 x1=2.1
100/(40/2)=12/x2 x2=2.4
GAP=2.1+2.4=4.5
Re:--------------
True unless the problem is presented with two different SSD's. Just easier for me to remember 1 formula.

Q=======================
Which of the following can occur that does not require full re-calibration of all beams & beam scanning?
-Changing klystron
-Bending mag replacement
-MU chamber replacement
-Target replacement
-waveguide replacement
Re: ---------------
I think klystron change requires only energy check.
Re: --------------
Another physicist in my group just told me it was the klystron, which has had to be replaced a few times here (but not on my watch).
Re: --------------------
by waveguide you mean not the accelerating waveguide but the RF Waveguide that carries energy from the klystron to the accelerating waveguide assembly,...then no, that is basically like replacing the klystron from the point of view of recommisioning. The klystron replacement (and RF waveguide) does not require rescanning and calibration.
The others do
From a senior Varian Engineer
Re:--------------
The klystron only affects the accelerating potential and ultimately the beam energy. The mu chambers (ion chambers I assume) are in the beam line and could affect pdd and beam geometry if manufactured or installed incorrectly.

Q=================================
I was looking at a problem from the 2005 tx-part 2 exam and was confused about one question.
Timer error of a orthovoltage unit was +-0.02 sec. the dose rate was 125cgy/min in water. PDD was 605 at 2cm. Determine what is the maximum dose that can be delivered with less that 1% error without having to take into account the 0.02sec.

Re-------------------------------
Dose (D)=DoseRate(DR)xTime(t)
When there is time error delta(t) cause a delta(D).
Let Dt be the total dose with time error and D be without.
Dt=DR*(t+delta(t))
D=DR*t
Delta(D)=Dt-D=DR*(delta(t))
Err%=Delta(D)/D=delta(t)/t. Then we can figure out the time and to get the dose

Q====================================
Can someone clarify the radiation sign on LINAC door is high radiation area or very high radiation area, also on Co-60 door, HDR door, Storage room, LDR implant room

----Re:---------------
Caution, Radiation area: Excess of 5 mR/hr at 30 cm from the source
Danger, High Radiation Area: Excess of 100 mR/hr at 30 cm from the source
Grave Danger, Very High Radiation Area: Excess of 500 R/hr at 1 m from the source

Linac door: 300 MU/min = 300 cGy/min ~ 300 R/min = 18000 R /hr > 500 R/hr -> Very High Radiation Area
HDR room: 4.69 R cm^2/(hr mCi) x 10,000 mCi x 1/(30cm)^2 = 52 R/hr at 30 cm -> High Radiation Area

Source room door -> From my experience I got 0.5 R/hr inside the Cs-137 source room and 0.02 R/hr outside the room -> Radiation Area
LDR implant room: We implant Cs-137 and I easily get 10 mR/hr at 1 m without shield -> Radiation Area
-----Re:
From the outside of Linac door, how can you get 500 R/hr since most radiations already attenuated by the shieldings.
----Re:
That definition is for radiation source only, not including the room shielding.
---Re:
Does state regulate Linac signs? On michigan's radiation safty web site I only find two type of signs: causion, radiation area and high radiation area. There is no "very high radiation area" sign. Our Linac doors have the "causion, high radiation area" signs.
---Re:
The regulations state >100 mrem in one hour, not per hour, for a high radiation area. Also, very high radiation area limits are given in Rads or Gy, not R in one hour.
This has been a board question in the past. You must understand the difference between in one hour and per hour to avoid getting buried.
--Re:
I checked signs in front of our linac and CT simulator. "Danger, High Radiation Area" for Linac and "Caution X-ray" for CT simulator.
The sign "Very High Radiation Area" applies to 500 R/hr at 1 m, which is approximately 500 cGy in one hour. Maybe 500 cGy should not be under the primary beam, instead maybe scatter beam which is about 0.1% of the primary?
A typical clinic treating 4~5 patients per hour with 200 ~ 300MU per patient. 5 x 300 MU ~ 1500 cGy
0.1 % of it is 1.5 cGy or ~ 15 mrem in one hour at 1 m. This is lower than 500 R/hr so no more "Very High Radiation Area". Because we assumed at 1 m it is only 0.1 % of the primary maybe we can assume 1% at 30 cm. 1% of 1500cGy is about 150 mrem which is greater than 100 mR/hr. Maybe that is the reason of "High Radiation Area".
This is the logic I have but not quite sure about the validity. Could someone direct me to the valid source?
---Re:
According to NRC definition, there are three levels as already mentioned. The factor is, for the LINAC machine, it is regulated by the state if you are in the agreement state. I checked the defintions in my state and found there are only two defintions: radiation area and high radiation area (the defintion is same as in NRC). I think the state law is more rigorous than the NRC.
---Re:
Actually Jongmin for the Cs room and implants you should have Radioactive Material sign and not a radiation area sign. This is for HDR as well.
---Re:
One should read the 10 CFR part 20 to comply with correct posting law. You should post both signs for rooms with radioactive material that is regulated by the NRC (or your agreement state).

NRC doesn't regulate linacs, so I would believe you would have to go to your state regs for the correct posting requirements (that is if you have state regs). Some states do not have state regs. Therefore, you can sling photons with Linacs anywhere you want with out posting. Yee haw!
§ 20.1902 Posting requirements.
(a) Posting of radiation areas. The licensee shall post each radiation area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIATION AREA."
(b) Posting of high radiation areas. The licensee shall post each high radiation area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, HIGH RADIATION AREA" or "DANGER, HIGH RADIATION AREA."
(c) Posting of very high radiation areas. The licensee shall post each very high radiation area with a conspicuous sign or signs bearing the radiation symbol and words "GRAVE DANGER, VERY HIGH RADIATION AREA."
(d) Posting of airborne radioactivity areas. The licensee shall post each airborne radioactivity area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, AIRBORNE RADIOACTIVITY AREA" or "DANGER, AIRBORNE RADIOACTIVITY AREA."
(e) Posting of areas or rooms in which licensed material is used or stored. The licensee shall post each area or room in which there is used or stored an amount of licensed material exceeding 10 times the quantity of such material specified in appendix C to part 20 with a conspicuous sign or signs bearing the radiation symbol and

the words "CAUTION, RADIOACTIVE MATERIAL(S)" or "DANGER, RADIOACTIVE MATERIAL(S)."
[56 FR 23401, May 21, 1991, as amended at 60 FR 20185, Apr. 25, 1995]

Q=============================

A lead pig with 2 cm wall thickness is inside a 30cm diameter polyurethane foam shipping drum. HVL of lead was given (=5.5mm). Exposure rate constant of 192 Ir was given (0.32 mR/mCi hr at 1 meter). Calculate max activity to keep exposure rate below 50mR/hr on the drum surface.

Could anyone else see wht answer they are getting for this question. I am getting. 0.0229mci.

-----------Re:

From your numbers:
2^-(2/.55) = 0.080417 (this is the transmission through the lead)
.32/0.09 = 3.5556 mR/mCi-hr @ 30cm unshielded
3.5556 mR/mCi-hr * 0.080417 = 0.2859 mR/mCi-hr @ 30cm shielded
so, 50 mR/hr = 0.2859 mR/mCi * x mCi
x = 50/0.2859 =~ 175 mCi
Hope my math is correct, and that this helps.

-----Re:

also, the distance from the surface to source should be 15cm, but not 30cm the allowed activity is scaled to be 43.75mci

---Re:

Good catch, radius = 1/2 diameter. the typical exposure rate is quoted as 4.69 that is why I stated that I was using their numbers. Also remember that this is typical not definitive. Ir-192 has a nasty energy spectrum and the exposure rate is dependent on source and manufacturer.

----Re:

Would someone please check my math and physics. I have a differnt result to this question.
Attenuation through lead 2^(-2/0.55) = 0.0804
Exposure rate constant for Ir-192 is 4.69 Rcm^2/mCihr Kahn page 358
4.69Rcm^2/mCihr/(15cm)^2 = 0.0208 R/mCihr
(0.0208 R/mCihr)*(0.0804) = 0.0017 R/mCihr
(0.05R/hr)/(0.0017 R/mCihr) = 29.4mCi

Q===============================

I was looking at the ABR questions for 2006 and there was one question. i was not sure about.
the question says dose at pt S is 6mrem/hr. how much concrete shielding to get dose at point Z less than 2mrem/hr. point S is 6m from the iso and point Z is 12m from the iso. how many TVL needed.
Well according to me we dont need any concrete at all. Is the question not correct or is my calculation not right. if so could someone please show me how to do the problem.

----Re:

You are correct:
The work is 6+1 and 12+1 distance
6 mrem x 49 = X mrem x 169
So the dose is less than 2 mrem/hr
Suleiman

Q=====================

I find this in the 2006 part2: Mammosite balloon w/ diameter = 4 cm and Rx point at 1 cm from surface of balloon. What is the minimum balloon to skin distance to minimize the hot spot to 150%? Could someone explain how balloon to skin distance affects hot spot? And where is the 100% IDL defined, at the balloon surface or 1cm away? Any good reference for this topic?

---Re:

"Hot spot" is not a good term, in this context -- unless you contour the skin as a region of interest, that is. You are trying to make sure the 150% line does not hit the skin at any point. Just as you want to make sure that air/seroma is less than 10% of the PTV and that 90% of your PTV (minus air) gets 90% of the Rx dose (340 cGy per day). Therefore, your Rx point is 1 cm from the balloon. A 4 cm diameter means a 2 cm radius so your Rx point will be 3 cm from the source.

You have a dose distribution that falls off as inverse square and hits 100% 1 cm from the balloon surface and 3 cm from the source. If you have seen a few cases beforehand, you know that the 200% line fits pretty neatly along the surface of the balloon. Therefore you expect
something near 5 mm balloon-to-skin distance (2.5 cm from the source). If I recall, this was the end of my problem-solving because there was only one reasonable answer. However, you can go further.

We assume that the dose falls off as r^2. As a quick check 100/((2/3)^2) = 225 so the surface of the balloon (2 cm) gets about twice the dose as the Rx point (3 cm). 100/x^2 = 150 gives us x = .817. But, x is just (r/3), where r is the distance to the 150 line and 3 is the distance to the 100 line. So, r is .817 x 3 = 2.45 cm. Or, 0.45 cm from the balloon surface.

Can someone check my math/logic, please? Really, there is no substitute for experience. Preferable sitting in on a case or 5 but just talking with someone who is comfortable with the process can help, too.

Oh, and they teach you not to accept three consecutive 5 mm slices because of skin dose, that also helped me come to a quick decision (RTOG limit is 145% to skin).

---RE:

Sorry, I gave the Rx dose wrong. 340 cGy/fx. 2 fx/day (at least 6 hours apart). 5 days for a total of 10 fractions (in 9 days max, I believe).

Q=====================

Main contributionto dose behind LINAC? A) Neutron B) Scatter patient, C)Scatter from wall, D)Leakage

---RE:

The answer is leakage. This question has been discussed at length on this group in the past.

---Re:

Leakage radiation is more penetrating than scattered radiation, thus the leakage barrier will be larger than the scattered radiation barrier. You'll find this explanation in 16.6 in Kahn for shielding.

Q=======================

Can someone suggest to me the best approach to solving this problem. I think I'm on the right track. If you know the exposure rate at point A then you can find the number of HVLs to reduce the exposure rate < 2mrem/wk at point B. Then use n=log(1/B) and find the number of
patients from B=Pd^2/WUT. Am I off the mark?

-----Re:

Since the exposure at A & B are known and the distance between the two is also known, wouldn't a simple inverse square argument give you the answer? Any other thoughts?

The problem is similar to Pt A is 6 m from Linac, Pt B is 12m from LInac. Dose
delivered per pt is 200cGy, exposure reading at A is 0.2mr/hr. How many patients can be treated to keep the exposure below 2mr/week at point B.

----Re:

You're on the right track, however n = # TVLs = log(1/B) not HVL. Then you convert TVL to HVL by the following: HVL=TVL/3.32

W="workload" or exp.rate at Pt A. U=T=1, and P=2mrem/wk and d should be in meters.

One thing to be VERY carefull of is that the units of P and W are the same!! I noticed on the boards that they like to mix units...a lot!! Be sure you answer is also in the correct units!!!!

Q============

1. TG21, TG51, what's the % difference in measurements? which is higher?
2. how to calculate the pressure change with 50m above airport?
3. What's the meaning of a phase space file in MOnte Carlo calculation?

----Re:

TG-51 is higher about 1-2%

Air pressure at height H can be approximated by:

P = Po exp(-Rho*g*H/Po)

Po atmospheric pressure at sea level, Rho air density at sea level, g gravity contant and H height.

---Re:

A phase-space file stores the information of a particle (i.e. position x,y,z ; angle of deflection
and history - previous interactions it suffered). Such a particle is used to calculate the Dose
Distributions in a patient. A phase-space file is actually the input to a user code (e.g. Electron Gamma Shower EGS4) for Beam/Dose calculations.

To be more precise:

- Monte Carlo generates a space-phase file of a hypotetical particle
- A code like EGS for Dose calculation is using this file in computations (energy spectrum of a linac and dose distributions in tissue)
- A planning software (TPS) is finally using all these to display the isodoses we love so much
to play with...

It is like a "source" file containing ALL the information on all the photons and electrons, necessary to complete their trajectories (using MC), at some plane between the target and the patient. Usually the plane is right before the Jaws so that the particle trajectories from the target thru the the flattening filters, monitor chambers, etc. do not have to be calculated everytime the jaws or the MLC are moved. This is a non-math explanation, of course.

---Re:

The rule-of-thumb that I have used is that, at least below about a few thousand feet altitude, the pressure drops pretty close to 1 inch Hg per thousand feet. I don't remember where I originally read this, but it was remarkably close and extremely linear, if I remember correctly. Therefore it is pretty easy to convert to mmHg per 100 ft or whatever you want (2.54 mmHg per 100 ft). I get 4.17 mmHg for 50m.

I have tried this formula out on our barometers to compare to the airport sea-level pressure and it has always been within or close to 1 mmHg. Currently, I get 756.7 (corrected sea-level) vs. 757.7 (barometer).
Can someone try this at their facility and let us know if it works there (preferably at an altitude above or around 1000 ft)? Either that, or correct me and let me know how I am mistaken.

--RE:

Just remember that pressure in Denver, the mile-high city, is about 80% sea level. So you get about 160 mmHg drop / 1600 m = 0.1 mmHg/m = 5 mmHg/50 m.

--Re:

I found this article. Hope it helps
http://www.colorado.edu/physics/phys1140/phys1140_sp05/Experiments/O2Fall04.pdf

--Re:

~ 0.6% less @ 50m

Q==========================

Does anybody know what TG-51 charge reading correction (P factor) can be less than one?

------Re:

Ptp can be >=1 or <=1 Pion is always >=1 Pelec can be >=1 or <=1 Ppol can be >=1 or <=1...

-----RE:

Gradient PQgr for electrons = Mraw(dref+0.5rcav) / Mraw(dref) < 1.0 (Such factor is included in kQ for photons but not in kQ for electrons)

Q==========================

1. sim film taken at 102 cm SSD, SFD 140cm. Want to treat at 120cm SSD. What distance to film should be used when cutting blocks.
2. multiple beam plan. AP weighted to 100% at dmax, laterals weighted to 100% at dmax. 200cGy delivered to 238% isodose line. Dose delivered by AP beam is ??? cGy.
3. apparent mCi is less, more or same as mCi.

----Re:

1) New film distance= Old film distance *(new SSD/Old SSD)
therefore the answer = 140 * (120/102) = 165cm
2) 238cGy isodose line = 119% line per prescription Therefore dose delivered by AP beam at Dmax= 200/1.19= 168cGy
3) Apparent mCi is less than mCi by definition

----Re:

I was taken aback by the first 2.
1. Wouldn't you just change your mag factor when cutting the blocks by (120/102)?
2. It stated the 238% isodose line, not 238 cGy. But I'm sure your interpretation is a correct one. Caught me up though.
3. Right on - it's lower than the actual activity. Apparent activity gives the activity of a source if it were a BARE point source. Thus the actual activity of the source may be higher, but due to filtration in the encapsulation the apparent activity will be used to measure what you see at 1 meter.

---Re:

Hey Ravi, could you expand a bit your answer for question 2? it's 200cGy at the 238% isodose line, therefore 100cGy at 119%, or 84cGy@100%. now how do you get the dose on just one of the beams without knowing energy/depth? it might be still to early to think and i haven't had coffee today. but bear with me. Thanks

---Re:

My take on question #2 is that each beam is set at 100 cm SSD and "calced" to deliver 200 cGy (100%) to Dmax and you get an isodose distribution that contains a 238% IDL (a 238% IDL would only happen in a very skinny person!). This is the way it used to be done folks so anyone out there that did dosimetry before 1985 should recognize this scenario. You can think in dose or in %. In this case 200 cGy=100% and 238%=476 cGy. What you want to do is either change the 238% to the new 100% or change the 476 cGy to the new 200 cGy.
200 * (200/476) = 84 or

200 * (100%/238%) = 84 cGy at dmax for each beam
Ravi did it exactly the same way - he just interpreted the 238% IDL as really being 238cGy (which is a much more realistic interpretation!).
The only good thing about this method is that it doesn't matter what the depth, energy or even how many beams you have because each beam is calced to 100% and then just modified by the %IDL chosen.
Question #3 just remember that "apparent" activity is what any measurement device "appears" to see after the real or actual activity is attenuated by encapsulation and self absorption.

---RE:
Right on Beth for both questions. I think I saw this 238 IDL seemed unrealistic so this is why I assumed they meant 238cGy, but you are right about the interpretation.
---RE:
My two cent on question #2
(1) Beth is right, this is old way (not too old though)
(2) The easiest way(at least to me) to solve this kind of problem is to use its defination. Since 238% is normalized to Dmax of each filed (not the composite dose at each Dmax) , so 200cGy/Dmax = 238%, that is Dmax =200cGy/2.38 = 84cGy. So each beam will give 84 cGy to their Dmaxs according to their weights.
(3) One should note that the 100% isodose line is not on those Dmax points because the other beams will also deliver some doses there, and the 238% isoline is normalize to each single beams Dmax regardless what is the composite dose at that point.
--_Re:
Again on question#2
200cGy is given by 238% isodose line. So total 300% by all 3 beams would be 200*300/238=252 cGy. Each beam contribution is 84 cGy.
---Re:
Why would you want a "new film" to look exactly like the old one (#2)? Wouldn't you just adjust the mag factor for the blocks by 102/120?
---Re:
What "new film"?? You only have a film taken at 102 SSD and 140 SFD. Your treatment machine has a fixed source to tray distance (or MLC). If you are cutting blocks your only adjustment on the block cutter is the SFD. If you are "digitizing" the film for MLC you can adjust the "mag factor" of your film to match the new geometry.
Either of these techniques will let you use your original Sim film and have it "match" your port film.
With the change in treatment geometry, in this case the patient is further away, the blocks (or MLC shape) need to be smaller. You can accomplish this by either increasing the SFD [140*120/102 = 165] used in the block cutter or decreasing the apparent mag of the Sim film [1.4 * 102/120 = 1.19] on a digitizer.
---Re;
I guess the question says to use the old film to cut the new block, so you need to place the film at a different distance to in effect look like you took it at the right mag factor to cut blocks for the new SSD. This comes directly from Bentel's book.

Q============
13: neutron dose equivalent (mSv) outside field per photon Gy at ISO.
14: neutron dose equivalent ratio 18MV vs 15MV, with possible answers: 1,2,5,10,100.
---RE:
This is from "Neutron Shielding Design and Evaluations" by Nisy E. Ipe. (AAPM summer school 2007)
Neutron yield at 1M from target
Elekta
Energy(MV) Neutron yield (mSv/Gy)
10 0.3
15 0.7
18 1.5
20 2.0
25 3.0
Seimens
Energy(MV) Neutron yield (mSv/Gy)
10 0.1
15 0.4
18 0.7

20 1.4
23 1.2

Q======================================
1. For isotope is the ratio of dose at d= 5cm to the dose at 1 cm is the lowest? Co, Cs, I125, Pd
2. What thickness of Al to compensate 5 cm missing tissue
3.Mammosite ballon with diameter = 4 cm and Rx point at 1cm from surface of balloon. What is the minimum balloon skin distance to minimize the hot spot 150%?
----RE:
To address the Mammosite question. I am pretty sure that was from last summer because it looks awfully familiar. I didn't actually do the calc at the time, but it is pretty simple, unless I am missing something...
It is just an inverse square. The distance to Rx pt is 3.0 cm and the distance to 150% Rx is X.
100/((X/3)^2) = 150
Or, X = 2.5 cm. So, the distance from the skin to the balloon is 5 mm.
---RE:
1. Pd has the lowest energy (21 keV)
2. Thickness = 5 cm * (0.7/compensator density) Kahn 12.6 (A)
3. This is actually straight from the mammosite protocol - 5 mm distance from skin.

Q======================
The depth of dmax for an 18Mv photon beam is 3.5cm. for parallel-opposed 15x15 cm fields, with a separation of 20 cm, the minimum depth at which 95% of the midplane dose is ? cm.
a 3.4 b 3 c 1.5 d 0.5 e0.2 cm
---Re:
Maybe 1.5 cm. at 3 cm I think you will get higher than 100% because it is too near Dmax
---Re:
Someone can correct me if I am wrong, but I think the answer is 3cm. If I use simple attenuation arguments (2.5% /cm for 18X beam), I find that the dose is pretty uniform between Dmax and midplane for a POP. So to get 95% of midplane dose you will need to be close
to Dmax only slightly lower in depth. Beth, can you comment on this? Thanks
I made an error in the math. The answer is 1.5cm. Based on the attenuation argument 95% of midplane dose is approximately the sum of the exit dose and build up
dose at 1.5 cm, not 3cm. –Ravi
---Re:
It has to be 3 cm. The entrance dose for 18 MV is only 13%, and the curve is broad around dmax.
Even with a contribution of exit dose you will only flatten that curve from dmax to the exit surface. Assuming 2.5%/cm the contribution from the opposing beam would be 62.5% of it's dmax. Forget math, look at the treatment plans you do with parallel opposed plans.
Ach. I'm wrong. Solving questions and sending them out before 8 a.m. is a bad idea. I'm looking at fig. 11.11 on pg. 211 of Kahn ed. 3 and 95% for 25 MV is about 2.5 cm (25 cm sep) and 10 MV is about 1 cm (25 cm sep).
Further, if I work out the PDD tables in the back for 10 MV (no PDD tables for 18):
0.5 cm 84% 1.5 cm 100.4% 3.0 cm 103.3%
1.5 would be closest for 18 MV. Right on Ravi!
---Re:
On my opinion, such type of subjects is made to use the physicists' (and in this Raphex case the dosimetrists') experience. There is no mathematics here! You should just remember the plans you are working on in your current practice, and simply estimate the result. No calculus needed!
Sometimes we push too hard to "work the numbers".
---Re:
I checked our 18 MV Linac's TMR and have the following calculation:
depth (cm) TMR INS cGy/mu (TMR*INS)
1.5 0.897 (108.5/100)^2 1.056
10 0.894 1 0.894
18.5 0.735 (100/108.5)^2 0.677
95% of midplane dose = 0.890*2*0.95=1.695
dose at d1.5 = 1.056+0.677 = 1.733

dose value at 0.5 cm seems too small. So the answer is 1.5 cm.
Correct me if I am wrong.
---RE:
i think that's correct, with the minor correction for the inverse sq. correction for the 1.5 depth, which would be in this case (100/91.5)^2 (pretty close to the 108.5/100 one). the isodose would be 94.8%

Q=========================
Dose anyone know what will happen to energy, profile, and dose rate when a linac target is worn off.
---Re:
Dose rate would deteriorate (you only have about a 1% efficiency in bremstrahlung production to start), lots of electron contamination so the PDD would would shift toward the surface.

Q==
IMRT does verification using small volume chamber (0.1cc). What should it's resoultion (or measured error) be in order to be able to use for dose verification (answers: 0.1%, 0.5%, 1%, 3%, 10%)
---RE:
I would have to pick 3% for the uncertainity. The only plausible answers are 1% and 3%. In table 17.3 in Khan, he states the total uncertainity in calibrating an ion chamber to be 1.6%. For such a small volume, I would expect the error to be greater.
--RE:
Dennis, I like your thought process. Usually IMRT plans are acceptable if they are within +-3% without making adjustments to the MU. Is this because the inherent error in chamber is +-3%? If so it would validate your argument more.
---RE:
I have always thought of resolution as the distance between 2 objects, as in spatial. In that case the resolution would be 0.2 mm.
The %error for field verification is 3%.
Please pardon for nitpicking, but I have a horrible fear of my interpretation in my notes (books, AAPM reports) and my job being articulated differently than the author of test questions.
--RE:
Do you mind to tell us where .2mm resolution for IMRT comes from? Is that from TGs?
3% uncertainty for a 0.1cc chamber used for IMRT verification looks like the only possible answer, but I still run into trouble. Assume 3% is totally coming from the 0.1cc chamber , what about the other uncertainties, like treatment planning, phantom setup and the procedure? All we really want to know from the IMRT verification is to see if the planning dose agrees with measurement within certain degrees. If ion chamber itself contributes 3%error, should we still setup 3% as our criterion that accepts an IMRT plan or not?
--Re:
I'm only aware of AAPM report 82, which states that the "The penumbra must be measured with high spatial resolution ~0.2 mm or better!." for the peacock dosimetry system.
A couple years ago the field verification would be on film and thus the error in spatial resolution - not sure how that works being that IMRT has a sliding window, but apparently a "spatial resolution" could be done that way.
We use Mapcheck, which checks 200 points in a 20x20 cm grid with a 3% tolerance/point. Table 20.1 on page 499 in Kahn (ed.3) has this, though I must confess that our senior Physicist (25 yrs. exp.)constructed the QA program not me (3 yrs exp). Sorry for the zig-zag answer, but that's what I've got.

Q=======================================
2. A 6 MeV photon interacts with a free electron in soft tissue. How many ions are produced by the scattered electron.
3. Considering a dual ion chamber scanning tank, an error in the PDD is not due to:
a. incorrect zero
b. RF interference
c. water/air differential
d. stepper motors not calibrated corrected
4. An unknown source has a range of 60microns in tissue equiv. plastic after traversing a 0.5mm Pb shield. What would be the range in plastic if the Pb shield was removed?
----Re:
1. If the question is asking about the possible maximum electrons.
Max Energy of scattered electron from photon, E = hv 2 alpha / (1+ 2alpha)
alpha = hvo/mc^2 (Khan 3rd p68)
hvo=6MeV , mc^2 = 0.511 MeV

E= 5.53 MeV = 5530000eV
Work ftn = 33.97 eV/ion pair
5530000 / 33.97 = 162791 ion pairs or electrons
4. electron (maybe other particles too) has the range about 1/10 in lead compared to water. Therefore 0.5 mm lead = 5 mm water. the answer 5 mm + 50 micro miter = 5.05 mm
Did you get the answer for 2, 3?
What is RF interference in the dual ion chamber scanning tank? Can the temperature differential between air/water can cause PDD difference?

Q=============================
Question: Determine the Effective SSD for 6 MeV electrons. Io = 100, at 20 cm gap reading was 44, and at 40 cm gap reading was 25. dmax for 6 MeV electrons not given.
--RE
One way to solve this problem
Sqrt (I/Io) = [ESSD + Dmax] / [ESSD + Gap + Dmax]
Sqrt(25/44) = [ESSD + 1.5] /[ESSD + 1.5 + 20]
.754 ESSD + 21.5x0.754 = ESSD +1.5
ESSD = 14.7/0.246 = 59.8 cm
Here we assume dmax = 1.5 cm for 6MeV
Also, please recheck the math.
---RE:
KAHN 14.4 G - pg. 317 in edition 3)
Effective SSD can be extrapolated from the change in ionization at one distance (say 40 cm) to another (say 20 cm).
Step 1 - find the slope of ionization vs. gap
[(Io/Ig = 40)^1/2 - (Io/Ig = 20 cm)^1/2] / (40 cm - 20 cm)
[(100/25)^1/2 - (100/44)^1/2] / (40 cm - 20 cm) = 0.49/20 = 0.0246
Step 2. - effective SSD = 1/slope - dmax = 1/0.0246 - 1.5 = 39.11 cm
We will have different results because those slopes of different Gap are not the same.
--RE:
Sqrt (I/Io) = [ESSD + Dmax] / [ESSD + Gap + Dmax]
It should read as Sqrt (I/Io) = [ESSD + Dmax +(gap1=20)] / [ESSD + (Gap2=40) + Dmax]
or Sqrt (I/Io) = [ESSD + Dmax] / [ESSD + (40-20) + Dmax].
At point A, D=ESSD (or called virtual source position), I=100, point B: D=ESSD+20, I=44, and point C: D=ESSD+40, I=25
--RE:
A&B:
(D+20+dmax)/(D+dmax) = sqrt(100/44)=1.508
D+dmax = 39.4
if dmax=1.3, D=38.1 cm
A&C:
(D+40+dmax)/(D+dmax)=sqrt(100/25)=2 (2)
D+40+dmax=2D+2dmax
D + dmax =40
if dmax=1.3, D=38.7 cm
B&C:
(D+40+dmax)/(D+20+dmax)=sqrt(44/25)=1.327 (3)
D+40+dmax= 1.327(D+20+dmax)
D+dmax = 41.2 cm.
if dmax=1.3, D=39.9 cm
It shows that the electron beam in this distance range does not exactly follow inverse square law. The average ESSD are 38.1, 38.7, and 39.9 cm for the range A&B, A&C and B&C respectively. Hopefully only one of the choices falls in this ESSD range.
--Re:
There could be three answers for this question:
1) SSD =100, Io =100, SSD =120, I = 44
f+dmax = 20/((100/44)^0.5 - 1) = 39.4cm
2) SSD =100, Io=100, SSD =140, I =25
f+dmax = 40/((100/25)^0.5 - 1) = 40.0 cm
3) SSD=120 Io=44, SSD = 140, I = 25

f+dmax = (40-20)*(44/25)^0.5/((44/25)^0.5 - 1) = 41.2 cm
The average f + dmax = 40.2 cm. If dmax = 1.5 cm , then f = 38.7 cm
So if the available choices are A) 20cm B) 30cm C) 40 cm D) 50 cm we will have no problem to find the correct answer. However if the increment of these answers is 1cm, we do need to say "Good Luck" to ourself.

--Re:

There is no mentioning in the original question that I0 is obtained with 100 SSD and 0 gap. In fact, most LINAC have 5cm gap for 100 SSD. Therefore, my humble opinion is to use the other two measurement and do a inverse sqare as Alex Chen has used (although I got 39.7cm from that calculation).

--RE:

Looks like the question about ESSD was not written "clearly". I had a similar question in my written board and it asked for Effective SSD (ESSD) giving the reading at two different SSDs (i.e. you determine the gap) and Energy So, you need to apply the formula in Khan's directly.
As mentioned before for those who are preparing, refer to the source as much as possible.
For radiosensetive tissues, there is a table in Hall's book (need to find the page) covering several organs.

--RE:

sqrt (44/25)= (f +1.5+40)/(f+1.5 +20)
essd = 40.5 ish

---RE:

I think the clinically relevant part is knowing that the ESSD >> dmax for 6 MeV, so you can ignore dmax in the calculation (even the famous Khan p. 317 also says something like this).
So, if X is the ESSD, A is a constant:
I(0) = A/X^2 = 100
I(20) = A/(X+20)^2 = 44
I(40) = A/(X+40)^2 = 25
Take any 2 equations and solve. Use the third to double check. The answer is 40. It gotta be a nice round number. It was late at night, the guy had done too many plans for treatment the next day, followed by several IMRT QAs, and he had already passed the deadline to submit
the questions to ABR. I don't think he would have come up with 41.32487... :)

Q===================

Q) A large volume ion chamber reads 1mR/hr at a crack in the linac vault. The same chamber reads 0.25mR/hr at a position far away from the crack along the same wall. Is the actual reading at the crack a)same b)greater c) less than what the chamber reads.
It seems that the chamber is reading 4 times more than the shielded wall at the crack. So even though intuition seems to say the actual rate at the crack should be higher why can it not be the same (i.e 1mR/hr)?

---RE:

I think this is because beam geometry. When large volume irradiated by a narrow beam, part of its volume recieve radiation. However, to compute the exposure or dose, it will use whole volume. This is why the real dose (exposure) rate at the craker should be higher than its reading.

--RE:

The answer is b) that the reading on the ion chamber at the crack on the wall would be greater than that read. The reason is that the whole volume of the ion chamber must be uniformly exposed to get a valid reading. Large volume ion chambers are good because they are more sensitive to lower exposure rates however they have an increased unreliability when at close distances from a point (or small) source because the exposure rates vary over the size of the detector.

--RE:

Did you mean to say that the reading on the ion chamber would be "less" than that at the crack
(meaning the crack actually has a higher exposure than measured by the chamber due to volume averaging?

--RE:

Perhaps I worded it a little funny, you are correct I should have said the "true" exposure rate at the crack would be greater than what was measured.

Q=========================

I came to this problem, found in some old materials. Maybe someone else is more inspired than me.
A patient is treated with a split field of overall size 12x12 cm2, blocked in the middle to shield a region of 3x12 cm2 on the surface. Answer the question given the following:
10 MV x-rays, 100SSD, dose rate in free space for a 12x12 field at 102.5cm = 1.011cGy/MU, cerrobend block thickness = 7.5cm, with primary transmission of 5%, block tray transmission=0.97, BSF(12x12)=1.027, BSF(6.5x6.5)=1.013, BSF(4.8x4.8)=1.009
What is the tx time to deliver 200cGy at 10cm depth at point P in the middle of the blocked area?

Possible answers:
a) 140 MU, b) 274 MU, c) 280 MU d) 283 MU
I know it looks like Ex.8/Khan, page 194, but i can't do it! The formulation is complete in the way I presented. Can someone put some light in here for me, please?
---RE:
I guess this question is very possible from those that recalled by
someone from previous exam. It is impossible to deliver 200 cGy under the block using less than 300 MU. Even in the case that the point is in the open area at the same depth recieving 200 cGy, it will need
200/(1.013*1.011*0.97*0.8) = 252
MU, where I assume PDD(d=10) = 80%. According to Khan's example, the point under the block at same depth will approximately recieve 20% of 200 cGy, which is about 40 cGy. So in order to pump to 200cGy at that point, it will be 252*5 =1260 MU! I guess this problem is so badly recalled and obviously miss something.
At least it should give PDD or TMR, otherwise who can get an answer that can distinguish between 280 and 283 MU.
---RE:
You look like you have 50% chances to answer correctly to this one!
The question is not someone remembered from the exam. It is printed on some old materials, together with different others. And it looks like very serious. It also has a possible answer (e) which is "can't tell". But... surprinsingly at the end of that booklet there is the grid with the answers. And that one has a very precise result: answer (c) which is 280 MU. But how did they get there in the absence of any PDD or TMR value?! Is there just a game to play with those BSFs?!
Or should I reconsider the problem, and say formulation is printed wrong, and actually they want to treat in the middle of one of the OPEN areas, and get even closer to Khan's problem. But again, the answer is not among the possible ones. Or is it?

Q==========================
What is integral dose?
Integral dose is the total energy absorbed in a volume. That's it. So it depends on what volume you're considering when calculating the integral dose.
You DO want a high integral dose to the tumor, if this is the only volume you're considering. However, the total energy absorbed in the patient goes up as the energy to a specific area in the patient (tumor) goes up. So, in essence you're trying to leverage a higher dose to the tumor (integral dose in the tumor) relative to the total patient volume(total integral dose).
The higher energy beams give a lower integral dose (figure 11.13 in KAHN).

Q=============================
An error of 2mm in MLC openning causes an error of xx% in 2cm radiation field?
---RE:
You're thinking too hard brother.
2 mm = 0.02 cm * 100 cm (SAD)/55 cm (SDD) = 0.036 cm (or 3.5 mm) at axis.
(2.0 - 2.0363)/2.0 = 1.8%
---RE:
2 mm = 0.2 cm which gives 18%?
---RE:
Thank you Kevin. So you think it is geometric problem other than dosimetric
question.
If it is geometric question, why you use a scale factor of 100/55? when we talk about position errors of MLC, are we always meant that they are projected at SAD or iso just like the leaf width (5mm or 10mm)? If this is true, then S= a*b, so Delta(S) = Delta(a)*b assuming b is not changed Delta(S)/ab = Delta(a)/a =0.2/2 =10%
If it is talking about one dimension, the anwer would be 0.2/2 =10%
Thank you again. you are right I may think too hard and that is how I treat those questions someone recalled from previous years. Since there no way we can figure out what really questions are especially there are some of them that are very confusing, I have to guss what they are asking and if I can anwer.
--RE:
I viewed the problem like this:
The change at the collimator, 2 mm, is 55 cm from the source. This changes to 3.63 mm at 100 cm SAD.
The change in field size at 100 cm goes from 2 cm to 2.036 cm, or 1.8% difference.
---RE:
I do understand what is 100cm/55cm when I ask Kevin, but i don't understand why we need it. When we talk about field size (jaws), we always refer to the jaw opennings projected at ISO plane and rearly refer to what real jaws openning are in their real positions(engineers may prefer). When we talk about MLC leaf width, we also

refer to the projection at ISO instead of its real width(e.g.5mm,10mm). I would like to believe that the 2mm MLC error is referred
to ISO(SAD) unless it mentions explicitly and gives us the distance from MLC to source. Please correct me if I am wrong.
--RE:
Check out the paper by LaSasso titled "Physical and Dosimetric aspects of a MLC system used in the dynamic mode for implementing IMRT." See Figure 8.

Q====================================
1) % increase in depth dose per cm of lung tissue for 6MV
2) % decrease in depth dose per cm of bone for 6MV.
Ans for both questions range from 1% - 5% in
increments of 1%. I have conflicting answers.
3) Function of a double flattenning filter? (I have heard of double scattering filters but not of double flattenning filters)
4) Patient treated with 3 fields. SSD setup with each fld 100% at Dmax. Dose of 200cGy to the 238cGy isodose line. Given dose from each field. (I got 168 cGy)
5) Planned 3 fx with 30deg wedge. Wedge isodose angle 30deg. Wedge inserted wrong way for one fx. What is the new isodose angle after 3 fx. (I get 20 deg)
6) Avg [A] and max [M] exposure rates at 1cm from a Co-60 teletherapy source head given. Activity of source is [S]. What strength is the source rated for?
------RE:
1. ABR website Easy Type A answered C 5%, yet Kahn has 3% (table 12.3 pg. 290 in 2nd edition)
2. 3% Kahn table 12.4
3. I've never heard of one. It is not mentioned in Kahn, Bentel, IAEA RadOnc Primer or Karzmark Primer.
4 & 5. I don't understand the way you wrote it.
6. That depends on the design of the linac head shielding.

Q==
In tissue from a 0.46-mCi permanent implant I-125 seed, what is the total dose to 1cm distance?
My calc: f factor for 30kev in muscle - 0.918 exposure rate constant - 1.46 Rcm*2/mCihr
t half - 60 days
Total Dose = 1.46*0.46*1.44*60*24*0.918 = 12.8Gy
The given answer is 13.2 Gy.
If I use f factor in water, the total dose is even less. The only other number is the exposure rate constant, which is unfiltered number from Khan's book. What is your calculation?
----RE:
Since we are supposed to choose the best possible answer do you think the answer you got (which is what I got) is good (close) enough? Maybe one of the ABR examiners on this group can comment on this question since this is not the only answer that I cannot get when working the examples on the ABR website. Very frustrating!!..
---RE:
It's good to know that I am not the only one who can't get the exact number in the answer. Since there weren't other information provided in the question, the only way to solve the problem is to lookup all the constants in the book. For now, I am just taking it as - our answers are good enough. BTW: for whoever have taken Part II, how many constants does the test expect you to know? For example, I can remember the exposure rate constant of Ir-192, but I have to check the book for Pd-103. Is it necessary to memorize all the numbers?
---RE:
The Anisotropy factor is <=1 isn't it?. Seriously do they expect us to remember these factors too? I thought if you remember the half-life, energy of emitted radiation and the exposure rate constant that is all we had to memorize.
---RE:
TG-43 Table II, exposure rate constant for ideal point source of I-125 = 1.51 R.cm2/mCi/h. If you use this in your calculation, with f=0.918, you get 13.2 Gy.
(Is this the true solution to your ABR enigma? Perhaps not. Who knows how much beer the guy had been drinking when he wrote up the question...)

4. In tissue from a 0.46-mCi permanent implant I-125 seed, what is the total dose to 1 cm distance?
A.55 Gy
B.10.5 Gy
C.13.2 Gy

D.30.5 Gy
E.50.0 Gy

I started with Dtotal = 1.44*Do*T where Do is the initial dose rate and T is the half life.
First I found the exposure rate ×(R/h) = (Ã*A)/l2 =(1.46*.46)/1= .00006716 R/h
Then I find the air kerma strength Sk = .00006716*.876(cGy/R) =.00005883cGy/h at 1m
This is where I get confused, there must be a better way. The answer is C 13.2 Gy. I could have narrowed it down to B and C but could not conclude which is correct from my analysis. Anyone know how to get C?
---RE:
This a the way I solve the problem when the dose rate constant is not given
total dose (cGy)=1.44*T1/2(h)*1.45(R/h.mci)*0.965(cGy/R)*A(mci)/d^2(cm)
Total dose = 1.44*60*24*1.45*0.965*.46/1^2=1335cGy = 13.35 Gy
if the dose rate constant was given then replace 1.45*0.965 by the dose rate constant.
Q==============================
If a patient is prescribed 200cGy a fraction with 30% open and 20% wedged for each field, what dose does the patient receive if the wedge is put in the wrong field? WTF=0.25
----RE:
I believe it means 60% open and 40% wedged.
200*0.6=120cGy open
200*0.4=80cGy wedged
120cGy/(1cGy/MU) = 120 MU if RX is at dmax
80cGy/(1cGy/MU)/0.25 = 240MU
if wedge is put in the wrong field.
120MU*0.25=30cGy
240MU=240cGy
Total 270cGy
70cGy overdose?

Q==============================
> 1. Beam current before the target for photon beam is ....times that > for an electron beam.
> 1000, 100, 0.1, 0.01.
1000 times
> 2. Six 1Ci Cs-137 sources form a Patterson circle: Diameter of the circle is 2 cm. What dose at 1 cm from the center of the circle.
6 * 3.26 R cm^2/(hr mCi) * 1000mCi * 0.971 cGy/R (f-factor in water) * 1/(2cm^2)= 9496 cGy/hr or using Table 13-3 in Hendee: Root Sqare 2 =~ 1.5, at 1.5 cm 3.241cGy/(mg hr) * 6 * 1000 mCi * 3.26 / 8.25 = 7684 cGy/hr or using Table 13-4 of Hendee, 187 mg hr / 1000 cGy -> inverse =1000 cGy / 187 mg hr * 6000 mci * 3.26 / 8.25 = 12679 cGy/hr
> 3. Calculate the thickness of concrete (HVL=4.6 cm) needed for shielding a nurse station that is 10 feet from HDR room. Dose per week delivered(Workload)=4000 cGy at 1 cm. Nurses are restricted to 0.1mSv/wk.
4000 cGy/wk *(1cm/(10*12*2.54cm))^2 * 10 mSv/1cGy * x HVL = 0.1 mSv/hr
0.431 mSv/hr * x HVL = 0.1 mSv/wk Approximately 2 HVL.
> 4.For a 3x3 electron field compared with a 10x10 field choose the correct ans
> a)the Rp remains the same
correct
> b)The R50 decreases (Changes)
correct
> c)The surface dose changes
correct
> d)the output changes
correct
> e)the depth of max doses changes
correct
> 5. In electron Arc therapy the
> a)dmax decreases
increases
> b)PDD decreases
increases
> c)Rp remains the same
increases
> d)Phton contamination increases

correct
> 6.Two lateral marks are put on a pelvis and a lateral simulation film was taken. What do you need to measure size of the actual tumor > on the film.
SSD & seperation or SAD, SFD
> 7. What produces the following distribution:
> 7.1 Box d) a) 60 deg wedges, 110 deg hinge
> 7.2 Diamond e) b) 30 deg wedges, 50 deg hinge
> 7.3 Ellipse c) c) bilateral 120 deg arc
> d) AP/PA, R/L lat box
> e) AP,R/L post obliques
8. AP/PA separation is 20 cm; R/L lateral separation is 38 cm; the dose ratio for a box technique for AP/PA vs. R/L is
> a)1/1,1.5/1.5
> b)1/1, 2/2
> c)1.5/1.5, 1/1
> d)2/2, 1/1
d)
> 9.What is use to block other organ in intraoperative electron therapy
> a)cerrobend/thin Pb
> b)Pb stips/superflab
> c)beewax/lucite
a)
> 10.A 10 Mev electron beam is used to treat the lung of a patient. > The lung starts 3 cm from the surface: lung electron density=0.5 > that of tissue. The effective Rp is
->3 (6MeV) + 4 (4MeV) = 7cm
> 11. In Rotational (arc) therapy
> a) the Mu/cGy remains constant
> b)Mu/degree remain constant
> Maybe b)

Q==========================
For an "ideal" Fletcher tandem and ovoids, with the loading shown below, the typical dose rate at Point A is _____ cGy/hr.
Tandem: 15-10-10 mg Ra equ
Ovoids: 15 each
---RE:
Typical dose rate is between 40-50 cGy/hr for LDR
---RE:
Total activity = 65 mgRaeq = 65 mCi
Exposure rate constant for Ra-226 = 8.25 R.cm2/mCi.h
Average distance = 3 cm, as shown in the picture below :)
Exposure = 8.25 x 65 / 3^2 = 60 R/h or about 60 cGy/h dose, which is
typical as pointed out by Steve.

Q===============================
1. HDR question. 10Ci is stuck for 360s. What dose is done to the patient at 1cm distance.
2. Parotid treatment with electron and photon
a) electron should be prescribed to midline
b)bolus should place on skin
c)electron field should be larger than photon field
3. Co60 treatment- Patient was given treatment to the wrong site for 1 out of 15 treatments. this is
a)recordable event
b)reportable event
c)call refering physician
d)contact NRC by telephone
4. head frame for SRS is fixed to the head by
a)pins through one plate of the skull
b)screws through one plate of the skull
c)screws both the plates of the skull
5. Why is there no bragg peak for electrons
----------RE:

1. Assuming your HDR is IR-192, Ã = 4.69 R-cm2/mCi-hr * (10,000 mCi * (1/1cm)^2)= 4,690 R
2. b. Bolus is used sometimes to reduce the dose to the spinal cord, and sometimes a wedge in the photon field, but this question is loaded.
3. There is no more recordable events, or misadministrations for that matter - it is now a "medical event". And the wrong site is automatically a medical event. The referring physician and the agency must be notified within 24 hours (C& D)
4. OMG - There are so many different apparatus used here
5. Electrons don't have enough mass to "plow" forward and then slowly come to a "tail end" curve, i.e. a bragg peak. They scatter quite a bit.

----RE:

1. Don't forget the time involved (36 sec.) and the Gy/R conversion to get to Dose.
2. I don't believe that bolus is used to protect cord (that's why you are using the electrons to begin with). Bolus would be used to bring dose closer to the surface. When treating Parotid with electrons and photons (seldom treat this way any more) we use an electron field that is 1 cm larger (in all directions) than the photon field.
3. We (Oregon, agreement State) have both mis-administrations and Medical events in our rules. Make sure you know the rules in your State for the Oral Boards.
4. I believe that only screws are used (to better control degree of penetration into the bone??) and I can't imagine system that would not use more than one plate (i.e. two sides of the scull).
5. Electrons lose there energy in a continual process as they traverse any material. However, because of their relatively small mass, the electrons suffer greater multiple scattering and changes in direction of motion. As a consequence, the Bragg peak is not observed for electrons. The multiple changes in direction during the slowing down process smears out the Bragg peak. Bragg peaks are associated with "heavy" particles. The rate of energy loss or stopping power is inversely proportional to the square of the velocity of the particle so as the particle slows its energy deposition increases creating a sharp increase of dose deposition at the end of their range resulting in the "Bragg Peak".

---RE:

1. Oops - damn "insert" button! The time (360 sec = 0.1 hr) was in the answer, but not the conversion.
2. We use bolus with higher energy electrons - there is a brief paragraph on pg. 312 in Bentel.
3. Great point! 10 CFR 35.3045 no longer has it.
4.. We use 4 screws on the frame w/4 plates on the frame, but our Radiation Oncologist refers to plates on the skull.
5. Nice!

Q==

1.A lesion at 1-cm depth in tissue is to be treated with 6-MeV electron beam with bolus. A dose of 1.5 Gy to 80% is prescribed. If output is 1cGy/MU, SSD is 104 cm and cone factor is 0.8, what should the thickness of the bolus be, and how many MU should be delivered?
2.An isocentric 10-MV oblique photon beam has depth of 12 cm, of which 6 cm is muscle tissue and 6 cm is lung. Without lung correction, the actual delivered dose at the isocenter compared to the calculated dose at the same point would be

-------RE:

1(a). 80% ~ MeV/3 = 2 cm, so you need 1 cm bolus to treat a lesion at 1 cm @ 80% isodose
[hint - section 14.4(A), pg. 307 in KAHN 3rd edition, states that "For a broad beam, the depth in centimeters at which electrons delvier a dose of 80% - 90% isodose level, is equla to approximately 1/3 to 1/4 of the electron energy in MEV. (3rd paragraph)
or more specifically 90% E/3.2 and 80% E/2.8 (4th paragraph)]
1(b)1.5 Gy * OF * 1/ISF * 1/cone factor * 1/Isodose line = 150 cGy * 1 MU/cGy * 1/(100/104)^2 * 1/0.8 * 1/0.8 = 253 MU
2. Lung correction = 6 cm lung ~ 6 * 1/3 = 2 cm equivalent tissue. So you need to correct the tissue by 4 cm.
4 cm "missing tissue" * 2.5%/cm missing tissue = 10% increase in dose at the point 12 cm deep

----RE:

I have some disagreement with you regarding the bolus used. The prescription of the dose of 1.5 Gy to 80% does not imply the 80% line at lesion. According to my understanding, the lesion should be enclosed or covered within 80% line. To ensure this goal, 100% should be at lesion, and as such 0.5 cm bolus should be used. Please correct me if I am wrong.

---RE:

From a practical standpoint you would have to look at the entire tumor volume to ensure that the PTV covers the CTV. But the dimensions of the tumor were not defined. Does it start at 1 cm depth and extend another 3 cm? If so, the answer changes.
Tests are funny thing - they couldn't possibly predict how well an actual problem would be solved in the workplace. Who takes 60 seconds to do a shielding evaluation? Who does an MU calc for Cobalt and Linac in

the same 120 second span? That said, the 80% isodose line at the 1 cm depth w/1 cm bolus (for 2 cm total) is correct.

---RE:

I used a standard Inverse Square Factor for a simple problem given that had no field size or tumor volume.
Clinical electron beams use an "effective SSD" that is measured for each energy and field size.
For us, a 10x10 field size for 6 Mev has an effective SSD of 85.84. Dmax for 6 Mev is 1.3.
The ISF correction formula is [(effective SSD + Dmax)/(effective SSD + gap + Dmax)]^2
The gap is 104-100 = 4.
So clinically the ISF correction would have been [(85.84 + 1.3)/(85.84 + 4 + 1.3)]^2 = 0.914
I used (100/104)^2 = 0.924.
Small margin, but another difference between the clinical and tests.

---RE:

Just to throw a twist on this, the problem quoted is from an example from the ABR website, the answer given by the ABR was 1cm bolus and 209MU. I never could get the 209MU to come out. I think Kevin's answer is correct but can anyone get the ABR supplied answer?

Q========================

the dose under a 1.5 cm width cord block(5hvl) in a 6mv photon beam at 5cm depth is approximately ____% of the dose in the open beam.
The answer is 15%. 3% due to transmission through the block and the rest is due to scatter. How would you know 12% is due to scatter?

---RE:

Beyond the depth of dmax, PDD is a product of exponential attenuation, inverse square, and scatter contribution. First, take the measured PDD and divide out the decerease due to inverse square from dmax to the point at depth. Then divide out the decrease due to attenuation in water from dmax to the point at depth, the remaining value is the scatter contribution to the PDD at depth.

Q==============================

Given mixed energy, electron and photon, dose to surface = 40 Gy and PDDs at surface for each given, and dose to d=5 cm = 55 Gy, PDDs for each at d=5 given, what are the relative contributions of photons and electrons at dmax?

----RE:

I think this is a general sense question. assume the x is the relative contribution of photons and y is for electron. a, b is the pdds for photon and electron at surface. c, d is the pdds for photon and electron at 5 cm. then there are equations: ax+by=40,cx+by=55. slove it then can have x and y.

Q ==============================

1)A service technician wants to decrease the current to the magnetron by 8%. What would this effect?

--Re:

I found the answer to it in the Karzmark book this morning. One of the techniques used for energy switching in a standing wave accelerator is to use a broad band buncher and reduce the output of the Klystron or the magnetron. So I am assuming the answer to the question is that it would reduce the effective energy of the beam, reduce the penetration (PDD10). It would
also reduce the output because with the increased energy spread, there are fewer electron clearing the energy slits in the bending magnet and the leakage in the accelerator head would increase as a result of that.

--Re:

In general terms, the answer I would give to your first question is: The dose rate delivered by an electron accelerator is controlled by the pulse repetition rate and the number of electrons per pulse.

--Re;

The pulse modulator synchronizes the pulsing of the magnetron/klystron and the E-gun.

--RE:

What happens is the magnetron current is decreased from 108 A to 100 A?
In Karzmark, Nunan and Tanabe book figure 5-2 page 90 appears the "Performance chart for EEV 5125 magnetron". Just looking at the figure one can see that if the cathode peak current drops from 108 to 100 mA then the peak power output of the magnetron will decrease. An explanation is given in the section just above the figure: the rotating space charge spokes departs from synchronism with the rf field in the anode.
I also think that by decreasing the cathode current one is decreasing the number of electrons available, so the total space charge is less. Therefore the induced electric fields in the anode are going to be less intense, they will affect the kinetic energy of the electron with less strength, and taking into account that the power of the microwave is acquired from the loss of kinetic energy of those electrons, then it will be less kinectic energy of

the electrons available to be converted into rf power. Therefore less power.
One interesting detail is that in the book it is admitted that the initial build up of oscillations in the magnetron is obscure... Does anybody know of a newer reference in which this issue is "de-obscured"?
2.- There was a question that asked why the electron bunches entering the bending magnet do not collide with the ones exiting it. Tony Morales gave an explanation a few days ago in this group, and I would like to share what he, more than I, refined later. Here it goes to your consideration:
Every electron bunch is separated by 10 cm (one wavelength at 3 GHz) in space and by 0.33 nanoseconds in time (the amount of time for a bunch at 6 MV (0.996 c) or 18 MV (0.9996 c) to travel 10 cm). By designing the bending magnet trajectory longer than 10 cm, say by an integer number of half the wavelength, it will allow for the bunches not to collide. In the extreme case, by making the trajectory of the bending magnet 15 cm long, if the bunch just entering the bending magnet "looks bak" will see the one that was inside the bending magnet at 0.33 + 0.33/2 nanoseconds later exiting it, and the bunch that was following him will see the same exiting bunch 5 cm ahead.
---Re:
Below is what two posters to the Linac-Eng newsgroup had to say. To summarize:
* Magnetron power output will change
Mis-match of magnetic field in resonant cavities leads to lower RF amplitude
* Change in electron beam
Energy spectrum due to changed acceleration and poor impedance matching Current due to reduced impedance matching
Focusing of beam by accelerator structure solenoid current mis-match

* Change in output

Energy spectrum and hence FDD curve in water

Flatness and perhaps symmetry due to poorer focusing

Reduced dose rate due to low impedance matching and filtering by any bend magnet

Calibration because spectrum is different (Coefficients are quality-specific)