Sample MU Problems:

2011 Test.

Notes: I don't remember using the TMR on any question! Surprising. There were only a few hand calcs (maybe three). Prob 8 or so shielding probs.

1.The steel/concrete 36in problem from old tests.

2.Calculate the MTF given a point source function and another function of the acquired signal I guess. I had no idea how to do this.

3. Given that the 5 cm fan beam, 0.43 pitch, 15 second gantry rotation period. What is the time to image a 100cm length on Tomotherapy?

4. On a 4 slice CT scanner with a 1mm slice thickness, pitch is 0.88 (for example). 30 rotations/min. How long does it take to scan 50cm? or something like this.

5. An isotope has an air kerma strength of 30,000U, dose rate constant is 2.45cGy/U. Radial dose function is 0.88 at 2cm. Anisotropy is 1. What is the dose rate at 2cm? (Two questions like this)

6. Goal is 0.02mSv/wk at 30cm beyond the boundary. It is 5m from iso to the boundary. 25 patients/day. 5days/wk. Avg of 3Gy per patient at iso. Occupancy is 0.25. Use factor is 0.25. What is the number of TVLs needed for the primary barrier.

7. The maximum field size is 40 x 40. Collimator can turn full 180. Primary barrier is 4m away. What should the width of the primary barrier be (to include 30cm past the light field).

8. A M(high) is 2.020, M(low) is 2.016. V(high) is 300V, V(low) is 150V. Temp. is 19.2. Pressure is 100kPa (really…yes!). kQ is 0.988. Ndw (Co60) is 4.74x10-8Gy/C. Pelec = 1.00. Find the dose to some point. No other measurement given except those for Mhigh and Mlow.

9. For an orthovoltage machine, where the cone is 15cm from the source. Two measurements are made: one right at the cone end and one 10 cm away from cone end. Measurements were 150 and 53.6 respectively. What is the effective source distance from the end of the cone?

10. The CT number of bone is supposed to be 1200, representing an relative electron density of 1.7 with respect to water. If the CT parameters where mistakenly altered (using a higher kVp) and the CT number for bone was taken as 1052, what type of error would you expect. Answers were 5% over/under attenuate, 12% over/under attenuate in calculation from TPS.

1. A 6x10 cm tumor is treated to a depth of 3cm on a Cobalt 60 unit (80 cm SSD) to 180 cGy/fx. What is the cord dose if the cord is located 8cm deep. Output is 180cGy/min at dmax.

Depth(cm)	PDD
0.5	100
3.0	90
4.0	85
8	63

=================

A get 126cGy, assumed single AP beam, assumed PDDs given were for a equ sq field of 7.5cm

Agree Agree

2. Patient treated using parallel opposed equally weighted fields at 80 cm SSD on a 4MV linac to total midplane dose of 80 Gy.Patient thickness is 20cm. Field size is 15 x 15 cm^2. Total dose to depth of dmax (1.2 cm) is:

Depth (cm)	PDD (15x15)
1.2	100
5	83.7
10	63.6
15	46.9
20	34.1
25	25.0

I assumed 80cGy total delivered, 84.33 cGy at dmax.   I assumed machine calibrated at 80cm SSD + dmax

Agree...Total dose = 40(100/63.6) + 40(34.1/63.6) = 84.3 cGy
I get 86.3 cGy. 40(100/63.6) + 40(37.2/63.6) = 86.3.   Since depth from opposing beam

is really 18.8 not 20. It might be nit-picky, but if the answers are close on the test it could be worth it.

True, but I highly doubt they will have us doing interpolation on the test, I hope not anyways

I will admit, I was sloppy and didn't interpolate :(

=====================

3. Patient treated using 18MV instead of prescribed 6MV. Prescribed dose is 180 cGy to depth of 5cm at 100 SSD. If calculated MU's were delivered, what is dose to 5cm depth?

18MV info: tray factor: 0.98, output factor: 0.98 cGy/MU, %DD(5cm)=96%

6MV info: tray factor: 0.97, output factor: 0.99 cGy/MU, %DD(5cm)=86%

Calced MU for 6MV: 218mu, then used mu to calc 18MV dose: 201cGy

Agree

Agree

4. calculate MU's needed. 180cGy, 20x20 field with a 5x5 section blocked. SAD = 100, d=12. TMR's given. (block not over CAX) Sc, Sp table given

5. calculated MU's needed. 250cGy , 12x8 field with around 20% blocked, 100 SSD, d=9, tray factor = 0.97 Sc, Sp table given, PDD's and TMR's given

Im using an equ. sq. of 9.6cm and a blocked equ. sq. of 7.7cm at 100 SSD; MU = 250cGy / [XcGy/mu*TMR(d=9,FS=8.4)*.97*Sp(FS=7.7)*Sp(FS=8.4)*((100+dmax)/109)^2]

6. calculate MU's needed. SSD = 105, d=22, WF=0.279 (PDD's, TMR's, Sc, Sp tables given), 2.5 cm off axis. OAR = 1.015

MU = Dose/ [XcGy/MU * TMR (22, FS@22)*.279*1.015*Sc(FS@127)*Sp(FS@105)*((SSD+dmax)/(SSD+d))^2

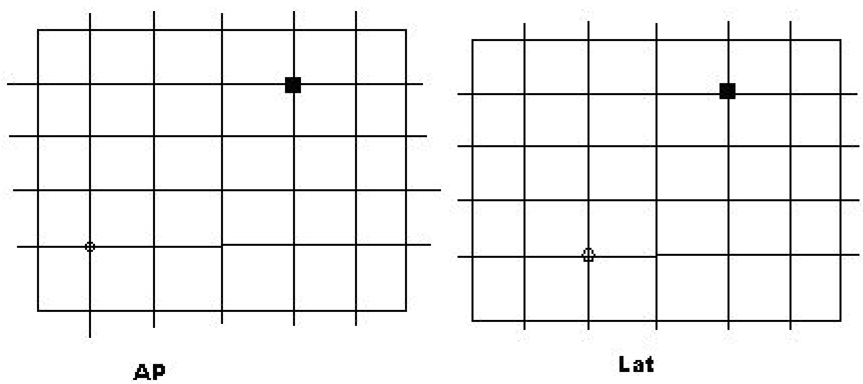
What I remember from ABR Exam 2005 PART II

-

-

Disclaimer: This is only what I remember, the problems can be poorly formulated. I am not responsible for misunderstandings.

1.- Given the grid in which every line intersection is at 1 cm. Determine the distance between the source (black dot) and the point of interest (white dot).

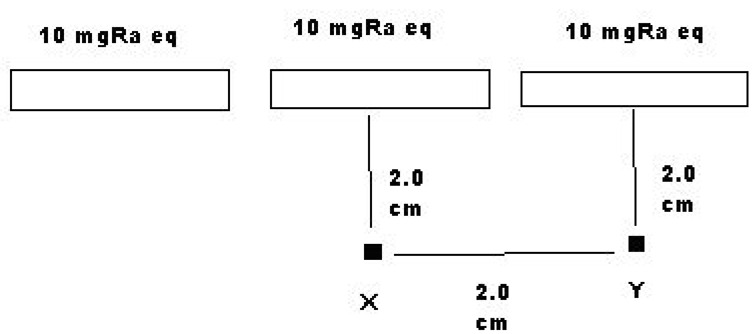


d = root(9 +9+4) = 4.7cm

agree

agree

2- Given three linear sources as in the figure, determine the ratios of the dose at point Y respect to point X.



I am guessing there is something missing that indicates that t1=t2=t3...otherwise the answer becomes more complicated: Dy = t(1/4+1/8+1/20), Dx = t(1/8+1/4+1/4); Dy/Dx = 34/40 = 0.85 assuming equal dwell times.

agree

Agree

Agree with answer, but Dx=(1/8+1/8+1/4)

3- Tables of 4 MV and 6 MV PDD and TMR VS field size were given in two sheets of paper. At the very bottom of the PDD tables for both enegies, a column with the BSF for every field was given. BSF, not Normalized Peak Scatter Factors were given. The calculations were to obtain MU settings for different field sizes:

-In general: most of the time the calibrations were at SSD + dmax.

-In some problems the Sc,p was not given. Even the whole exam doesn´t refers to this magnitude like that (in some other problems OF was given, which is Sc,p)

- Use of SAD and SSD setups, change in SSD´s (to require one to use the Mayneord factor to get the new PDD at a different SSD).

- Calculate the dose to cord at 4 cm, given every thing needed for a SAD setup.

4.- A shielding problem like: Available space 36 inches. Required thickness of concrete was 66 inches. TVL for concrete = 13.6 inches. TVL for steel 3.8 inches. Determine how much of steel has to be in the 36 inches wall for the shielding to work out.

66/13.6 = 4.85 TVL's needed; 2 equations, solve for number of TVL's steel(s). c + s = 4.85,

13.6c +3.8s = 36; s=3.06 TVL, 11.6 inches steel needed
agree

I get s=3.26, so 12.4in steel.
I Agree with s=3.06 if s=3.26 and the above equations are correct, which I believe they are, then s=3.26 on gives us a total of 34 inches

Hint: develop a system of two equations and two unknowns (X, Y being the thicknesses of concrete and steel).

5.- The same method (a system of two eq. and two unknowns) can be used to quickly solve for problems like: How many fractions with a PA cord block if after the block is added the dose to cord is reduced to 18 % of what was being given

without it. Total of dose to isocenter 6000 cGy, total dose to cord 212 cGy per fraction. Constrain: cord dose can not be more than 4500 cGy

Hint:

eq 1: x Dose to cord + y * 0.18 * Dose to cord = 4500 (Dose to cord 212 cGy/fraction)

eq 2: x Dose to iso + y Dose to iso = 6000 (Dose to iso = 200 cGy/ fraction)

(b+u)*200 = 6000; u(212) + b(0.18*212) = 4500; SOLVE for b, b = 10.7..... 11 fractions blocked

I guess this is for a PA only field. Agree with 11 fractions.
Agree with 11 fx for PA

6.- Again a problem in which two post oblique fields traverse 9 cm of lung. Detph of isocenter from the two posteriors is 18 cm. TMR given for 3, 5, 9, 12 and 18. (Better formulated in previous years).

effective depth problem. 9cm tissue + 9cm lung(1/3) = 12cm effective. look up TMR 12

I agree with the TMR 12, This may be the problem that alos has an AP field and you need to find the ration of dose delivered from AP vs 2 post obl. fields

7.- A problem in which you had to calculate the thickness of a compensator, given the missing tissue = 5 cm. Density of compensator material and electronic densities of water and compensator material. Compensator thickness = (missing tissue amount)(0.7/density compensator)
khan pg 262 (3rd edition)

8.- A problem in which the transmission factor B had to be calculated given everything you needed. In ALL the radiation protection problems the Xp (effective dose limits were given, so there were no ambiguities in this regard).

Bpri = (P*d^2)/ (W*U*T)

Bscat/sec = (P*d1^2(distance to iso)*d2^2(distance to calc point)*400) / (W*T*FS^2*scatter fraction)

Bleak = (P*d^2*1000)/(W*T)

9.- Two problems like the ones that appeared in previous years regarding transferring a patient to a Co-60 unit after being simulated and treated in a SAD = 100 cm setup in linac. The treatment in Co-60 had to be done with SSD setup. Thickness of patient given.

10.- 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.

Dose rate @ 1cm from balloon = (4.69)(10,000)(0.97)/(3*3) = 5055 R/hr = 1.404 R/sec
1.404R *.867cGy/R = 1.22

time = 340/1.22 = 278.8 seconds

I'm not sure about this answer here. I'm assuming the 0.97 in your first line is the "f-factor" which seems pretty good for tissue. However, that already converts it to cGy/hr so the extra 0.876 isn't needed. I get an answer of 242 sec.
Your right, no need for extra conversion. I also get 242sec

11.- A problem in which the timer error of a orthovoltage unit was + 0.02 secs. The dose rate was 125 cGy/min in water. PDD was 60 % at 2 cm. Determine what is the maximum dose that can be delivered with less than 1 % error without having to take into account the + 0.02 secs.

haven't reviewed timer error yet...so check me on this one. seems like with a timer error, we would be asking what the MINIMUM dose that we can deliver while ignoring the timer error because the longer the time the less significant the error. So the dose rate at 2cm is 125/0.6 = 208.3cGy/min. Dose rate*(t)/[Dose rate*(t-0.02s)] =1.01; solved for t = 2.02s, 208.3cGy/min * 2.02s * 1min/60s = 7.01 cGy at 2cm

I agree with 2.02 seconds. I solved for dose at surface 1st: 125 cGy/min * 2.02 seconds / 60 sec/min = 4.21 cGy at surface
for dose at depth 2 cm: 4.21 cGy * 0.6 = 2.53 cGy at 2cm

I agree with both methods above depending on were they define the 125cGy/min. If we assume it is at dmax, then I agree with the second method. If they define it at

2cm depth, then i agree with the first method.
Went back over my problem..must have worked it fast b/c I divided dose by PDD instead of multiplying. still got t=2.02s. should have finished problem: 125cGy/min*(0.6)*(1min/60sec)*(2.02s)= 2.525 cGy at 2cm (agree)

12.- Another problem in which the leakage transmission factor B had to be calculated. Basically you only had to known that there is a factor of 1000 (1 / 0.1 %) for leakage.

B=(P*d^2*1000)/(WUT)

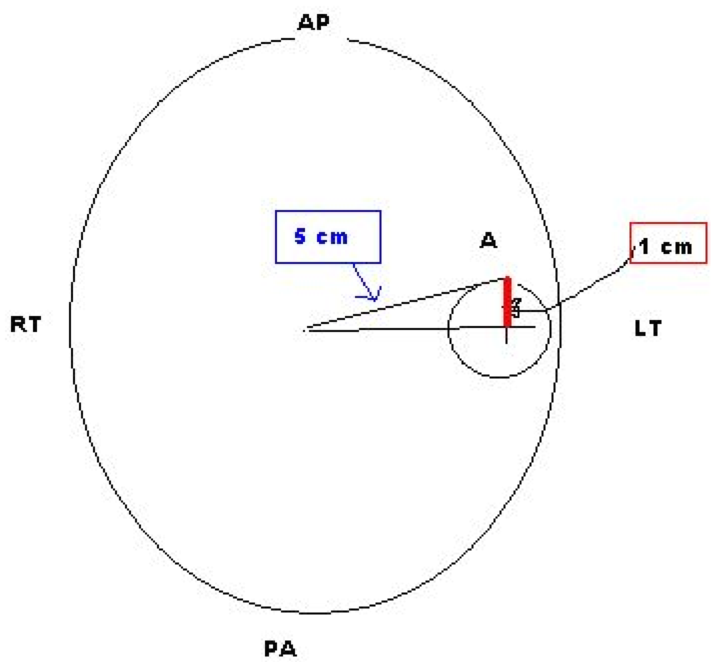
u=1 for leakage

In general, and it is very fair, all the time the T, U and W was given. It is better to leave the decision of selection for an oral test scenario.

13.- 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.

I get 0.087cm shifted down (towards PA) if the head is tilted clockwise in this view (but not confident about this answer)

Here I don´t remember if the isocenter was centered on the circle or at the origin from where the 5 cm are measured. This is a key issue for solving the problem.



14.- Another problem with a 1 cm grid superimposed on a AP and Lateral Fletcher applicator. Essentially like problem 1. Determine the distance from one of the ovoids to a point. And calculate the dose rate to the point due to that source in that ovoid only. (mgRa eq for the source were given, 8.25 R-cm2/(mCi – hr) one had to know, I think f factor also was not given (source was Cs-137).

1st: convert to mCi, XmgRa eq * 8.25 / 3.26 = Y mCi Cs-135
2nd: Dose rate = A * 3.26 / d^2
I guess you could not convert to mCi and just use mgRa * 8.25 when solving for dose rate. I just like mCi.
Agree
Agree, I think still need f-factor for conversion to dose.

15.- Given a universal wedge with Wedge Factor = 0.5. Calculate the ratio of wedged / open field to make the wedge a 30 degree wedge.

1 to 1 ratio. I solved for ratio of MU's...wedged to open.

33% wedged and 67% open. 1 to 2; I think this depends on if it's the ratio of MU or not. W%=tan(30)/tan(60)=W/(W+O) = 33% If MU's, it would be 46% of total MU

remember, if you use thatcher it gives the ratio of MU(wedged) to MU(total)..not open. so if you got 0.5, then 1 MU wedged would be used to every 1 MU open

For these tpyes of problems, do most of you think about using the Tatcher equation (wedged fraction = ratio of effective to universal wedge angles) or the updated Philips equation (wedged fraction = ratio of the tangents of the 2 angles)? The Philips equation has papers showing it is better, what does everyone think? It could make a really big difference if the universal wedge angle is 60 degrees. I had trouble about a year back finding a paper on the wedge angle equation so I derived, B=tan(x)/tan(60), B/(B+(1-B)Wf). It seems that this is the thatcher equation. What is the philips equation? This one I've been using gets withing 1% or so to what pinnacle calculates for Wedged MU but it is true that it does not give exactly the same answer. I like it being a separate equation as a good second check and I think it would be fine to use for this type exam.

You are using the "Philips" equation, the ture original tatcher equation would just be, B= x/60 where x is the desired effective wedge angle. Example needing 30 degree wedge with 60 degree universal.

Tatcher: B = 30/60 = 0.50 (fraction dose from 60 wedged)

Philips: B = tan(30)/tan(60) = 0.33 (fraction dose from 60 wedged)

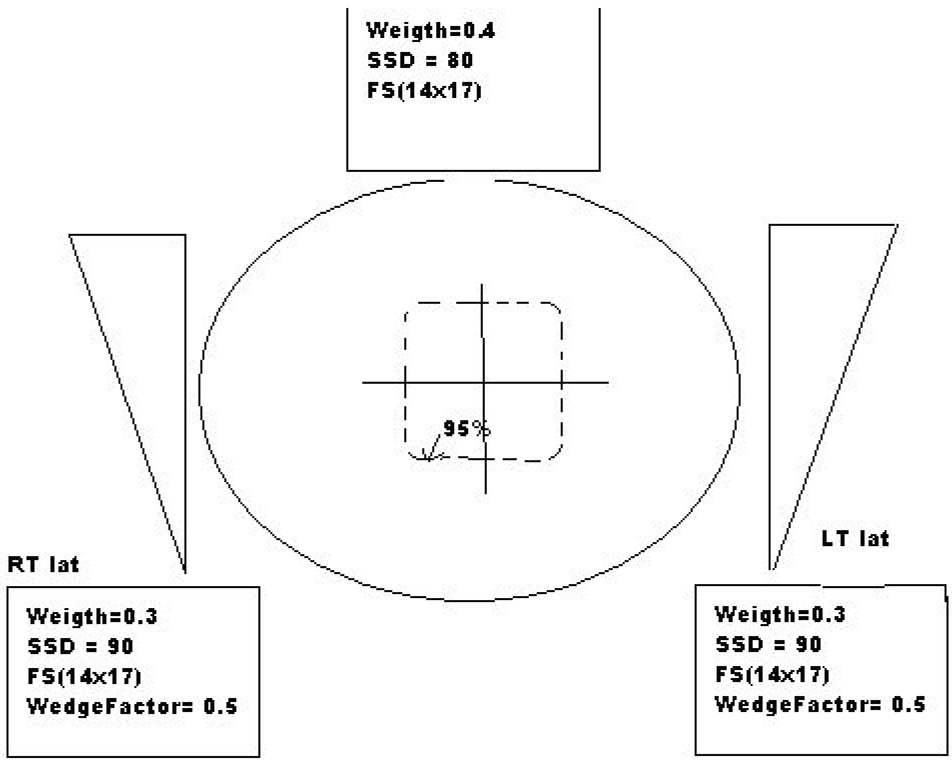
Hint: use Tatcher relationship: new Wedge angle = (1-F) Universal wedge angle, and take into account the with a WF = 0.5, twice the mu´s has to be given for the same dose.

16.- Shielding calculation for a HDR room. Ir-192 source 10 Ci, exposure rate constant of Ir-192 given, weekly limit given (0.01 R/week), T = 1 given. And workload W = 100 min/week given. Distance 2.0 meters. Determine B.

First determine exposure rate to find workload in terms of R/wk. Xrate = A*gamma/r^2 = 2 R/wk; then use B = Pd^2/WUT = <u>0.02 m^2</u> = 1.7 TVL's needed

I think the answer should be actually 2.3 TVLs. I agree with finding the workload of about 2 R/wk at the point in question. One TVL takes the exposure rate from 2 to 0.2, another takes it down to 0.02 and then 1 HVL takes it to 0.01. Therefore you need 2 TVLs and an HVL which equals roughly 2.3 TVLs
The answer is 2.3 TVLs. Solve for the workload at 1 meter, not 2 meters (2 meters will be taken into account in the B equation). W at one meter = 7.667 R/wk
Then B=P*2^2/WUT = .005217, #TVL = -log(B) = 2.3

17.- What is the ratio of MU´s given the weights of AP = 0.4, RT lat and LT lat = 0.3 to deliver 200 cGy to 95 % Isodose line. Fsize for every was given. WFactor for lat. Fields given. SSD for every field given. Table with TMR´s (FS, depth). Calibration 1cGy/ MU at SSD + dmax.



Assumed 6MV for dmax

Ratio of AP to PA = [80cGy / (1cGy/MU * .95 * TMR(15.4, 20cm) * (101.5/100)^2)]

[120cGy / (1cGy/MU * .95 * .5 * TMR(15.4, 10cm) * (101.5/100)^2)]

18.- Total dose at 2 cm from one seed of Pd-103 given its dose rate constant (0.868 cGy/hr), g(2cm) was given, Sk for the source was given= 2.5 U. Phi (anisotropy) = 0.939.

Find initial dose rate. (dose rate constant)*(1/d)^2*Sk*anisotropy*(radial dose function); Then total dose = (initial dose rate)*1.44*T1/2

Assume g(2cm)=1; Initial dose rate = (.868cGy/h*U * 2.5U *.939)/2cm^2 = .51 cGy/hr; Total dose = .51 cGy/h * 1.44 * 17d * 24h/1d = 299.3 cGy

19.- 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.

SSD effective = 1/slope - dmax, where slope is the slope of the plot of SQRT(I0/Ig) vs gap. Khan p 317

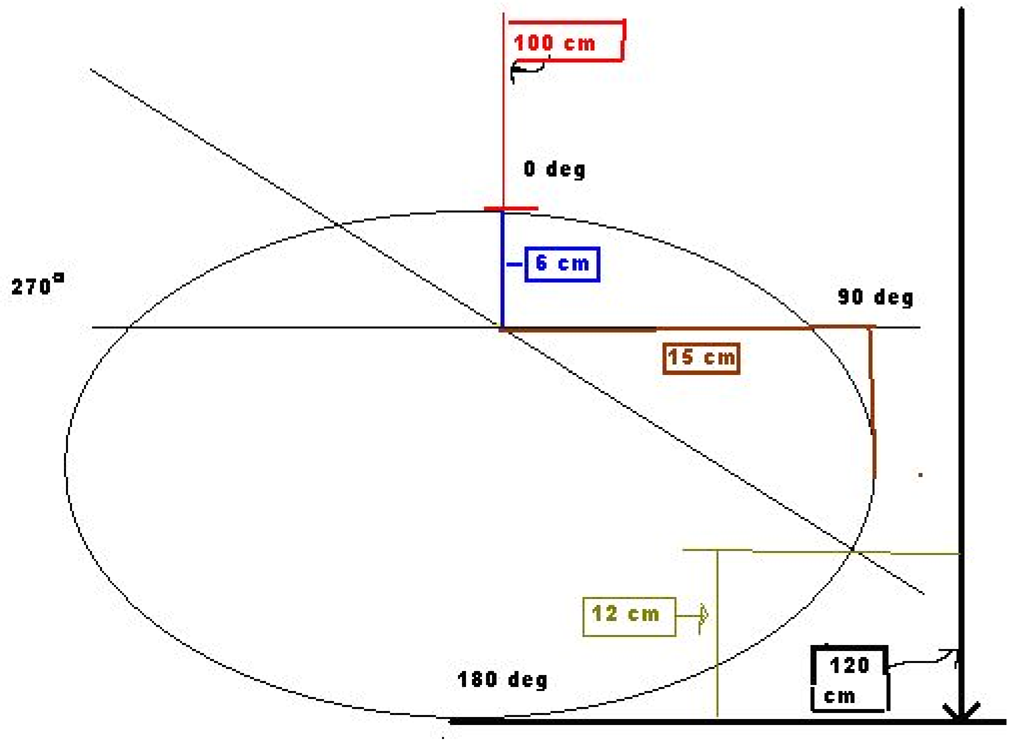
gap = 20, SQRT(100/44)=1.5

gap = 40, SQRT(100/25)=2

solve for slope: 1.5 = 20a + b, 2 = 40a + b, a = .025
gap = 1/.025 - 1.2 cm = 38.8 cm effective SSD

20.- A geometry problem:

Determine the angle, following the IEC convention of angles, of the medial field, given the dimensions in the figure:



120-12-6-100=2cm tan-1(2/15)= 7.59 degrees. +270 = 277.6

Agree

21.- What is the change expected in mmHg when reading at 50 meters of altitude from the airport level. ~4.45mmHg

22.- Given the density of air 0.001293 g/cc, chamber with 0.19 cc, given 1 R = 2.58 e -04 C/kg. Calculate the approximate exposure calibration factor of the chamber in R/C.

0.001293*0.19*(1kg/1000g)=2.457E-7kg; 1 R = 2.58E-4C/kg*(2.45E-7kg); calibration factor = 1.58E10 R/C

agree

23.- Three or four problems that are solved using equivalent triangles rules for field sizes transferred from SAD setups to SSD setups.

24.- A DVH was shown. What is true from it?

25.- A graph of raw (not shifted) PDD´s VS depth shown. Diameter of chamber 0.6 mm. Determine the PDD(10 cm). **Look at graph and pull out PDD(10+0.6*0.03cm)=PDD(10.018)**

26.- What percent higher/lower difference is expected when going from TG21 to TG51**I thought I saw 2% somewhere**

1 % lower for photons

1 - 3 % lower for electrons

TG51 is 1% higher for photons, and 1.5% - 2% higher for electrons. From paper published by MD Anderson showing ratio of TG51 Dw to TG21 Dw and answer was >1

27.- What is the meaning of D90 = 110 Gy?

The minimum dose that covers 90% of the volume is 110Gy

agree

28.- Scatter transmission factor B given distance to patient 1 m, distance to secondary barrier 5 m, field size 20 x 20, alpha= 0.001, W = 500 Gy/week, Xp = 0.02 mSv/week.

Bscat= (P*(distance to patient)^2*(distance to calc point)^2*400) / (W*U*T*alpha*(20*20)) U=1, Make sure you add the distance from the wall to the calc point. Usually .3m beyond wall.

29.- A simulator shielding problem. 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.

Find effective workload (R/wk): (0.01R/mA*s)*(600mA*h/wk)*(3600s/hr)=21600R/wk; B=Pd^2/WUT, TVL's=-log(B) = 4.8 TVL's needed

agree

30.- Main difference between Magnetron and Klystron. Hint: Klystron is not a microwave generator. **klystron only amplifies RF signal**

31.- Select proper order of parts in a LINAC. Different orders of parts were given. Hendee's and Khan's book.

e-: electron, collimator1, Foil1, Foil2, MUchamber, collimator2

photon: electron, target, collimator1, flattening filter, MUchamber, Collimator2

32- Main n contribution to dose behind LINAC. Select among neutrons, scatter from patient, scatter from walls, leakage from LINAC head.

agree

33.- Penumbra calculation from LINAC given target surface distance, target block distance, depth in patient and target dimensions.

Penumbra thickness = FSsize(SSD+d-SCD)/SCD

agree

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

Beta, .540 MeV, but these are mainly absor by the applicator....Y-90, 2.2MeV Beta treats

35.- The only factor less than 1 in TG-51. Select from Ptp, Pelec, Ppol, Pgrad.

As long as Dref > (Dmax + 0.5rcav), Pgrad will be less than 1.0.

(*However, for low energy e-, I have had it be slightly larger than 1.0, because Dref ~= Dmax*)

36.- Flatness and symmetry tolerance figure according to TG-40

monthly 2%,3% respectively , TG142 IMRT (annual) 1%,1%

37.- What percent of a batch of seeds has to be checked in a prostate seed implant procedure.

10% or 2 ribbons, whichever is more
agree

38.- Tolerance for deviation between light and radiation field according to TG-40.

TG40 2mm or 1% a side; TG142 2mm or 1% on a side

39.- Necessary thickness of lead for 6MeV electron cut-off

3mm

agree, .5mm/MeV

40.- Which components of a LINAC are pulsed after Thyratron is fired?

electron gun and magnetron/ klystron
agree

41.- A tumor is reduced because of its higher mitotic activity , was my answer.

42.- PET cant bring information about (metabolism, metastasis, pathology, TX follow up, tumor)

43.- An error of 2 mm in MLC opening causes an error of xx % in 2cm radiation field

unless there is a rule of thumb that I have not heard of, we will need either a Source to MLC distance or a MLC to 100cm SAD distance. I assumed that it was 40cm from source to MLC. (2mm*100/40)=5mm; 5mm/20mm = 0.25 ---> 25% error

44.- What condition is not required for collimator output factor Sc.

phantom measurements

45.- What doesn’t change by reducing field size in electron beam.

Rp

agree

46.- TVL for neutron attenuation in maze according to ?? is:

5 meters

47.- Energy at which theoretically can be produced a neutron in LINAC (6,8,12,16,20 MV): Answ: 8 MV.

I believe the threshold is 10 MV so that would mean 12 for answer

I think think it is 8. Neotrons are produced in a 10, 12, 16, and 20MV beam. As far as I know, no neutrons in 6MV. This leaves 8MV as a "theoretical" option.

48.- Given a graph of ionization current vs polarization voltage with different areas marked select which detector works at specific area

areas on graph from left to right should be ion recombination region, plateau region (ion chamber), proportional region (proportional counters), Geiger-muller region, (geiger counter) then spontaneous discharge region.

49.- Measurement of the crack in a LINAC vault with high volume IC. Chamber over the crack measures 1 mR/h and far from the crack 0.5 mR/h. Estimate what would be the actual exposure rate (less than 0.5, 1, more than 1, etc).

Seeing that we are still getting a reading that is half the reading of the crack at a long distance away, this seems to be a partial volume effect. If the entire volume of the chamber is not contained within the radiation beam then the dose measured will be too low. I would say more than 1 mR/h.

50.- Calculate the time required to achieved 95% of the total dose for a I-125 permanent implant

[ln(.05)/ln(2)]*60days =259days

51.- Permanent implant of Pd-103. Activity was given. Calculate total dose delivered.

52.- 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). See RAPHEX for a better questions.

53.- Detector resolution required for SRS field profile is (less than 1mm, 2mm, 3mm, etc)

2 mm

3mm for regular SRS, I thought gamma knife was 3mm PDD and 2mm profiles

54.- What is the meaning of a phase-space file in Monte Carlo calculations?

A phsp is defined as a collection of representative pseudo-particles emerging from a radiation therapy treatment source along with their properties that include energy, particle type, position, direction, progeny and statistical weight for every particle crossing a scoring plane

55.- Sliding window in IMRT means A, B, C, D, etc?

56.- A set of CT numbers was given -1000, -100, 0, 100, 1000. Select proper order of tissues that correspond with the order of these CT numbers. Air, lung, water, soft tissue, bone were in all possible answer in different orders. Air, fat(or lung I guess, but I thought around -400), water, soft tissue, bone

57.- A DVH graph was given. A point on the DVH curve was marked. Select proper meaning of this point from different enunciations.

58.- For what purpose a beam spoiler for 10MV breast treatment is used ?

In general use spoilers (ex. lucite trays) to increase dose in buildup regions. They can move dmax slightly closer to surface. I would think for a breast treatment this would allow for the benefits of a 10MV beam at depth, while preserving dose near the skin and shallow tissue (like 6 MV)

59.- Amount of X-ray contamination for a 18 MeV beam is around …. %.

around 3.5% (kahn)

60.- Dose limits for the public for frequent and infrequent exposure is ….

0.02 mSv/wk

Annual limits to public: 1 mSv (frequent), 5 mSv (infrequent)

2004 ABR Therapy Part 2, Written

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. Dwell times in 1 and 3 are the same. What is the ratio of dwell times 1 to 2 to make dose A equal dose B.

I get t1/t2 = 2.5 I think this is a very drawn out problem and easy to make a simple mistake. It would be best to memorize the ratio for this particular geometry. Must know t1=t3, then set Da=Db ; Da=t1(1/1^2)+t2(1/(1^2+1^2))+t3(1/(1^2+2^2)), Db=t1(1/(1^2+1^2))+t2(1/1^2)+t3(1/(1^2+1^2))

2. TG51 question (no TG21 in whole exam). Given Ppol, Pelec, T (deg C), P (mmHg), Vhigh = +300V, Vlow = +150V, 100mu Reading for Vh = 1.71 …., 100mu reading for Vl = 1.70…., given 60CoNdw Gy/C for chamber, given pdd photon, given kQ (not asked to do energy determination to find kQ) calc cGy/mu at dmax for photon beam. Answers approx 0.6% apart. (Also given plenty of irrelevant information such as TG51 electron beam parameters)

D=M*Kq*Nd,w; M = M'*Pion*Ppol*Ptp*Pelec; Pion= (1-(Vh/Vl))/((Mhraw/Mlraw)-(Vh/Vl)); Ptp = (760mmHg/P)(T(K)/295); NOTE I've seen slight variations the standard T value. I'm most familiar with 273 +22. also note that 101.33kpa = 1atm=760mmHg. Then use PDD to get to dmax since this will be dose at 10cm. Also note that this was for 100MU

3. 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?

assumed 30fx treatment . #b+#u=30, 62(30)+150(u)+0.18*150*(b)=4000

solve for b=19.2 FX. So you would need to block for 20 Fractions

I agree with 20fx. I assumed same number of fx 62x+150y=6360, so y=42.4-.41x

62x+(.18)(150)y=4000, x=64.52-.44y substitute into above equation for y.

y=42.4-26.45+.18y; y=19.45, so block for 20fx

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?).

I think this is just knowing that the wipe test limit is 5cCi and that the count rate will be proportional to activity. (there is not any dead time calculation or saturation etc...) so.. Xcpm/(REFcmp)= XActivity/REFActivity (make sure to convert mCi --->nCi) Since you are doing the ratio I don't think any conversion to bq is needed

6. 2cm diameter lead pig inside polyurethane foam inside 30cm diameter shipping drum. HVL Pb given. Exposure rate constant of 192 Ir given (but not the one I know!). Calc max activity to keep below 50mR/hr on surface. Another variant of this question used 137Cs (again I didn't recognize the exposure rate constant provided), activity provided and asked to calc thickness of lead to reduce exposure rate to certain level (TVL given).

exposure rate = (Activity*exposure rate constant)/d^2 Use the (1/10^n) trick since they give TVL. so Exposure Rate = (Activity*exposurerate constant*(1/10^n))/d^2 ; where n = # of tvls, d = 15cm since that is surface of bucket. Rearrange equation to solve for Activity

7. Parts definitely not included in EPID – options were ion chamber, CCCD camera, mirror, silicon screen, some other dose detection device.

what about liquid filled ion chamber EPID's ? unless it mentions aSi ? THE ANSWER IS SILICON SCREEN! EPID's have a phosphor screen.

8. TBI, diode reading 450cGy on surface, presc midline 600cGy POP laterals, 30cm separation. TMR's given, 350cmSSD. What is error in midline dose? Answers approx 5% apart, both + and -. I had to assume entry beam only, and diode reading relevant to dmax (not surface – no TMR at surface given) to get anything reasonable.

Agree with statement above that reading is for dmax (not surf), still need inverse square for surf though

Used ball park TMR(6MV, 40x40,15cm)=0.745

assumed only one field gets dioded. so, d=300cGy. %diff = [((300cGy*(1/TMR(15))*(365/350)^2))/450cGy] = 0.979............ so 2.1% low

I used same approach: ratio of TMR to find dose at dmax.
300cGy*(1/TMR15)*(365/351.5)^2 = 434cGy   I assumed E=6MV since diode is reading at dmax I used dmax depth in inverse square. 434cGy/450cGy = .965; so 3.5% low

Since we are comparing MIDLINE DOSE, shouldn't we use 450 to solve for actual dose delivered at midline? 450*(TMR15/1)*(350/365)^2 = 308, so actually 2.7% high

I'll buy that^^^^ Since the Rx value is what we want, then that value will be high or low. We then have to assume the diode is the correct value due to it's calibration. I just redid this with GREEN method and I get 3.5% high. I still think you have to do your ISQ from dmax since a diode reading is a dmax reading. (351.5/365)^2

3. Simulator shielding question, NCRP 116 level to worker with office leve

above simulator
room. Occupation mentioned – I don't recall but was an al
allied health profession not
related to radiation oncology/ radiology. Floor to floor = 12 ft, iso = 48" above floor, SAD = 100cm, given U=1/4. W=800mA.min/wk. Asked to work out the thickness of concrete shielding required. Answers about 4mm apart. Provided with a graph of R/(mA.min) at iso on vertical axis (log scale) vs concrete shielding thickness (cm) on what you had to do was find allowed R/mA.min at point where person is sitting, then thickness.

B = (P*d^2)/(W*U*T*exposure rate at one meter), must know P for controlled or uncontrolled are in R/wk.

P for a simulator, controlled = 0.1 R/wk. T=1 (office). d = distance from target to a point 0.5 m from above floor normally. This graph that is talked about seems to normalize the workload to iso. So I took distance from iso to a point 0.5m above floor. = 9.5' = 2.9m
Pd^2/WUT = 0.0042 R/mA*min

9. Three beams 120 deg apart, AP and post obliques. Each 15 cm depth to calc point. 60cGy from each beam to be delivered to calc point. Post beams have 9cm lung, e density = 0.33, TMR's given at 3,6,9,12,15 cm. Ratio of mu's post to ant.

MU ap = 60/TMR15

post depths = 6+9x.33 = 9   MU post = 60 / TMR9 when doing ratio, don't forget there are 2 posterior oblique fields and 1 ap field

10. Several TMR and PDD questions that needed the 4A/P rule.

11.Extended SSD calc that needed the Mayneord F Factor. Was only given a graph of output vs field size ie could not separate Sc and Sp.

12. Ratio of dmax (25 MV)/ dmax (4mv) for same dose to midline using POP setup with SSD =100cm. PDD's given.

13. Neutron dose equivalent (mSv) outside field per photon Gy at isocenter.

Good info found in the AAPM 2007 Summer School: http://www.aapm.org/meetings/07SS/documents/ipe_AAPM2007FINAL.pdf

14. Neutron dose equivalent ratio 18MV vs 15 MV. Answers were fairly widely separated ie 1, 2, 5, 10, 100.

Ratio is 4X more at 18MV than 15MV, so in this case, I'd probably choose 5!

15. Given distance iso to maze and maze length, neutron dose at iso (mSv) per photon cGy at iso, what is neutron dose (mSv) at door per photon cGy at iso. Told TVL of neutrons is 5m, but not where it applies. I applied kersey formula ie ISL iso to maze, then 5m TVL down maze to door.

16. Numerous questions of dose ratio where had to use TMR ratio and change of ISL.

17. 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.

Both scattering foils are in place

why are both scattering foils in place for electron only? Wouldn't gun current reduce significantly going from photon to electron?

^^^just seemed like the scattering foils would need to be in place since they would not be in the photon field. I can see how the gun current could be reduced. Lot's of electrons needed to produce xrays in the target since efficiency hovers around 1-2% for brems. production. What is the efficiency of the scattering foil for producing more electrons?

18. g(r) for 125I vs 103Pd. A. same at all depths, B. Pd exceeds I beyond 1cm, C Pd exceeds I beyond 4cm, D. I exceeds Pd beyond 1cm, E. Same at all depths.

I exceeds Pd beyond 1cm
22. TG 40 photon flatness spec. 2%

Flatness = 2%

Symmetry = 3%

23. TG40 field size spec A. 2mm/1%, B. 2mm/ 2% C others not 2mm

2mm or 1% on a side

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

E: every use, pg 25

25. TBI – what is not true – A. Dose Uniformity < 15% B. Tissue Equivalent compensators are used C. High SSD D. AP preferred over lateral.

Dose uniformity < 15%; uniformity must be +/- 10%

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

A. Distance to fetus

"The most important determinant of the peripheral dose is

the distance from the radiation field edge," from TG-36

27. S/rho and rho given for lead. Calc MeV/cm then use to calc lead thickness needed to shield 18MeV beam.

9mm Pb, since .5mm/MeV to stop electrons

28. 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 between last treatment and source exchanged does not matter. Need the Activity of last treatment. Then decay the new source from its installation date to the treatment date to get current treatment activity. Get ratio of activities and multiply the factor by the original treatment time. Since new source strength should be larger, the treatment time will be shorter.

30. 10MV through 6cm lung, dose actual vs dose without inhomogeneity. No other data given.

10 MV attenuated around 2%/cm in tissue. So that would be 12% without inhomo and %4. So an 8% difference in dose with/w/o correction. If question is asking about dose deposited its 8% lower. if it is talking about dose to a point past the lung then it would be 8% higher

31. A question involving 10mg Ra – simple application of "xA/d2 – but needed to know (ie not given) exposure rate const. = 8.25 Rcm2/mg.hr

Exposure rate = A*gamma(Ra)/d^2

32. Shielding question. 36 in space available for needed 6 TVL (this information was given). Pb TVL given. Concrete TVL given. What is the minimum thickness of Pb needed.

# of concrete TVL = x, # of steel TVL = y

# of TVL = 66/14 =4.71

14x+4y =36

x+y = 4.71 Solve equations

x= 1.716, y= 2.99

Total thickness= 14x 1.716+2.99x4 =36 inches, since TVLs of concrete & steel are 14inches & 4 inches

Hope it helps ---- KA

I would do it like this
from problem we know #TVL=6=x+y

and 36in= x*TVLconcrete + y*TVLPb
2 unknowns, 2 equations, solve

Done further down document

33. How many TVL's in a linac head. 3

35. The only IMRT question:
In IMRT the physicist does not define: A. Beam Weights B. Field Sizes C. Gantry Angles
field size. determined by volume drawn by Dr
…..Most of the time we do not determine field size, but some times we do (like if we are matching to a SCLV field in HN IMRT). We never determine beam weights.

agree with beam weights never defined in IMRT

36. Field size required at midplane is 25cm, maximum can open is 20cm. What is SSD? (separation = 22cm) 114

Agree. The field is defined at midline so 20/25 = 100/new iso ; new iso = 125; 125cm-11cm = 114cm SSD

37. Sim film taken at 102cm SSD, SFD 140cm. Want to treat at 120cm SSD. What distance to film should be used when cutting blocks.

Keep mag factor the same for both setups; 102/140 = 120/SFD2; SFD2 = 164.7

Agree, M=SFD/SSD M=1.372 ; new SFD = 1.372 * 120cm SSD = 164.6cm

38. Standard question about the couch kick angle required to make inferior borders parallel on lateral brain fields. arctan(SkullfieldLength/2*SSD)

agree - couch = arctan(0.5*lateralCranialLength/SSD)

coll = arctan(0.5*posteriorSpineLength/SAD)

I've seen couch kick listed as arctan(inferior field length/SSD) that guy is a quack, what he meant by that is that if the field is not symmetric then its the inferior part of the field (i.e. the X2 field size, if symmetric then divide total field length by 2) hope this clears things up --- The quack

39. Breast Tangent pair. Field widths at 100 SAD = 10.5 cm. LAO has gantry angle 45 degrees. What gantry angle does RPO have such that posterior borders will be parallel.

arctan(10.5/2*100) = 3 degrees. 45+180-3(2) = 219 degrees

Agree. Must remember that when one field is static you have to multiply the gantry kick by two.

40. I'm vague on this one but I'll give it to you anyway. The question went like …. The simulator couch wouldn't go low enough, so the film was taken at X SSD, separation 25 cm, distance to film = 140 cm. Physician wants to treat at 132 SSD, simulator film needs to be placed at what distance to cut blocks.

41. No diagram with this one making it tough. Patient on simulator couch with isocenter 5cm right of midline. Wire placed on midline (didn't say A or P). R Lat film taken. Measured cord depth of 6.7cm, but therapist forgot to reset isocenter to midline. What is the true cord depth. If you think this is confusing, then I agree. Basically I think the depth was measured assuming isocenter at midline, then question was asking what is the true depth.

This is a bit confusing. I take it to mean from the BEV of the Rt. Lat that the wire is 5cm too close. Thus the depth would have a different mag factor by (100/95) thus the true depth would be (100/95)*6.7 = 7.05cm. What does everybody think?

disagree; I get 5cm too close as well, but I though closer would mean smaller 95/100=x/6.7; x = 6.37cm, but I am not sure if I am followin gquestion correctly. After thinking about how the mag factor works, I think that the ~7cm is correct. I initially went the wrong way with my magnification.

Hmm if "5cm right of midline" means patient's right, then I don't think that the number 95 should be a factor rather it seams that isocenter from the R lat is 5cm to the right of patient midline. . . therefore the midline, from the R lat field, is at 105cm. So then it seems the ratios should be 6.7/100=x/105 which gives x=7.04 or 7.0cm. Hopefully on the test it will be less ambiguous.

I agree with above, given the very limited info we are given.

42. PDD for wedge increases over open field due to: A. Photon interactions in the wedge B,C,D,E….. other options that didn’t look right.

Beam hardening

Agree

43. Beam steering vs gantry angle in a linac. Signals to steer originate from ….. ion chamber …. various other options.

Bending magnet current. I think
ion chamber

44. Considering a dual ion chamber scanning water tank, an error in the PDD (a shift up or down – I don’t recall which) is not due to A. incorrect zero – ie set above water level B. RF interference C. water / air temperature differential D. Stepper motors not calibrated correctly.

RF interference
I think the temp differential is the correct answer. The chamber in the air is just a ref chamber to cancel out the pulses from the linac. All measurements are relative and temp doesn't matter at all.
^^^That is true, temp will cancel out.
46. Electron cutout changed from 6x6 to 4x4. What doesn’t change, A. Bremstrahlung B. Output Factor, C. Depth of 80%, D. Surface Dose.

Depth of 80%

47. I50 ionization depth of an electron beam is 5.1 cm. The energy of the beam is …..

I know that R50(cm)*2.33 = Eo(MeV). Would need ratio of stopping powers to use this though.

R50=1.029I50 - .06 = 5.2 cm,   Eo=2.33 x 5.2 = 12 MeV

48. Saturation in an ionization chamber refers to ….A. voltage high enough to prevent recombination ….other options that were not correct.

49. A survey points a linac beam at a primary wall and measures 2mR/hr. Is this OK? There were various options in the answers, but this was the point of the question.

Partially dependent on room radiation rating.

50. 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 C… other options that looked to me like they were required

I was corrected later in the doc. It is A

.
51. SAR for this radial section: Diagram given, table of SARs given.
| | Block | |
0cm   6cm   9cm   10cm

Just average the SAR values
went over this in kahn (p176). Appears that SARavg = SAR10-SAR9+SAR6. Then to get TAR = TAR(0) + SARavg
SARavg does NOT equal SAR10-SAR9+SAR6. That is SAR10 for one sector with a block in the middle (like a mantle field). You still have to find the SAR of other sectors and then average all SAR values. That is true for the total averaged SAR to point zero. You would have to do multiple spokes representative of different angles around the block. But the SAR from this spoke would still be SAR10-SAR9+SAR6, no?
I like bananas!
52. Classic electron ISL calculation straight from Kahn, ie calculate the effective SSD, given energy, field size, dmax (2cm), given slope of (Io/Ig)1/2 = 0.0111.

khan p 317 (3rd edition): effective ssd = 1/slope - dmax = 1/0.0111 - 2 = 88 cm
53. Superficial question. 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.

52.3/150 = x^2 / (x+10)^2, where x is effective SSD. solve for x = 14.5 cm
agree. solved same as #53. find slope between root(Io/I)=1 (no gap) and root(I0/I)=0.693......slope = 0.0693. dm(superficial) is the surface, so d=0. SSDeff= 1/0.0693-0=14.43cm
55. Purpose of the guard ring in a plane parallel chamber is to? A. “Define the collection volume” appeared to me to be the only reasonable answer.

Keep electron fluence from curving over the collection area for a parallel chamber; it defines collection volume in farmer type chamber.

56. A question where you were given air kerma and had to calculate roentgens from this. I think you just divide by 0.876 rad/R – this gave one of the answers.

Kc=(W/e)X

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

58. Most radiation sensitive part of the eye is ….. lens

59. TVL is related to HVL by A: TVL = ln10/ln2 HVL, B… other impressive but erroneous relationships.

This rule and it's generalization can be used to speed up all sorts of calcs, not just in shielding but with regard to time as well – use it!

60. Film exposed for dosimetry. Given transmitted light is 200 times smaller than original, what is the dose? OD vs dose table provided that required interpolation.

OD=-log(1/200)

agree

61. Electrons at extended SSD, which is true?

A. Width of the 90% extends proportionately B. Penumbra increases C. Output follows ISL with 100 to source …

I say penumbra increases

62. 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)

Surface dose does change. Look at Khan 3rd ed pg 314. As field size increases, R90 increases, surface dose decreases, Rp remains constant, Dmax increases.

I thought that once the field edge was farther than Rp/2 from central axis the surface dosn't increase very much with an increase in field size. "....the percent depth dose initially increases, but becomes constant beyond a certain field size when lateral scatter equilibrium is reached."

63. Why does the equivalent square technique work? A. Because scatter doses are equal between square and rectangular fields, B.other options involved statement about collimators and scatter that sounded wrong

64. 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.

65. Order of materials in door for high energy linac – inside to outside.

steel, lead, poly, lead, steel

66. Electron backscatter from internal shield versus Energy and Z – just had to know increase vs decrease. Z^2/E

Z increases, backscatter increases, E increases, backscatter decreases

67. 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.

I think that if you could tell the isodose data looked fairly homogeneous then I would have gone with 200 also

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

If the unit is calibrated by ADCL and used for calibration; Leakage, Redundancy, and Collecting potential

69. Classic isocentric POP where you had to calculate the maxdose / midplane dose ratio. Given TMR table, output factor as a function of field size graph (normalized to 1.000 for 10x10), cGy/mu at dmax for 100cm SSD and 10x10, no Sc or Sp given anywhere in the test.

70. 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.

71. Had to do single field 125 cm SSD calculation. 300cGy to 10cm deep. Given output factor as a function of field size graph (no Sc or Sp which in my opinion makes it

impossible to do this question accurately), given PDD table, TMR table, given output at dmax for a 10x10 at 100cm SSD. Answers all very close ie approx 1% apart.

MU=300/[(output)*(TMR d=10)*(OF from graph)*({100+dmax}/{125+10})^2]

agree. a bit tricky b/c non-isocentric but above uses correct 1/r^2 correction
72. Multiple beam plan. AP weighted to 100% at dmax, laterals weighted to 100% at dmax. 200 cGy delivered to 238% isodose line. Dose delivered by AP beam is ??? cGy.

42cGy?

depends on where the dose is delivered. at the Rx iso line of 238%, D(ap)=200/3=66.7 (assuming 3 beams, equally weighted as it states)
at dmax: 238%/3 = 79.3%, 66.7 * 100%/79.3% = 84 cGy at dmax

73. Monte Carlo calculations require a random number generator and ….A. probability distributions, B,C,D,E other options that didn't look right.

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

With respect to dmax, for 6 MV, 10x10, 0.67 due to depth, 0.03 due to dist from field edge =2%

75. " factors given on several questions were not what I expected for the isotope in question. But I always used the one given.

76. Pacemaker dose limit. 2Gy (with weekly monitoring, up to 10Gy with special monitoring and Cardiac surgeon present)

77. Apparent mCi is less / more / same as mCi

I think apparent will always be less due to collection efficiency < 1 (not positive about this one)

78. No shielding questions were simple "plug in and solve for B". Every one required something "non-standard" or use data in a non-standard format.

oh joy
79. TG40 photon flatness specification:A 1% B 2% C 3% D 4% E 5%.

Re: ABR Part II type written questions from 2002

Which of the following is used for palliative treatment of bone mets? Sr-89,

I-125, P-32

Sr-89, (1.47 MeV Beta, halflife = 50.5d)

The NRC requires HDR shielding to be surveyed: daily, weekly, monthly,

annually, after source change.

10CFR-35 (35.652)-(b) Shielding need only be checked when a unit is installed or repaired.

should be after source change

What detector is best for calibrating an Ir-192 IVRT source? (well chamber)?

Yes, it's a well chamber (TG-66, pg 144, #5)

What is the TG-40 photon field flatness spec? 2% , 2%

According to the report by Kersey (sp?), what is the attenuation TVL of linac

neutrons in a maze?

After referencing NCRP 151, pg. 43-45, I believe TVL is supposed to be TVD (tenth value distance) for neutrons in a maze. TVD = 2.06* SqRt(cross-sectional area of maze in the direction of travel (m^2)). It appears to be ~ 5m as general conservative rule.

If referencing TVL for the door in the maze. 4.5cm of BPE (borinated polyethylen) is accepted, but there is no reference to Kersey pg. 46

The largest contributor to dose at a point behind the gantry stand is ____:

patient scatter, head leakage, neutrons from (gamma,n) in the walls

I believe leakage radiation is the answer. This is based on barrier thickness calculations done on pg.125-126 of NCRP 151. "Examining the computed barrier thickness in this example, it is observed that the leakage-radiation thicknesses are thicker than the scattered radiation thicknesses (due mainly to the reduced scattered-radiation TVL's at 90 degrees)"

Electron virtual source- for linac with end of applicator at 100cm.

Given ion chamber readings at several distances, the virtual source position

is __ cm.

At 100cm, 100; at 120cm, 44; at 140cm, 25.

The location of the virtual source may be determined by extrapolation from a plot of 1/SqRt(R), where R is the reading from an ionization chamber.

Agreed, plot SSD on x axis and 1/SqRt(R) on y axis, extrapolate plot back to get intercept. VSD = 100-(X-intercept), If we assume the SSD =100cm
I get VSD = 100-60cm = 40cm (answer seems odd but thats what I get)

I also get 40 cm.

AAPM Report 54 (TG-42? SRS)- What is the max size of a scanning ion chamber

for SRS beams?

TG-54 says 2mm max SRS scanning chamber diameter.

According to NCRP-49, what is the max allowed exposure/dose for films in a

storage area? I could only find .1 mGy over the storage life of the film, however, this is for Canada

1mR (can't remember where I know that from)

Pick out the false statement about TG-51 (applicable to 3-50 MeV e-?)

TG 51 mentions 4-50 MeV for electrons.
Co60 to 50 MV for photons

For a H&N case, calculate couch kick given the field sizes to match the

inferior borders to an SCLAV field.

tan-1(InferiorFieldLength/SSD) (this is for non-symmetric fields....if symmetric then use 0.5total field length/SSD)

Calculate the gantry angle for a half-beam blocked medial breast tangent beam,

given a bunch of geometrical distances.

Numerous calculate TVLs, Blx, Bsx for shielding needs. On one, the patient

scatter area was 20 sq cm rather than 40 sq cm.

An I-125 implant gives 95% of the total dose in ____ days?

D = Initial dose rate * Tavg * (1-$e^{-t/Tavg}$) where Tavg = half-life / ln(2)

0.95 = (1-$e^{-t/Tavg}$)

or just dose ~ activity proportionality with decay

A = A(0)*$e^{-(\text{where the hell is lambda * t})}$

0.05 = $e^{-\text{lamba*t}}$

$0.05 = e^{-\ln(2)/\text{half-life}*t}$

for both for I-125 with half-life of 59.4 days, we get 257 days

1-.95 = 1/2^n; where n = NUMBER OF HALF LIVES, n*T1/2 = days to deliver 95%

Agree with the half-life shortcut, but should be: 0.05 = 1/(2^n) or 2^n = 20. Also, for windows calculator, type it

in like: LOG(1/0.05)/LOG(2) to get to n = 4.32

Calculate Dy/Dx for a train of 10:10:10 mgRaeq sources at a spacing of 2cm, X

and Y are 2cm off the transverse axis of the middle and an end needle. See 2008 exam (freebie, sweet!)

Numerous RAPHEX-type MU calculations. Find cord dose given CAX dose from

AP/PA treatments.

What is the range of a Sr-90 beta in air?

E=2.2 MeV, 2MeV/cm in water, taking ratio of density, somewhere around 10 m

E=0.58 MeV, around 1.6m in air

E=.58 MeV, the 2.2 MeV comes from the decay product of SR-90, 1.6m in air

What I remember from ABR Exam 2006 PARTII

22. kyshine steradian question. solid angle - 2*pi(1-cos(theta)), where theta = the angle between central axis and the field edge.
23. Shown GTV, CTV and PTV asked to identify the PTV GTV will be the most steep. The PTV will be the least steep......more rounded near 100%

24.

- **A**
- **B** Given the dose at A, find the dose under the block at the same depth at B.Dose under block = Dose open - Dose blocked(1-block transmission) ; so if they give you the Dose at A, this will be the "blocked field dose". You will also need the open field dose (i.e. the dose without any block in the field) and a transmission factor.

25. When to check the wedge interlock **Monthly** **(TG-142)**
26. IMRT Head and Neck treatment. What are the dose constraints for critical organs.
    a. RTOG 0920: Cord+5mm (<48 Gy to 0.03cc), Brainstem+3mm (<52 Gy to 0.03cc), Lips (mean dose <20Gy. Max Dose is 30 Gy for non-oral cavity cancers and 50 Gy otherwise), Oral Cavity (Mean Dose < 30 Gy for non-OC, 50Gy otherwise), Parotids (Mean<26 Gy, or 50% of one parotid <30 Gy, or at least 20 cc of all parotid tissue <20 Gy), Pharynx (Mean Dose < 45 Gy), Esophagus (Mean < 35 Gy, No more than 15% receivex >60 Gy), Glottic and Supraglottic larynx (GSL) (Mean Dose <45 Gy), Mandible (Maximum dose <66 Gy, our physicians actually look at 1cc < 70 Gy).
27. The tolerance dose for the kidney **20 Gy**
    a. **Quantec: (Mean dose < 15-18 Gy for 5% chance of failure, Mean Dose <28Gy for 50% chance)**
28. Scanning PDD curves given and asked to identify which is which.
29. What is the reference depth used in photon beam calibrations (per TG-51) 10cm ,agree

Linac

Storage

Office

A

B

Shielding problem. Distances given: Linac to A=6m, Linac to B=12m. Survey meter measures xx mrem/hr at point A. Dose delivered at each treatment is also given. How many patients can be treated to limit the exposure at point B to below 2 mRem/wk

31. Gamma strength problem related to HDR treatment.
32. Question on changing Brachytherapy sources from ^{192}Ir to ^{125}I (or vice versa) and calculating activity/dose rate.
33. IMRT dose verification using small volume chamber (0.1cc). What should it's resolution (or measured error) be in order to be able to use for dose verification (ans: 0.1%, 0.5%, 1%, 3%, 10%)
34. 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)

Hot spot on the photon side, cold spot in the electron side due to difference in scatter

31. Morning (daily) QA for a HDR brachytherapy treatment source per TG-40
    a. Room safety door interlocks, lights, and alarms.
    b. Console functions, switches, batteries, printer.
    c. Visual inspection of source guides.
    d. Verify accuracy of ribbon preparation (Autoradiograph).
32. Daily output tolerance for X-ray and electrons (3%:5%, 3%:3%, 2%:3%, 5%:5% etc) (TG-40)
33. $E_p = E_0 (1-d/R_p)$ given that at depth d1, the energy is E1 and at depth d2 the energy is E2, at depth d3 what is the energy
34. 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)

BSF is direct proportional with Z and inverse proportional with E, so increses as Z increases and as E decreases

31. This time there were about 4-5 questions about the TG-51. We were provided all the detailed information about the different factors and asked to calculate the Mu's/cGy to deliver at Dmax. 2

questions about the Photon beam and 2 question about the e -beam. In some questions you have to calculate the Pion & Ppol. **P_{ion} = (1-VH/VL)/(MHraw/ MLraw - VH/ VL)**

P_{pol} = (M+raw – M-raw)/2Mraw

P_{grad} = (Mraw @ dref + 0.5 rcav)/ (Mraw @ dref)

P_{tp} = ((273.2+T)/295.2)*(760/P) ------> ^{o}C = 5/9 (^{o}F-32)

HDR shielding calculation. Everything was provided. Just use the formula and answer was there.

31. One beam profile diagram was provided with profile line variation at the surface. The reason for that.....Ans was---Water fluctuation.
32. 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.

2006 ABR Part II – Therapy Physics Type

The photon energy of Co60 = 1.25 MeV (avg.), Cs137 = 0.66 MeV, I125 = 0.028 MeV, Pd103 = 0.021 MeV.

The higher energy Co60 beam will have the highest dose at the depth of 5 cm

Pd would have the lowest.

2. How often are electron energies checked according to TG-40? Once a week, Once a week if they are used, twice a week, etc.?

Output constancy (daily) 3% - diodes can be used

(monthly) 2% - ion chambers should be use

each electron energy should be checked twice/ week (TG-40, Table II, footnote, "All electron energies need not be checked daily, but all electron energies are to be checked at least twice weekly.")

3. DVH - which plan has the lowest fraction of volume receiving 15-20 Gy?

4. What measurement device is best for a simulation room survey? ion chamber, ion chamber w/ electrometer, GM, scintillation counter? Ion chamber.

5. If a patient is prescribed 200 cGy 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.

So we have wedged fields contributing 40% of the dose and open fields contributing 60%. So this is what was planned:

W: 0.40*200=80cGy --> 80cGy/0.25 = 320 MU

O: 0.60*200=120cGy -->120cGy/1 = 120 MU

I assumed from the wording of the question that the open MU's were used with a wedge and the wedged MU's were treated open.

W: 120 MU ---> 120MU(0.25) = 30cGy

O: 320 MU ---> 320(1) = 320cGy

Total Dose = 320+30= 350cGy

This question could be interpreted differently. On Elekta Machines (motorized wedges), the 30%/20% would refer to the share of MUs, rather than the share of dose. In which case (someone please verify this calculation), the error would result in a lower dose:

If no error occurred: #MU*(% * (Transmission-open) + % *(Transmission-Wdg))=#MU(0.3(1) + (0.2)*(0.25))=#MU*(0.35)=100 cGy.

If the error occurred: #MU*(0.3(0.25)+0.2(1))=#MU*(0.75). Since the #MUs remain constant, the dose would be 0.275/0.35*100=78.6 cGy. Multiply by 2 = 157 cGy..

I agree with the 350cGy. I think the point of the question is to illustrate the significance of the WF.

6. What is the definition of wedge angle?

The angle that the isodose line at a reference depth or sometimes isodose line(depth of 10 varian) makes with respect to normal.

7. Given lots of TG-51 parameters, calculate cGy/MU for photons.

8. Given lots of TG-51 parameters, calculate cGy/MU for electrons.

9. 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?

10. Shown CT with depths of tissue anad lung, single direct field, and attenuation coefficients, what is the dose w/ and without heterogeneity corrections?

11. 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? De*Pdd(5) + Dp*Pdd(5) = 55; De*Pdd(0)+Dp*Pdd(0) = 40; Solve for Dp/De

12. 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%?

if the diameter is 4, the radius is 2. Makes the distance from the source to the RX pt 3cm. so we can take the ratio of inverse squares.

(1/3^2)/(1/x^2)=100%/150%, solving for x = 2.44cm (this is the distance from the source, so 2.45-2.00cm = .45cm

I agree.

13. What thickness of Al to compensate for 5 cm of missing tissue?

thickness = Tissue Deficit * (0.7/density of compensator)

(where 0.7 is the approximate thickness ratio if you are greater than 20cm FS)

14. Dose at point S is 6 mrem/hr. How much concrete shielding to get dose at point Z less than 2 mrem/hr. Point S is 6 m from iso and Point Z is 12 m from iso. Given TVL of concrete.

just due to inverse square, doubling the distance from source (12 vs 6m) will have a 4x reduction in dose. Thus with current amount of shielding Point Z would be getting 1.5 mrem/hr.

15. If the daily output is greater than what % is patient treatment suspended immediately according to TG-40? >5%

16. What is the overall uncertainty in dose delivered to a point in a patient with all uncertainties taken into consideration? Kahn - 5.6%

I think is 5 % per TG40

17. What method cannot be used to verify an IMRT plan? Film, point hand calc?

*Film (+absolute dose with chamber), MatriXX, Mapcheck can be used.

*Point calc - not alone.

18. What is the purpose of the bending magnet? Reduces the energy "BIN". Makes the beam energy more monoenergetic.

19. Where are the electrons generated in a linac? The "GUN"

20. What does Gamma measure? Gamma index is a way of combining distance to agreement and dose difference. Used in IMRT QA comparison.

21. 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.

We need the SSD of the spine field and the length of the sup field (spine) for this calc: tan^-1(sup field length/SSD) ; So I assumed that the FS of the spine field was 27cm on the skin. So if it was 37cm at 100cm it would be 100*(27/37) = 73cm SSD. tan^-1(17/73) = 13.1 degrees

reading back through this I disagree with my assumption. I have a hard time believing that you could set up a spine patient at 73cm ssd. should have assumed that the 27cm field was at iso.....37cm at patient SSD. this would make SSD = 100*(37/27)= 137cm. Thus tan^-1(17/137) = 7.07 degrees

43. Skyshine steradian question.
44. Shown GTV, CTV and PTV asked to identify the PTV
45.

- **A**
- **B** Given the dose at A, find the dose under the block at the same depth at B.

46. When to check the wedge interlock

monthly

46. IMRT Head and Neck treatment. What are the dose constraints for critical organs.

Typical Contraints: Max Cord <45Gy (RTOG .03cc<48Gy) , Mean Parotid <26Gy, Max BrainStem <54Gy, Max Mandible <70Gy or minimize >70Gy

46. The tolerance dose for the kidney

    20Gy

46. Scanning PDD curves given and asked to identify which is which.
47. What is the reference depth used in photon beam calibrations (per TG-51) : d=10cm

Linac

Storage

Office

A

B

Shielding problem. Distances given: Linac to A=6m, Linac to B=12m. Survey meter measures xx mrem/hr at point A. Dose delivered at each treatment is also given. How many patients can be treated to limit the exposure at point B to below 2 mRem/wk

52. Gamma strength problem related to HDR treatment.
53. Question on changing Brachytherapy sources from ^{192}Ir to ^{125}I (or vice versa) and calculating activity/dose rate.
54. IMRT dose verification using small volume chamber (0.1cc). What should it's resolution (or measured error) be in order to be able to use for dose verification (ans: 0.1%, 0.5%, 1%, 3%, 10%)
55. 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)

56. Morning (daily) QA for a HDR brachytherapy treatment source per TG-40
57. Daily output tolerance for X-ray and electrons (3%:5%, 3%:3%, 2%:3%, 5%:5% etc)
58. $E_p = E_0 (1\text{-}d/R_p)$ given that at depth d1, the energy is E1 and at depth d2 the energy is E2, at depth d3 what is the energy
59. 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)

BSF direct proportional to Z, inverse proportional to E

52. This time there were about 4-5 questions about the TG-51. We were provided all the detailed information about the different factors and asked to calculate the Mu's/cGy to deliver at Dmax. 2 questions about the Photon beam and 2 question about the e -beam. In some questions you have to calculate the Pion & Ppol.
53. HDR shielding calculation. Everything was provided. Just use the formula and answer was there.
54. One beam profile diagram was provided with profile line variation at the surface. The reason for that.....Ans was---Water fluctuation.
55. 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.

1st: solve for mu(6x) and mu(18x), mu = ln(10)/TVL

2nd, exposure(6x) = X(6x) = X0 e^(-mu(6x)t) solve for X (this assumes we know the current thickness, t)

when we know X0, exposure (18x) = X(18x) = X0 e^(-mu(18x)t)

2007_Therapy_Part II_Type

Simple Questions: (each one counts 1 point, total 53 questions/points)

1. Neutron dose equivalent (mSv) outside field per photon Gy at isocenter for 20MV beam. 2% @ 1m

2. 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.

3. Parts definitely not included in EPID – options were ion chamber, CCCD camera, mirror, silicon screen, some other dose detection device. The EPID basically consists of a fluorescent screen, mirrors and a CCD camera

can also have a matrix of ion chambers

4. TBI – what is not true – A. Dose Uniformity < 15%, B. Tissue Equivalent

Compensators are used, C. High SSD, D. AP preferred over lateral, E. Lower dose conformity with increased energy. **E. , Are you certain about this? I know that uniformity is supposed to be <=10%. I just want to make sure.**

Agree with E not being true

5. S/rho and rho given for lead. Calc thickness of lead used to shield 20MeV beam. 1cm

6. How many TVL's in a linac head? 3TVLs

7. PDD for wedge increases over open field due to: A. Photon interactions in the wedge B, C, D, E…..

8. Purpose of the guard ring in a plane parallel chamber is to? A. "Define the collection volume" appeared to me to be the only reasonable answer.

Purpose of the guard ring in parallel plate chamber is to prevent undue curvature of the electric field over the collector.
Purpose of the guard electrode in farmer chamber is to prevent leakage from high voltage electrode (the collector) and to define ion collecting volume. (Khan Pg-88)

9. Electrons at extended SSD, which is true?

A. Width of the 90% extends proportionately B. Penumbra increases C. Output follows ISL with 100 to source … B. Penumbra increases

10. Why does the equivalent square technique work? A. Because scatter doses are equal between square and rectangular fields. Other options involved statement about collimators and scatter that sounded wrong

11. TG51: what's upper limit for Pion? 1%, 3%, 5%, 10%. 5%

12. TG51: where is cylindrical chamber's center placed for photon beam calibration?

The chamber center is shifted down into water 0.5*rcav

This is only true for obtaining the PDD/PDI curve, for photon beam calibration the chamber is placed at 10cm depth.

13. TG51: to cross calibrate parallel-plate chamber, what should use?

Co60, high energy photon, high energy electron, low energy electron.

it should be high energy electron

14. TG51: KQ depends on what? (choices included beam energy, ion chamber, both)

ion chamber and beam quality - converts absorbed dose to water calibration factor for Co60 beam to beam of quality Q (photon)

15. TG51: What's energy specification for electron beams? R50, the depth in water at which the absorbed dose falls to 50% of the max dose for the beam (10x10)FS

16. TG51: total consecutive measurements were done with 20% difference, the reason is: 100 SSD vs 100 SAD; etc.

17. TG51: where is the effective point of measurement of parallel-plate chamber? The center of the front (upstream) face of the chamber air cavity

18. How do you convert ionization curve to %dd curve? Multiply by ratio of stopping powers for each depth. (Energy of beam is changing with depth)

19. Agent used in PET? F18 FDG

20. 9MeV electron beam. At 4 cm depth, how much lead should be used to shield deeper structure? No other information.

Ed=9(1-(4/4.5))=1 MeV, so we need 0.5 mm Pb

21. Difference between physical wedge and dynamic wedge. Beam hardening.

22. IMRT: Difference between simulated annealing and gradient reduction in IMRT? Faster, more accurate in dose calculation in build up, better with step-and-shoot than with sliding window, achieve global minimum instead of local, etc.

23. IMRT: one fluence map is shown for 5 fields prostate IMRT, identify the field. AP, RPO, RAO, LAO, LPO.

24. Klystron's function. Amplify the RF frequency

25. Gas pressure low fault is related to which part in Linac? Gun, Waveguide, Magnetron, Accelerating tube, etc. I'm guessing waveguide, gas is used as insulator.

26. 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.

27. What’s PTV? planning target volume, GTV (or CTV) plus a margin.

28. Which organ shows partial volume effect? Brachial Plexus, Kidney, Optic nerve, etc.

kidney

29. 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.

SAD= 100 (place buildup of at least dmax to eliminate incident electron comtamination)

30. Photon field abuts electron field, where is the hot spot?

in the photon field, at depth. (there will be a cold spot near the surface).

31. The Transport Index represents the exposure rate…. (choices included “on the surface” and “at one meter”)

The transport index is the radiation dose rate expressed in millirem per hour at 1 meter from the surface of the package.

32. Mayneord's Factor is more accurate for: 6MV, 6x6, 110 SSD; 6MV, 30x30, 150 SSD; 15MV, 6x6, 110 SSD; 15MV, 6x6, 150 SSD; etc. The f-factor does not take into account the effects of scatter. So I would choose the setup that would have the least scatter. I assume there was one option for 6MV, 6x6, 150SSD.

according to Khan p 168, Mayneord F factor works better for smaller fields, higher energy, smaller depths and small SSD change. So definitely 6x6 FS, 110 SSD. I would probably choose 15 MV as well.

33. What "stereotactic" means in stereotactic radiosurgery "SOLID ORDERING" from the Greek. Refers to making use of 3-D coordinate system to localize treatment

34. TG43: what is L? Dose Rate Constant

35. Tolerance for simulator laser vs. gantry center (or some other mechanical center)?

*For conventional simulators, all mechanical isocenters are 2mm. (TG-40)

*For CT Simulators, it is also 2mm (TG-66).

36. Amount of X-ray contamination of 18 MeV electron beam? 1%, 4%, 10%, etc.

37. IMRT shielding: how much more shielding needed? All wall + TVL; Primary + TVL; Secondary + HVL; Secondary + TVL; etc.

38. 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.

39. 45Gy photon treatment to neck. Choose electron energy for boost to treat nodes at 3cm depth and spare cord at 5cm depth. 9 MeV. Using energy / 2.8 to cover with 80% pdd to 3.2 cm, and using a lost of 2 MeV/cm to have energy dissipated by 5 cm.

40. Treat 4.3 cm depth with 12 MeV and 200 cGy, dose at dmax. Using energy / 2.8 to cover with 80% pdd, 80% pdd gets to 4.3 cm. So 200 cGy / 0.8 = 250 cGy at dmax.

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

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

43. 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?

I would use highest and assume we use that energy 100%= 7Gy/wk

44. Decay rate of 192Ir per day.

~ 1%

45. Weekly dose limit for unrestricted area. 0.02 mSv/wk

46. GM counter property.0

47. A question involving 10mg Ra – simple application of ΓxA/d2 – but needed to know (i.e. not given) exposure rate const. = 8.25 Rcm2/mg.hr

48. Breast Tangent pair. Field widths at 100 SAD = 10.5 cm. LAO has gantry angle 45 degrees. What gantry angle does RPO have such that posterior borders will be parallel?

49. Difference between Acceptance Test and Commission of Linac. Acceptance shows that linac meets agreed upon specs with vendor. Commissioning gets linac ready for treatment.

50. Tolerance for deviation in a light field for a CT sim

51. How much dose is given for an I-125 seed 1.44DoT1/2(1 - e^ln2/t1/2*t) Since I-125 seed implants are permanent (usually) D= Do x 1.44 x T1/2

52. What is the dose rate at 1m from a patient receiving external beam treatment Only going to be dose from scatter which is 0.1% of primary beam at a meter. (so 1/1000 cGy/MU) at most

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

54. Which modality (photons or electrons) and energy is used to cross calibrate a parallel-plate chamber with a cylindrical chamber. 20MeV Electrons

55. Electron beam quality is specified by (R50, Dref etc, dmax etc) R50.

56. Given a table of PDD's 4 MV and 18 MV what is the ratio of max dose 4MV/18MV.

57. Effect on point outside treatment field when using dynamic wedge versus hard wedge. Less dose using dynamic wedge because of decreased scatter.

Complex Questions: (each one counts 3 points, 27 questions, and total points 81)

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?

not sure if this question was supposed to give you a T3 or if it wanted an answer in terms of T3. Problem is easy if they give a T3, involves a bit more algebra if they dont. Using a value of T3=5s ; T1/T2 = (T2+3)/T2

if the answers were in terms of T3 I get: T1/T2 = 1+3/5(T3/T2). The ratio will always be dependent on the value of T3

D(Atot) = T1*(1/1^2) + T2*(1/(1^2+1^2)) +T3*(1/(1^2+2^2)) = T1 + .5T2 + .2T3;
D(Btot) = T1(1/(1^2+1^2)) + T2*(1/(1^2)) +T3*(1/(1^2+1^2)) = .5T1 +T2+.5T3;

D(Atot) = D(Btot) SO, use above equations and solve for T1. We get T1 = T2 + .6T3. Divide both sides by T2: T1/T2 = 1 + .6T3/T2

T3 would be set equal to T1 in these types of treatments. A simple HDR procedure like this would be symmetric.

2. 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?

If we assume a tumor dose of 6000 given in 30 fractions, 4000 cGy (total cord) = 30 * 62 cGy (from AP) + x * (0.18 * 150 cGy) (from blocked PA) + (30-x) * 150 cGy (from unblocked PA)

x = 19.2, so cord would need to be blocked for 20 fractions.

3. 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.

4. 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.

5. Three isocentric beams 120 deg apart, AP and post obliques. Each goes through 15 cm depth to isocenter. 180Gy at isocenter weighted equally for three beams. Post beams transfer 9cm lung (electron density= 0.33), TMRs given at 3,6,9,12,15 cm. Calculate MU(post obliques)/MU(AP).

6. Ratio of Maximum Dose between 25MV and 4MV for same dose to midline using POP setup with SSD =100cm. PDD's given.

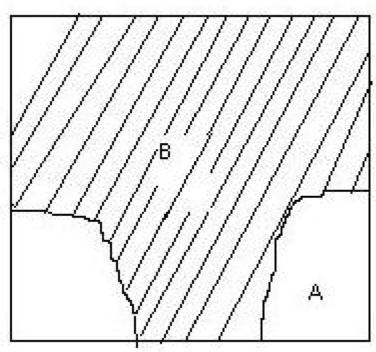
7. Given Kersey's formula and the distances and ratio of maze areas, neutron dose at isocenter (mSv) per photon cGy at isocenter, what is neutron dose (mSv) at door per photon cGy at iso. Told TVL of maze for neutrons is 5m.

8. HDR 192Ir. Patient treated with time 420sec with Activity 3.75Ci on Aug 1st. Source got replaced with activity 9.43Ci on Aug 16th. Calculate treatment time on Aug 21st. No 192Ir half life given.

ratio of activities to find what time would be on aug 16, then decay and use ratio of activites to find time on aug 21. (420)(3.75/9.43) = 167s, 167/(e^(-(0.693/73.83)5)= 175s

I agree, I tested the 1%/day rule of thumb for I-192 which gave me an activity on Aug 21 (.896mCi) so I got a time of 175.78s or 176s. So if the answers are farther apart than 2s, I think yo can use the rule of thumb and feel confident.

9. Given dose to point A 200 cGy, calculate thickness of block to achieve point B dose 90 cGy. TMR, %DD, and HVL given, depth may be different for B.



10. 36 inch space is available for 6 TVL shielding. Given Pb TVL (2 inch) and Concrete TVL (18 inch), what is the minimum thickness of Pb needed?

let p be the number of TVL's of lead. let c be the number of TVL's concrete:

(1/10^6)=1/(10^(p+c))... or just 6=p+c ; 36 = 18c +2p .... solve for p. p = 4.5 TVL's

Agree

11. Sim film taken at 102cm SSD, SFD 140cm. Want to treat at 120cm SSD. What distance to film should be used when cutting blocks.

Keep mag factor the same b/t two setups. 102/140 = 120/SFD2; SFD2=164.7

Agree

12. 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.)?

I assumed that the 40x40 was at 100cm. This allows you to find the angle between central axis and field edge. Then it's a matter of geometry to find th edistances and field sizes that you need.

I tried it a little different: 40/100 = 56/(167-x) and solve for x. x = 27cm

40/56 = 100/x, SSD to Patient is 140cm. so the patient is between the ssd and the couch, 167cm - 140 = 27cm (Agree)

I just repeated my method and got 27cm

13. Given diagram of one dimension blocked field with distance from CAX and table of SARs (0cm 6cm 9cm 10cm etc), calculate SAR. (| | Block | |)

look up SAR for each vector from cax to block (based on radius) and average all SARs went over this in kahn (p176). Appears that SARavg = SAR10-SAR9+SAR6. Then to get TAR = TAR(0) + SARavg
The average SAR value that you are finding would be for the point at 0cm. I think the look up table would give you SAR values in terms only of depth

SARavg does NOT equal SAR10-SAR9+SAR6. That is SAR10 for one sector with a block in the middle (like a mantle field). You still have to find the SAR of other sectors and then average all SAR values.

14. 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? 14.5cm, problem done in 2004 exam above

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

seemed to me like one of those ratio of TMR problems:

Dcord = 100cGy*[TMR(4cm)/TMR(11cm)]+ 100*[TMR(11+7)/TMR(11)]

Needs ISQ: Dcord=100cGy*(TMR(18)/TMR(11))*(100/107)^2 + 100cGy+(TMR(4)/TMR(11))*(100/(89+4))^2

16. Film exposed for dosimetry. Given transmitted light is 200 times smaller than original, what is the dose? OD vs dose table was given.   -log(1/200) = 2.30

17. Single field 125 cm SSD, 4x17. 300cGy was prescribed to 5cm deep. Given PDD table and TMR table, calculate MU. No Output factor vs. field size! No machine calibration condition, SSD or SAD!

A/p @100 = 6.5, @SAD = 6.5(130/100)=8.4;
MU=300/[TMR(8.4,5)*((100+dm)/(125+5))^2]

18. 15 x 20 POP, calculate MU for dose required. No Output factor vs. field size! No machine calibration condition, SSD or SAD!

19. Multiple beams plan: AP weighted to 100% at dmax, laterals weighted to 100% at dmax. 200 cGy delivered to 238% isodose line. What is the dose delivered by AP beam?
(200/3)*2.38 ?????

I would say that 100% is dmax, so AP = [200cGy/3]/238% = 28.0cGy

20. Given readings at 10 cm depth for 10 x 10 and 20 x 20 fields with 100 cm SAD, and two TMRs, calculate the Scp(20).

21. 15 x 15 field with 3 x 15 block in the center, which has 5% transmission factor. Depth at 7 cm, dose to point A given with 1.01 OCR, calculate dose to CAX under block, given table like:

FS	5, 7, 10, 15, 20
OF	
TMR(7cm)	
%dd(7cm)	
A	

I think all you have to do is DoseCAX = DOSE A * .95 / 1.01

Also, the rule of thumb for the dose to a point under a cord block is ~18% of dose to that point without cord block.

I think that the 18% is a good rule of thumb and I would try that first. If that didn't get me an exact enough answer:

For the Same depth of pts A and B:

Dunderblock = Dopen - Dblocked(1-trans factor)

22. 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.

I believe the reading will increase by (7/5)^2 =1.96   Then I think you can set the ratio of readings = to ratio of TVLs i.e if it initially took 2 TVL (10^n/10^2)=(1.96 reading/reading). This actually gives the total thickness needed for the new position in TVL. SO new TVL - old TVL = thickness that must be added.

agree with exposure readings being 1.96x higher than initial due to distance reduction. To get #TVL's needed I used #TVL's= Ln(1.96)/Ln(10)=0.292 TVL's needed

C

B

A

23. From source to point A, there are: 100 cm SSD to surface, then 3 cm tissue, 2 cm inhomogeneity (re=0.25), 3 cm tissue, another 3 cm inhomogeneity (re=2.5), finally 4 cm tissue. So depth is 15 cm. 4MV beam delivers 200 cGy to point A with inhomogeneities. What's the dose to point A without the inhomogeneities? TMRs were given.
200(TMR15/TMR18)

A'

d = 15 cm

A

Density = 0.25

Density = 2.5

2 cm

2 cm

2 cm

3 cm

24. Given primary workload, distance to office, and TVL, calculate shielding thickness to achieve 1/10 of MPD. U, T, MPD were not given.

25. 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.

This problem seems a bit too simple...so from how i understand it. 200cGy (0.56/0.65) = 172.3 cGy b/c it appears that the SSD's are not changing.
agree

26. 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?
D*(TMR16.7/TMR6)

Depth uncorrected = 2+4=6, Depth corrected = 2(0.3)+4(4)=16.7

27. Orthovoltage shielding calculation given the workload.

28. What would cause the biggest change of the depth of the 80% IDL for a 9 MeV electron? (choices included: add 1 cm bolus, change to 18 MeV, increase FS)

Change to 18 MeV :1cm bolus changes by 1cm. change to 18 MeV changes by (18/2.8 - 9/2.8 = 3.2cm, increasing FS would not make as big of a difference)

General Observations:

- Shielding questions -- lots of them!
- Lots and lots of dosimetry calculations:
- If you have the PDD or TMR data, how many MUs required?
- Know when to use Mayneord F factor and when to ratio TMRs

- Know relative depth doses for all electrons and photons
- Know definition of terms in TG-51:
- Numerous gap calcs
- Lots of SSD and SAD treatments, max dose, midplane dose.

- One or two, electron beams problems. Not too many. All the fields were rectangle and you had an additional calculation to convert to the equivalent square. TG 51 questions but not difficult. Raphex is very good for the easy questions and Khan and McGinley are good for the others. Lots of practice with the windows calculator. Some problems with long sets of calculations.

2008_Therapy_Part II_Type

1. Which scenerio would you most likely talk to the Dr.?

A. if he had a small cut-out to place on the skin and he ordered 12 Mev electrons?

B.

C.

2. Which curve represents 18 Mev , 6x6 FS

3. Had several curves, asked to select which one was 6x6 from field sizes of

4x4, 6x6, 10x10 or 12x12

4. Orders for 30 fractions, AP/PA, 180cGy/fx SAD. When will the cord dose reach 4500cGy?

TAR PDD and TMR tables given, Separation is 12 cm, Cord is 5cm posterior Take ratio of PDD for each beam ((PDD of point in question) / (PDD iso)) * dose from beam at iso. Do this for each beam. Divide 4500cGy by the summation of the two doses that were just calculated. It can be done with TMR, but it will be more complicated; requiring an ISq correction and a field size correction.

20fxs

24fxs

26fxs

28fsx

5. What is the dose for irreparable damage to the kidney?

1000cGy

2000cGy

3000cGy

4000cGy

6. Two isotopes Pd (lamda = .016) (rho =) and I125 (landa = .)(rho =) half life is 17 days for Pd and 60 days for I125. After 120 days what is the ratio of doses?

[Total Dose = 1.44*Half Life *Initial Dose Rate] may be needed for this problem. since it is after a period of time D = Initial dose rate * Tavg * (1-$e^{-t/Tavg}$); Tavg = 1.44*T1/2

7. Monte carlo calculations stop calculating at what energy and bundles everything into one

10 kev (haha.....dave did this one I just lifted the answer)

100 kev

200 kev

500 kev

1 Mev

- How often according to TG40 should the wedge latch be checked? Monthly

- What are Monte Carlo space files??? I believe they are phase-space files A phase space file contains data relating to particle position, direction, charge, *etc.* for every particle crossing a scoring plane. Phase space files can be output for each scoring plane in an accelerator.

A. It registers where electrons are in space for calculation???????

B.

- A picture of a DVH
- Shows critical organs, PTV and GTV curves. Choose which curve represents the GTV

- 13.05 nC exposure, W/e = 33.3J/c 2.58 x 10 R/C What is the volume of gas in the chamber? 1R = 2.58 x 10^-4 C/kg ; question not complete, but pretty easy as long as you know the conversion and density of air/gas
- TG51 calculation. You have to calculate Ppol, Pion and TPC (in kPA). Mraw high and low given, everything given.

- What is the range of a Y 80 beta 2.2Mev in air?

10 cm

20cm

100cm

200cm

400cm

2.2 MeV in should have range ~900cm , but their no option of 900. Is anyone have same ans?

I got about 10 meters, or 1000 cm, so similar to your answer, but not listed above.

- Effective energy of an electron Ez 4 Mev, depth is 1.7cm and an Eo is7.1 Mev Two energies given. Markus Range Eqn: E0(MeV) = (Rp(cm) + 0.376)/0.521 , Rp = 36.6cm

Rp = 7.1 MeV*.521 - .376 = 3.3 cm

Using Harder's rule: Ez = Eo(1-z/Rp) = 3.89cm

- Picture of squares, 3cm, then 2 cm then 1 cm which equals tissue, bone and air. What is the effective depth when the beam is directed through each material. Normalize using Bone = 1.6, air = .3, tissue = 1

Effective depth = [(3cm x 1)+(2cm x 1.6)+(1cm x .3)] = 6.5cm

- A universal wedge has a 0.65 wedge factor. A 60 degree wedge is needed. 100 Mu are given for open and 200 Mu given for the wedge field. What is the average WF? WF = (100 x 1 + 200 x .65)/300 = .77

- Overall uncertainty according to TG40? 6%, 5%, 4%, 3% : TG-40 calls for an overall treatment error of under 5%

- If the collimator rotation is off 1.2mm, the couch rotation is off 1.4mm and the gantry rotation is off 1.5, according to AAPM what is the overall uncertainty? Based on a cryptic looking calculation on an aapm slideshow it appears to be SqRt(1.2^2 * 1.4^2 * 1.5^2) =2.376mm Please verify!

I got 2.4 mm as well.

- Gap calculation: SAD 90 depth =10, FS = 24cm , but the treatment distance is changed to 100 SAD, d=10, FS=32cm

it seems like the question has been lost here so I will try to fill in. Lets assume it asks how much the gap will change by changing the setup and we will have to assume I believe that the 2 spine fields (upper and lower) are identical for the two setups

and that the fields themselves are symmetric

GAP = 2(FS/2 * d)/SSD, I get a gap of 3cm for the first setup and a gap of 3.56cm for the second. Difference of 0.56cm

I disagree. If this problem is followed to the letter, then we are assuming you can in fact have a 90cm SAD. If you use the SSD method, then all fields have to be defined at SSD, if using the SAD method, then all fields are defined at SAD. In a situation like this it would be easier to follow SAD method. I did both methods and got 2.95cm gap. d/2[FS1/SSD1 + FS2/SSD2] must get field size at surface. Or d/2(FS1/SAD1) + d/2(FS2/SAD2) where I assumed since it is an SAD setup the fields were defined at SAD.

I disagree. FS is defined at SAD, so equation should have SAD in it, not SSD. 1st gap = 2.6. 2nd gap = 3.6. Difference = 1 cm.

- Calculate the steradian of a 50cm diameter area on a standard linear accelerator.

a. .137
b. .122
c. .187

solid angle = 2*pi*(1-cos(theta); solid angle is in steridians, theta = angle between central axis and beam edge; theta = tan^-1 ((field size/2)/100cm) for field defined at 100 cm.

2m

- HDR shielding question. How much thickness for 10 patients per week, 5 days a week, 500cGy/patient. The drawing showed a distance of 2 meters (I think that's what it meant).

6 ft

6 ft

X

A

B

- For an instantaneous exposure it gives 30 mR. If a secretary is sitting at point B and the wall is shielded for 6X how many patients a week can be treated for a weekly dose of 0.02mSv?

- Shielding question that gives a thickness of concrete and the room is shielded for 6X. How much more shielding is required for 18X?

- Why do the doctors leave a strip around each side of the treated area on a sarcoma?

A. for lymphatic drainage

4 cm

2 cm

B

–

- What is the dose to point B?

1. Range of Sr90 in air
2. Universal Wedge, WF = 0.2, what % MU needed for 30 degree effective wedge

B=Tan(30)/Tan(60); B/[B+(1-B)Wf]=MUw/MUtot ; 0.714 % wedged MU's

1. What does a fMRI measure Brain Activity
2. What is primary purpose of a bending magnet? Make the electron energy bin smaller (i.e. filter out lower and higher energy photons) Direct e-beam to target / iso
3. 1 R delivered, 3x10-10 C measured… what's the size of the chamber? 1R= 2.58x10^-4 C/Kg   density = mass/volume; **watch your conversions** I assumed density of air 1.2x10^-6 Kg/cm^3

   agree with above, got 0.97cc

1. 30 cm2 field directed at roof, what is sold angle subtended at a point on the ground? solid angle = 2*pi(1-cos(theta)) theta = angle from source to edge of field; answer in steridians 0.0695 (if it is talking about a 15x15 field) if it is talking about a 30cm^2 circle then its 0.003
2. HDR Cylinder with 5 sources 1 cm apart. Point A is midline, 4 cm from sources and receives 200 cGy. Point B is 2 cm lateral to Point A. What is Point B dose? 173.6cGy   172.8cGy Calculation can be seen farther down document.
3. Increasing the current to the magnetron does what? Adjusts energy. I confirmed this with an Elekta engineer on 7-30-2010; However, I find it strange that when a magnetron gets changed our output stays the same. Dose rate changes with magnetron adjustment.
4. Retrofit a linac to perform IMRT… how much shielding do you need to add? From NCRP 151: Typically assume 50% IMRT unless vault is dedicated to IMRT, then use 100% IMRT %, then calcultate TVL's or thickness. Much more information needed.
5. What is the source of electrons in an electron treatment? filament in electron gun
6. Given density of lead and mass atten coef for a random energy… what is TVL? Two approaches I believe. 1) TVL= 3.32*HVL where HVL = 1.44*linear attenuation coefficient 2) TVL = ln10/linear attenuation coefficient. ; linear attenuation coefficient = mass attentuation coefficient * material density

7. You check the source strength from the vendor 2 weeks after receipt. Given calibration factor, and reading… how far is the vendor off? A=A(o)e^-(lambda*t)
8. Given DVH curve… which curve has the least homogeneous dose? Look for a completely linear curve with shallow slope.
9. Given DVH curve… points to a line, what is it? Answers were PTV, GTV, OAR, Volume receiving 100 of dose
10. SRS treatment, 4mm cone… what is max dose? Answers were 10 Gy, 20 Gy, 40 Gy, etc
11. All readings, voltages, kq, Nd,w, temp & pressure… how many cGy per MU?
12. You calibrate a machine with the outside temp and press…. But this is the inside temp and press… how far off is your output? A couple % depending on the difference in temp and pressure, use Ptp
13. Treating with parallel opposed wedge fields for 60 Gy in 30 fxs and the MU per beam in 160 MU. After 10 fxs… realize WF was not in calc. How many MUs required for remaining 20 fxs to get to 60 Gy? WF = 0.3 720 MU's for the remaining 20 FX's I agree 720MU per fraction per beam . 160mu /WF = 533mu 533 * 30fx = 15990 total mu per beam per treatment. We have already treated 1600 mu per beam. remaining left to treat per beam is 14390mu 14390/20fx = 720 mu/fx per beam remaining.
14. Electron Eo = 7.1 Mev, mean E at 2 cm = 4 Mev… what is range? Ez=Eo(1-z/Rp), =4.58cm
15. According to TG51… you need to adjust you %DD by what? 0.6rcav for photons (upstream), 0.5rcav for electrons and the ratio of stopping powers (to yield PDD)
16. What happens to surface dose and %DD by adding a physical wedge? Surfact dose lowers and PDD is increased b/c of beam hardening wouldn't PDD increase because of beam hardening (higher energy = higher PDD). I'm not sure about surface dose...I was thinking it would increase because of scatter off of wedge...

%DD increases because of beam hardening (a few percent) and surface dose increases

1. Three layer material. First layer is 3 cm thick, HU = 0. Second layer is 4 cm thick, HU = -800. Third layer is 2 cm thick, HU = -100. What is effective depth? The intended method is to us CT# = [(u (tissue of interest) - u(water))/ u(water)]; where u = linear attenuation coefficient. Solve for the *u*(i)/*u*(w) of each material to get the effective depth. *u*(i)/*u(w)* = ((CT#/1000)+1); *[u*(i)/*u(w)]**y(i)*;* where y is the depth of material HU(0) depth = 3cm , HU(-800) depth = .8cm, HU(-200) depth = 1.6cm , total depth = 5.4cm

. I used HU = 1000*(um-uw)/uw and solved for (um/uw) which will give us the effective thickness when multiplied by the physical thickness. (um/uw) first material =1 (water)*3cm = 3cm effective for the second and third I find (0.2*4)=0.8cm, (0.9*2)=1.8cm. my total is 5.6cm

1. Why cant MRI be used for hetero corrections? Does not contain any electron density information
2. Why should you convince the doctor to not use a 25 cm x 3 cm electron cutout? The dose inhomogeniety on the field will be too great (TG-25)
3. You have a half beam 6 MV photon beam and a parallel 9 Mev electron that match on skin surface… where is hot spot? I think it will be close to dmax of the electron, the question is whether we use the energy/2.8 to get the 80% depth for the calculation. Hot spot at depth on the photon side, cold spot near surf
4. What is definition of EUD? Equivalent Uniform Dose (EUD) for tumors is defined as the biologically equivalent dose which, if given uniformly, leads to the same cell kill in the tumor volume as the actual non-uniform dose distribution.
5. What is definition of integral effective dose? (I think) effective dose accumulated over a period of time. Not to be confused with integral dose
6. What part of curve is an ion chamber used for calibration operated in? ionization chamber plateau (Hindee p. 130)
7. Why would a doctor use Pd103 instead of I125 for prostate implant? Deliver dose over a shorter time interval
8. Given an axial cut with weird dimensions drawn all over it… had to determine LPO angle? Easy geometry
9. Which part of linac is not water cooled?
10. Probably 10 MU calcs that I thought were very hard.
11. Probably 5 or 6 TG43 brachy physics calcs
12. According to TG40… how often do you check wedge interlocks?

Monthly (p.12)

35.Probably 5 or 6 shielding calcs.

1. You use a 3x3 electron cutout… what doesn't happen? Dmax decreases, output decreases, flatness decreases, range decreases
2. Probably 3-4 questions where you had to know that Total Dose = 1.44 times Half Life time Initial Dose Rate

1. giving a dose rate constant of I125 (Ir192?) measured experimental 0.7, two numbers calculated by Monte Carlo method (0.64, 0.67), something like that, ask according to TG-43, which one to use in planning system, 0.64,0.67,0.7,0.65 (the experiment one, one of the Monte Carlo one, or the average of the two Monte Carlo)

(appreciate that this took forever to find) p. 217 Section VI(A) TG-43 recommends using only Monte Carlo values by Williamson.

An update to this recommendation is in the TG-43U1 (update #1). They say that both MC and measurements have strengths and weaknesses so one is to use an "equally weighted average of the average measured and average calculated values".

2. The universal wedge question like the one we had in the old exams, given a universal wedge, wedge factor= 0.25, to make a 30 degree wedge, what's the MU ratio of the wedge field and open field. I didn't know we need to assume the universal wedge angle is 60 degree until today, I thought something is missing in this question when I was working on it from the old exams.

(tan30/tan60)/[(tan30/tan60)+{1-(tan30/tan60)*0.25}] = .666, This is the ratio of MUwedged/MUtotal . so ratio of wedged to open is 2/1

3. one of the shielding questions like the old one, an office will be add next to the storage room, distance to the point in storage room from the source is 6meters, to the point in office is 12meters, the reading in the point at storage room is 0.6mSv/hour, how many patient can they treat per week to get less 2mSv/week in that point in the office, the barrier between storage room and office has no attenuation, beam shoot on the barriers only 30s per patient, clinic is running 5 days per week. somehow I just can't get a number close to one of the answers.

4. Some of the questions have the answers are very close, I remembered one of the TG-51 calculation questions, the answer is like, 0.62,0.63,0.64...something like that, I got the answer is like 0.624 first time.

****

1. TG-51 calc. Given raw data. Need to calculate Pion and Ppol. Need to know standard pressure in kPa. Find dose at isocenter if 100 MU were given. Also given rcav which I didn't use.
2. Shielding –lots.
3. HDR calculation using point source formalism from TG-43 (given dose rate constant, radial dose function, some other stuff) From TG43 : the dose rate D(r,theta) = dose rate constant * air kerma strength*[G(r,theta)/G(1,pi/2)]* anisotropy factor* radial dose function. G(r,thete) is the geometry factor. Dose rate constant units are cGy h^-1 U^-1, air kerma strength units are U ; For a point source G(r,theta) = 1/r^2, for Ir-192 th anisotropy factor can be set to 1, Through simplification (pg 375 Khan) For a point source **Dose rate(r) = dose rat constant*air kerma strength* [g(r)/r^2]*average anisotropy factor**; g(r) is the radial dose function, The average anisotropy factor is 1 for Ir-192, otherwise: 4*pi*(dose rate at some radial distance) / (dose rate at same distance along the transverse axis) Important: Problem could require the calculation of the air Kerma strength U = exposure rate * (W/e)*l^2, l will most likely equal 1m; U is

broken into microGray m^2 h^-1, air kerma strength = exposure rate (R/h) * 8.76 x 10^3(m^2 microGy/R) Side note because I see it here in the book. 1U = .138 mg-Ra eq

4. Treating a stereotactic lesion in the head with a 4 mm diameter beam. What is the largest dose you can prescribe? ~ 20Gy to 50%
5. Standard Gap Calc between a treatment with an SSD setup and a treatment with an SAD setup. Answer was 1.95 cm gap on skin. Options included 1.9 cm and 2 cm. I chose 2.
6. Photon and electron field
7. Concrete is used for neutron sheilding for what reason? It slows down the neutrons (thermalizes) and then is effective at capturing the neutrons (heavy in hydrogen).
8. Using lead and concrete to shield Primary wall. From the inside, what is the order of the materials? (lead then concrete, concrete then lead, other combinations), of those options I would choose the first. Other than that I would just choose concrete.
9. Given 125I half life of 59.4 days, given exposure rate constant in cGy/hr/U or cGy/U/hr. After 30 days what is the dose rate to the tumor in mSv/hr?

   The ratio of the gamma constant at 30 days to that of the given at t=0 is just given by exponential decay, and is 0.704. For x-rays, the quality factor is 1, so 1 cGy = 10 mSv. I assumed the air kerma strength of the seed to be 0.31 U. Gamma (cGy/hr/U) * 0.31 U = Abs(Gamma) * 0.31 gives us a dose rate in cGy/hr. Multiply this by 0.704 to find he dose rate in cGy/hr in 30 days. Multiply this by 10 to find the dose rate in mSv/hr in 30 days.
10. 200 keV beam. The density of copper is given in g/cm^3, and the μ/ρ for copper is given in cm^3/g. If 3 mm of copper attenuates the beam to 63% of its original intensity, what is the TVL for copper? TVL = ln10/linear attenuation coefficient. IF LAT is given, then this should be a very quick and easy problem. If not, then solve for LAT first I=I(o)e^-(LAT*x)

(u/p)*p = u, HVL = 0.693/u, TVL = 3.32*HVL

given mass atten coef and density, solve for linear atten. Use to find HVL, Use to find TVL

Method in blue above will work but this is simpler to solve using stupid windows calculator.

1. Shielding: the distance from isocenter to point S is 6m, and iso to point Z is 12m. Point S is in a store room and point Z is in a room being considered as new office space. A survey meter measures 0.2? cGy/hr at point S. A beam is aimed toward this primary wall for 30 seconds per treatment. For a maximum dose of 0.08? cGy/week at point Z, what is the maximum number of patients you can treat per day? Consider only photon interactions. Since we are given the dose rate at point S, we need to use the inverse square law to find the dose at point Z (6/12)^2 = .25cGy/hr; .2cGy/hr * .25 = .05 cGy/hr at point z. Next we need to

calculate the dose per treatment. .05cGy/hr * 1hr/3600s * 30s/tx = .00042 cGy/tx . We have a limit of .08 cGy/wk, so .08cGy/wk / 00042 cGy/tx = 192 tx/wk; The number of patients available for treatment per day is 192 tx/wk * 1wk/5 days = 38.4 so 38 patients/day

Agree

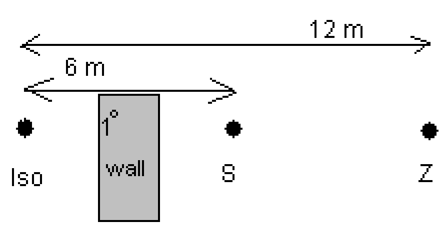
Agree, but does the fact it went from a store room to office space change occupancy factor?

^^^^I believe it does, I over looked it. Remember that their are new occupancy factors in NCRP 151;1, 1/2, 1/5, 1/8, 1/20, 1/40 I think that a store room would be 1/8.

I actually believe in this case that you don't take into account occupation factors (atleast the way the problem is recalled). The problem makes it seem like we are given an instantaneous reading directly. If the problem talked about the equivalent dose per week at a location and wanted to know how many patients could be treated, then I might think about using occupancy factors. What does anyone else think?

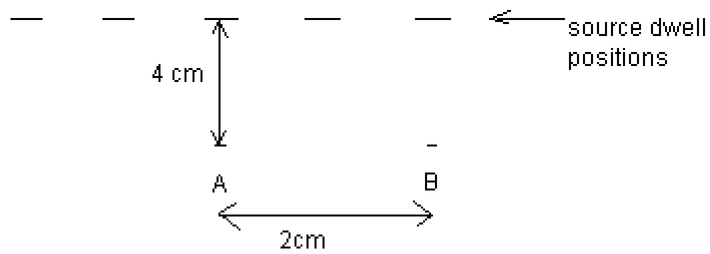
^^^^ I agree with you. I overlooked that it clearly gives you .08 cGy/wk at Z. It must have been a shielding study day and I was determined to calculate a barrier thickness.

I've always thought of the Use and occupancy factors as modifying the workload. In this case you really aren't getting a workload but instead comparing dose rates. I can see this problem being done both ways but would not use the occupancy factors myself



12.

Given 5 HDR sources. 1 cm between each source dwell position. 4 cm between middle source and point A. The dose at point A is given. What is the dose at point B. Equal dwell times for all sources. (Also given source active length which is less than 2*distance, so I treated as pt sources)



Had trouble finding a quick way to do this one. Since each dwell position had equal times I ended up finding ratio of 1/r^2 for the 2 points where r is the distance from sources to each point. Db = 0.868 Da

I used a similar method: I found each point individually, which turns out to be a big failboat in this situation since time is of the essence. We know that the initiall dose rate of all sources is the same since the dwell times are the same. D(Atot) = Sum of (1/r(n)^2)*D(n) where n = the dwell position from 1-5 starting from the left. .281D = D(Atot) solve for D and substitute. Solving for D(Btot)= .243D = .864D(Atot)

This system is symmetric. It does not depend on anything except the relative positions of points A and B.

Only considering inverse square, Point A receives:

1/(4^2)+2/(4^2+1^2)+2/(4^2+2^2) = 0.28

**** Use the triangle formula c^2=a^2+b^2**

Point B receives:

1/(4^2)+1/(4^2+1^2)+1/(4^2+2^2) +1/(4^2+3^2)+1/(4^2+4^2) = 0.243

0.243/0.28 = 0.866

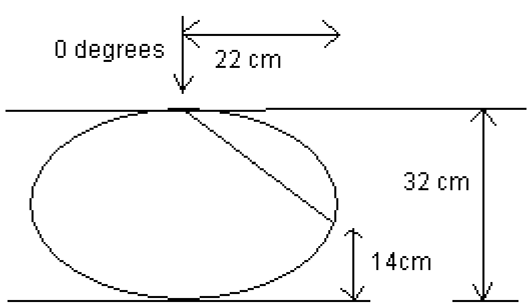
So basically it finds a factor for a single point source D in one step, and takes full advantage of Pythagorean theorem. , So D(A) = .28D, and D(B) = .243D substitute and solve. This was much faster than the way I did it.

13. A setup calls for a 25 cm field length at 100 SAD. The SSD is 88 cm. However, the field requires a wedge that has a field size limit of 20 cm at isocenter. What must the new SSD be in order to accommodate the wedge? If we are at isocenter the depth must be 12cm (100-88)=12. If the FS of the wedge is 20 at 100cm, then (20/25=SADw/100), the new SAD must be 80cm to allow the wedge to cover the whole field. 80cm-12cm = 68cm SSD.
    I disagree. You can't change the parameters of the machine (SAD is fixed). So you will have to increase the SSD to to increase the effective field size at a depth of 12. It would be easier if I could draw a diagram, but essentially I did the following:
    Using similar triangles: 12.5/(100+x) = 10/100, where x is the distance the SSD will change by. x = 25 cm, so SSD = 88 + 25 = 113. So still treating a 25 cm field size at depth of 12 cm, but can use wedge.

I agree with 113.

Drew diagram of this problem and it became clear. agree with 113 SSD, does seem a bit easier than changing SAD for LINAC ;)

13. Find the RPO angle given the following (diagram). The line represents the central ray of the beam through the patient.



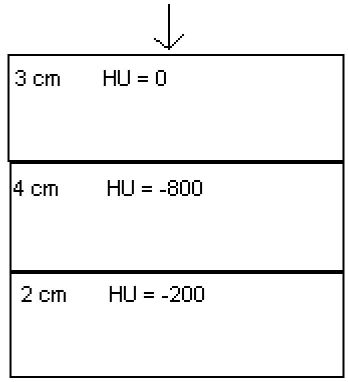
disagree. I calculated 39.3 = (tan-1(18/22)) but this is from normal (90 or 270) not 0 or 180. If we are solving for RPO it will be 90+39.3 = 129.3 (supine) If the patient is prone then the angle will be 270+39.3 = 309

In the other problems they appear to want the medial field. It also seems to mean that screen right is patient left when supine.

15. Parallel opposed fields with equal weighting. 60 Gy in 30 fractions is prescribed to the isocenter. The fields are equally weighted. (SAD setup with iso at midsep). The patient separation is given, as well as the depth to the cord. The TMRs at three different depths are given. Find the maximum number of fractions that can be given with the limitation being the cord tolerance dose. 60Gy in 30 fractions means 20cGy per fraction. So 100cGy per beam. We will say it's an AP/PA setup. I am willing to bet that the TMR values will be for iso, AP depth to cord, and PA depth to cord. We know the dose delivered by each field at iso so I think the dose at the cord from each field will be calculated as follows. D(APcord) = 100CGy * (TMR(AP cord depth)/TMR(AP iso depth))* (SAD/ (SAD + d(AP)))^2; D(PAcord) = 100cGy * TMR(PA cord depth)/TMR(PA iso depth) * (SAD/ (SAD + d(PA)))^2 ; D(AP) + D(PA) = D(cord)/fx ; 4500cGy/ D(cord)/fx = Number of fractions to treat cord limit.

I think you are missing the TMR value for the isocenter depth in your calculation...otherwise I agree with your method.
Yes, I did leave it out. Thanks, i edited the solution.

15. Memory foggy on this one: You measure a brachy source and get a measurement in air at 1 meter of (given)R/S. The chamber volume is given, the chamber calibration factor is given (in cGy/C?). You are given the density of air in kg/m^3. The stated activity from the manufacturer is given. Given 0.876cGy/R, given 33.95 J/C, NOT given 2.58E-4 C/Kg = 1R. What is the relationship between your measured dose rate and the dose rate stated by the manufacturer? It appears to be a problem where you need to convert the exposure rate to air kerma strength to find the exposure calibration factor. See Khan pg 366 ; (15.6 - 15.8), and, exposure rate = [(exposure rate constant*Activity)/ l^2] In this case l = 1m
16. For a photon skyshine calc, What is the solid angle of a circular beam with a 50 cm diameter? (0.187) solid angle = 2*pi*(1-cos(theta); solid angle is in steridians, theta = angle between central axis and beam edge; theta = tan^-1 ((field size/2)/100cm) for field at 100 cm.
17. A beam travels through tissue (see diagram). What is the radiographic depth? The intended method is to us CT# = [(u (tissue of interest) - u(water))/ u(water)]; where u = linear attenuation coefficient. Solve for the *u*(i)/*u*(w) of each material to get the effective depth. *u*(i)/*u(w)* = ((CT#/1000)+1); *[u*(i)/*u(w)]**y(i); where y is the depth of material HU(0) depth = 3cm , HU(-800) depth = .8cm, HU(-200) depth = 1.6cm , total depth = 5.4cm



19. A Shielding calculation was performed assuming no IMRT. If you will now be doing 50% IMRT, how much additional shielding will you need to add? Multiply Workload by IMRT factor for leakage workloads: IMRT Factor = % IMRT x IMRT ratio + (1 - % IMRT), IMRT ratio is from table and is vendor dependent, but between 3 and 5, Typically the IMRT factor with a 50% % IMRT is 2-3. The IMRT can also be calculated by taking the ratio of MU from IMRT divided by the MU from conventional treatment. MU(IMRT)/MU(conv) = IMRT factor. B(L) = P(d)^2/(.001W* IMRT factor*T), At 1m meter the W and W(IMRT) are the same.

I disagree....using IMRT does not affect the primary shielding calculation. The reasoning behind this is that the radiation reaching a primary barrier is proportional to the isocenter dose. Therefore, even though we are running many more MU through the machine for IMRT, the isocenter dose is left unchanged. As stated above, it will affect the leakage calculations.

Agree with method of getting IMRT workload but it should only be used for leakage calculation as the primary barrier is only shielded with a workload calculated from dose, which is not changing. As a side note, the SRS primary workload does not change even though very high doses are being given due to how long the treatments take to perform. For TBI, the primary does not change, only the amount of MU's delivered, which results in ONLY a leakage workload increase equivalent to 12-13 patients per TBI patient treated.

Agree, should not be primary, only leakage, I will edit

One note of caution about TBI workload is that it may give roughly the same dose but that is located at about 4 meters from target instead of 1 meter. When figuring the workload, you'd need to inverse square the dose back to isocenter, thus having about 16X the dose at isocenter. Obviously this could be a big difference if treating a large number of patients, plese correct me if I'm wrong on that.

That is correct W(TBI)= D(TBI) * d(TBI)^2 If you have one TBI patient per week with 12 Gy at 4m, the workload will be increased by 192 Gy/wk at iso.

NCRP 151 (pg 56) also notes that this increases your overall workload for primary and leakage.

19. universal wedge with a wedge factor of 0.25 is used to deliver a beam with and effective wedge factor of 30 degrees. What is the fraction of MU's delivered by the wedged portion of the field. (There were 2 questions like this. For this question, I tried using both the Tatcher universal wedge equation and the equation from Greene and Williams (Linear Accelerators for Radiation Therapy). BOTH answers were in there. Maybe both will be counted as correct???

$F = \tan(30)/\tan(60)$; $MU(w)/MU(tot) = F/(F+(1-F)*.25) = .66$

I believe F is the WEDGED fractional dose. The way you have calculated above is that F is the OPEN field fractional dose. Does anyone else want to comment on this?

The second part is correct. I use $F=\tan(30)/\tan(60)$

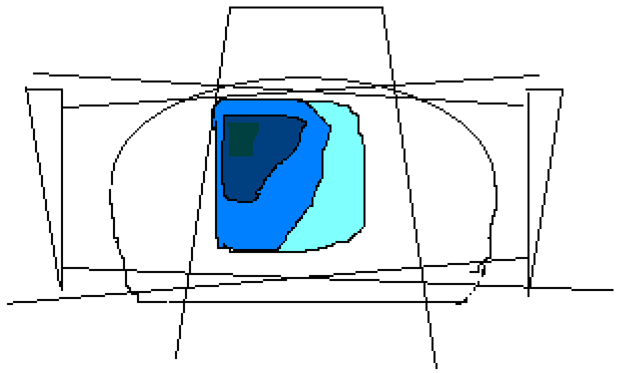
My bad...I agree with above. I was calculating the ratio of wedged to open mu, not the fraction of the total delivered.
I edited to make less confusing

19. Shown a setup with AP, Lt Lat, and Rt Lat fields. The Rt and Lt Laterals were wedged. The isodose distribution looks like the picture below. Another picture with a uniform isodose distribution is shown. You must choose which field weights and wedge weights to change in order to make the picture below look like a uniform isodose distribution: (patient supine, view looking from foot to head)

You are given a choice between answers like this:

RT LAT wt	LT LAT wt	AP wt	RT lat wedge	Lt lat wedge
decrease	increase	same	increase	increase

I would suggest decreasing rt lat, increase lt lat, and decrease AP, I selected this response because current isodose distribution appears to be pulled anterior and left. increasing rt lat would pull iso distribution to middle. Reducing ap would reduce anterior weighting. You could also just increase rt lat and reduce ap contribution leaving the lt lat alone.



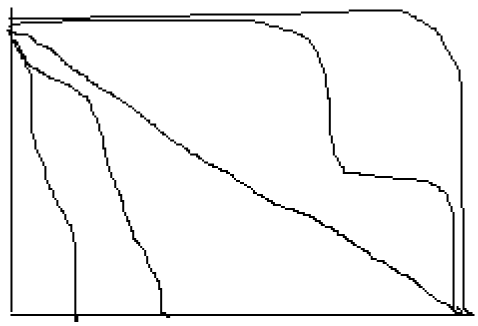
(patient supine, we are looking foot to head)

Rt. Lat Weighting : LOWER, Lt. Lat Weighting: HIGHER, AP weighting: same, Rt. Lat Wedge : Higher, Lt. Lat Wedge: same

looking at the (patient left) side it appears that the AP weighting will be okay. Need to increase wedge on Rt. side. Need to put more weighting on Lt. side, less on Rt. Lt wedge looks pretty close to appropriate (will even out once Rt. wedge is changed)

22. Electrons are produced in a linac by (thermionic emission from anode, thyratron anode, heating a filament, etc)
23. When the current in the magnetron increases: The magnetron voltage increases, other answers I can't remember. The frequency will change as the current changes, but I'm unsure if this is a choice. current will adjust energy of beam. The voltage does increase with an increase in mag current. The voltage is indirectly controlled by the current.
24. Overall error expected according to TG-40 (ICRU) dose delivered be within 5% of RX (TG-40, p. 584)
25. definition of QA : All those planned or systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality (TG-43)
26. definition of wedge factor : ratio of the doses with and without the wedge, at a point in the phantom on the central axis.(kahn, p. 207)
27. Meaning of Equivalent Uniform dose (given a non-uniform dose distribution, find the uniform dose that gives the same biological effect)

28. Shown DVH and must choose the DVH line representing most heterogeneous dose distribution

 (The very middle line is the least homogeneous)

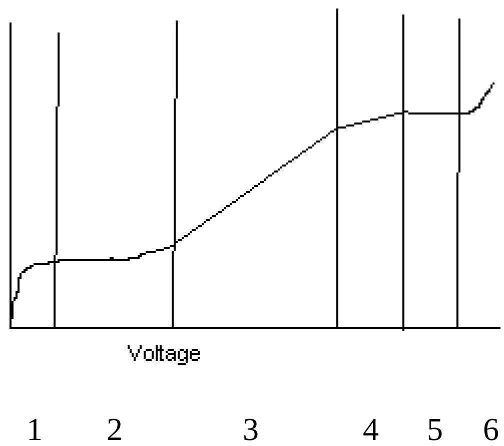
29. Which structure does line 2 represent on this DVH for an IMRT plan? (organ at risk, GTV, PTV, etc)

    It was an obvious PTV

30. Why, when treating an extremity, do we block out a sliver of skin? (spare lympatic system, aid in skin healing after radiation, other choices)
31. When treating a lung tumor, what is the dose associated with radiation pneumonitis? (V20=30%, V50=10% etc) Doc here says they try to keep V20 < 32% and see Pneumonitis in 15% of patients
32. Neutron dose from 15 MV photons: (2%, 5%, etc) neutron dose equivalent is .5% on central axis for 15MV-25Mv I get that it is 1.4% using a quality factor of 10
33. All of the following change when an electron beam is made significantly smaller by adding a cutout EXEPT: Rp, dmax dose, etc. Rp
34. When an electron beam has an oblique incidence on the surface, what happens? (how does it change dmax, Range, etc) (Khan p.321, 3rd ed.) Increase dose at shallower points, decrease dose at deeper points as the angle of obliquity increased. dmax shifted towards surface, decrease depth of penetration.
35. According to Bragg-gray cavity theory, the diameter of the air cavity should be (greater than the range of radiation in cavity, same as range of radiation in cavity, less than range of radiation in cavity – Khan p.114) Disagree here...the diameter of the cavity should be small when compared to the range of electrons crossing

the cavity. One of the rules is that the cavity does not appreciably perturb the radiation fluence, thus the need for a small cavity. Agree. I think I read the answer backwards or something.

36. In which region would a cylindrical ion chamber be operated on a voltage versus ion pairs collected graph? Saturation region. Also known as plateau region. Region 2.



37. In Monte Carlo Treatment Planning Algorighms, what is the cutoff energy under which the path a particle will no longer be mapped discretely, and instead it will be lumped in with a general energy distribution function. (100keV, 10 keV, 1keV, two other options) Multiple papers indicate that 10 KeV is the photon cutoff and 600-700 KeV is the electron cutoff
38. How much do shift your curve to get a PDD (PDI?) curve?

.

Shift **photon** Percent Depth of Ionization curves upstream by 0.6rcav, then this is effectively the PDD

Shift upstream by 0.5rcav for **electron** beams and multiply by the ratio of stopping powers at each point to yield PDD (not needed for TG-51)

37. What is the purpose of the bending magnet. Options included: to accommodate a horizontal waveguide, and to focus the electron beam on the target. Some linacs also incorporate energy defining slits for energy selection.
38. There was a question that required you to know that the bending magnet was NOT between the target and primary collimator. It may have been included in the previous question.
39. On fluoro images in the simulator, wires used toward the outer edges of the field of view can appear to be (farther apart?) than they actually are. This is due to: image intensifier, automatic brightness control, scatter grid, another choice I don't remember. x-rays are converted to light, then electrons by the input screen. The electron beam has to be accelerated and focused to retain its spatial pattern.

Focusing uses a lens which requires the input screen to have a curved surface. This leads to unavoidable pin cushion distortion. All of this happens inside the image intensifier.

40. A dose calc where you have SSD, Dose rate at Dmax for 100 ssd setup, and a depth of 10 (PDD given). For the given setup, they give you the MU required to give the dose. for the same dose delivered to an SAD field at a depth of 10 (They stated the TMR), how many MU's do you need? Need to do a back calculation to get the output factors that are not mentioned, then do the SAD calc and include the output factors This sounds like you need to calc the dose being delivered to the target, then back calc the MU for SAD setup.
41. Prescription is 200 cGy/day delivered by parallel opposed, equally weighted beams. They say they gave 147 MU per beam, but left out a wedge factor of 0.8 for the first 10 treatments. The patient is to receive 30 treatments total. What is the MU required (per beam) for the remaining 20 treatments in order to deliver the prescribed dose for the entire course of treatment?

Patient was treated with too few MU's.
Correct value would be 147/0.8 = 184 MU.
This would give us 184(30) = 5520 MU for the total treatment.
We have already given 147(10) = 1470 MU's leaving
(5520-1470)/20 = 202 MU's/ FX for the remaining 20 treatments Agree

No questions on TBI this time. No questions about occupational or public dose limits. Lots of dose calcs. No electron calcs that I can remember. A sizable amount of rather obscure information was included in the simple questions. Most of the complex questions were more reasonable but I ran out of time and had to guess on the last few. Don't waste time on the simple questions you don't know!!

<u>2009 ABR_Physics_Part II_Type</u>

1. What is the energy of 12 MeV electron beam at depth of 0.5 cm of a thick lead slab? 2 MeV; (electron beam loses 2 MeV/mm of lead)
2. A treatment room is designed for 6 MV photons and the primary thickness wall is given. Then it was decided that 18 MV to be upgraded. What would be the required thickness of the 18 MV? (both TVLS for 6 and 18 MV are given)
   Find # TVL's currently to shield 6MV, n= thickness/TVL(6MV), multiply nxTVL(18MV) to give the thickness of shielding needed for 18MV. subtract out current thickness to give the thickness needed to add.
3. Using wedge, the wedge factor is given, and both the dose and the dose rate are given. Calculate the MUs. MU = D/ (Dose rate cGy * WF)
   Disagree. D=MU*WF. MU=D/(Dr*WF)

4. A plot for DVH is given, what the dose is given to 90% of the organ. D90.
5. What is the tolerance dose for 1/3 of the kidney? 50 Gy (clinical nephritis)

   Our docs use 20 Gy to 1/3 of kidney.

1. Which of the following element has equal effect from both Compton & Photoelectric effect: I, Ir, Co, Cs. Cs-137 avg energy .662 kv, Z = 55, closest to graph on attix pg 125, Iodine could be a possibility Equal effect in what material? Not sure that the diagram on page 125 of Attix explains this. There is not enough info presented here, but I am assuming that it means equal probability from Compton and Photoelectric in Water. Anyone else confused here?
   hmm.. lower energy is predominantly photoelectric effect, right? I-125 I'm pretty sure.
   Chances are they are talking about water...then equal amounts of PE and Compton happen near 25-30 keV...answer is I-125
2. Using HDR Brachtherapy, Which is better to employ Ultrasound or CT scans or both of them. (CT is adequate?)
3. A question about scout images and DRRs. DRR (digitally reconstructed radiograph): an important feature of the 3D planning system where is has the ability to reconstruct images in planes other than that of the original transverse image from the CT scan. (pg 469, Khan, 3rd edition)

I've seen questions in the past talk about scout vs. DRRs...sometimes on previosu oral exams. If this is what they are asking, the problem with scout films is they are not divergent in the longitudinal direction because each slice of the CT set does not have the same source position

1. Procedures for commissioning 3 D treatment planning.
2. Stereotactic Question: what would be the dose to the surrounding healthy tissue to achieve a uniform dose to the target of 20 Gy. (We shoot for a conformance ratio of under 2.5, not quite sure what this question is asking)
3. Question to determine the gap at different 2 SSDs **gap = d*[(FSLength$_1$/2)/SSD$_1$ + (FSLength$_2$/2)/SSD$_2$], where d is the depth of treatment, and FSLength is the length of the field size along the desired gap. Calculated from similar triangles**
4. Question about TG-51, about the right procedure to perform electron calibration. Given the following options: field 10 x 10 cm

R50 is 8.5 cm

d(ref) = 0.6 r(cav)-0.1

pg. 137, Khan 3rd edition

13. Question on Kernel and Heterogeneity. pg. 477-479, Khan 3rd edition; Pg 527 New Khan version. "Heterogeneity corrections are made by scaling the kernel dose by electron density in the convolution integral" A few more kernels of info.....Convolution superposition dose is determined by summing the dose from pencil beam kernels. PB Kernel is pre-calculated in a water phantom using Monte Carlo.
14. Question on dose homogeneity using TBI.Compensators are required to achieve dose homogeneity of +/- 10%, excluding extremities. Beam energy is selected based on patient thickness and specification of dose homogeneity in TBI protocols. Khan google book pg 412 key notes
15. Determine the linear attenuation coefficient for a material, where both of d and d(eff) are given, and also HVL is given. linear attenuation coefficient = ln2/HVL or ln10/TVL
16. Question on 3 D cone mean artifact. What is reason of the noise? combined effects of beam hardening and x-ray scatter causing inaccuracy of CT#, contrast reduction, and cupping.
17. Question on Gating I would guess prospective vs. retrospective gating or duty cycle.
    prospective is accept/reject if it is in/out of motion window, retrospective analyzes image echos. The rest is over my head ;)

13. Question on MonteCarlo pg 478-479 (Khan, 3rd edition); computer program that simulates the transport of millions of photons and particles through matter, using fundamental laws of physics to determine probability distributions of individual interactions of photons and particles.

13. Question on the effect of IMRT on a treatment planning: low gradient & low dose, low gradient& high dose, high gradient & low dose, high gradient & high dose.

13. On TSEI, to increase 5% homogeneity which is better to extend the distance or to reduce the energy used or what other method? pg 341, Khan 3rd edition, discusses methods, but haven't figured out answer to this question specifically. The only common theme I see for increasing uniformity is to use multiple fields. Up to 6 in the stanford method Check elsewhere in the document. I think someone answered a question where you had to pick the "false" statement. The false statement was that "reduce energy to increase homogeneity."

13. Suppose we have a malfunction in the bending beam magnet system, What would you expect to realize a change in: energy agree
14. To increase the energy in the accelerator, what you do? Increase the current in the magnetron, or Increase the voltage in the magnetron, Increase the current in the Thyratron, or, increase the current to the Gun Increase gun Current. Am I right ??? KA

changed mind again, back to current in magnetron. Bending magnet current would be my number one answer.

I'm feeling pretty good about current in magnetron on this one.

13. Question on Radiobiology. The given dose is 54 Gy through 30 fxs. The doctor wants to do accelerated fractions to 20 fxs so that patient will get the same radiobiology effect. The therapeutic ratio is 10. What is the new dose? Therapeutic ratio refers to TCP (tumor control probablility) vs NTCP (normal tissue complication probability) I think the 10 is the alpha beta ratio (10 Gy) BED = nD[1+D/(alpha/Beta)] = 63.72Gy; 63.72 = 20FX*D (1+D/(alpha/beta))....solve for D = 2.55Gy / fx (quadratic)
14. What is the highest dose to Public? 100 mrem (<2 mrem/hr)
    1 mSv / year (frequent exposure) or 5 mSv / year (infrequent)
15. Question on convolution to correct the heterogeneity, what kind of Algorithm is used.It is a "model based" algorithm. convolution superposition is the one that comes to mind. The equation considers seperately the transport of primary photons, and the photon electron scatter components emerging from the primary interaction. Khan pg 476

13. Question on the definition of KERMA.(there were: four almost very similar definitions, and I barley was able to get the right one) **Kerma** is the sum of the initial kinetic energies of all the charged particles liberated by uncharged ionizing radiation (i.e., indirectly ionizing radiation such as photons and neutrons) in a sample of matter, divided by the mass of the sample. It is defined by the quotient $K = dE_{tr} / dm$. kerma has two parts to it: Collision kerma k_{col} and radiative kerma k_{rad}. i.e. $K = k_{col} + k_{rad}$. Collision kerma results in the production of electrons that dissipate their energy as ionization due to the interaction between the charged particle and the atomic electrons. Radiative kerma results in the production of radiative photons due to the interaction between the charged particle and the atomic nuclei, but can also result from annihilation in flight.
14. Question on definition of ITV. It is: ITV= CTV + IM; pg 222-223 Khan 3rd edition, internal margin to compensate for internal physiological movements & variation in size, shape, & position of CTV during therapy.

13. Question on the disadvantages of Diodes. Energy dependence in photon beams, directional dependence, thermal effects, and radiation-induced damage.
14. Question on the electron density disadvantages of using MRI for treatment planning. It appears that MRI can not make a large enough distinction between different density tissues so when using mri for treatment planning you have to manually assign electron densities to the tissue.
15. if a photon beam penetrating 3 cm of healthy tissue then 9 cm in the lung then 1 cm of healthy tissue to reach the point x, where the prescribed dose at x is 250 cGy, what is the dose at x because of the lung? Effective depth problem. 3(1)+9(.333)+1(1) = 7cm effective compared to 13cm effective. Need TMR's or can use rule of thumb for attenuation / cm for energy. For example, its around 2 %/cm for 10 MV so this would be about 12% higher than 250 with the lung included = 280 cGy

I agree with this, if you didn't take into account the lung, then you would use a TMR with d=13cm instead of 7cm. Resulting in a 12% overdose for 10MV and ~20% for 6MV

13. Similar to last question, what the MU would be because of the lung/ density in lung would give effective depth of 1/3....
14. The strength of a radioactive source is given and has a unit of U.cGy/hr, both distance and anisotropy function are given, what is the strength at a distance of 2 cm? 1 unit of air kerma strength = 1U = 1cGy cm^2/ hr
15. Question on TG-51 for photon calibration, what is the difference between 10 AND 10(X). 10(X) is purely the photon component. 10 includes electron contamination.
16. What we do to cancel the e contamination effect at energy higher than 10 MV (not sure if we are "cancelling the e contamination" but we are changing the e contamination to a standardized amount uzing lead foil PDD, 1mm)
17. Determine the angle of the collimator of craniospinal treatment (both SSD, and spinal cord length are given). tan-1((Length upper spine/2)/SSD)
18. A treatment room has no office on the tope of it. The dose rate is 40 msv/week. If an office to be established over that room and the dose rate to be 2 msv/week. What is the thickness of the steel layer that is should be added to the concrete ceiling? Both TVLs for concrete and steel are given. #TVL's needed = ln(40)/ln(10) = 1.6, multiply this by the TVL of steel. TVL concrete not needed b/c is already installed, not installing more, and we have the dose rate with it in place already.

I'm understanding this as the dose rate currently where the room would be is 40mSv/wk, and when the office is in place it needs to be 2mSv/week. The concrete is already in place so we need TVL of steel that will take 40mSv/wk --> 2mSv/wk (2mSv/wk/40mSv/Wk)=(1/10^n) ; 10^n = 20; n=ln(20)/ln(10); thickness of steel = n* thickness per tvl. I get n=1.3

One TVL goes from 40 to 4, then one HVL from 4 to 2. Therefore, 1 TVL + 1 HVL = 1.3 TVL.
ln(2/40)/ln(10) = 1.3

13. Which will give the highest portion of the photon dose at the door of the maze: is it from the head, or from wall between the door and the accelerator or from the scattering wall facing both the accelerator and the door? >10MV patient scatter is ignored, leakage photons and neutron capture gammas are much higher. <10MV From NCRP 151 it appears to be from the wall facing the door unless the wall is thin, then it will be leakage through the maze wall. >10MV and neutron dose becomes a higher concern.
14. A point C is outside a treatment room; if the dose at c is the same for 6 or 18 mv. Both TVLs are given at 6 and 18 MV. What is the increment in the wall thickness if the dose rate increases to a given value? I'm not sure if the questioned is remembered completely, but I would use only 18MV to figure this out. (TVL18inital/nTVL18)=(initial doserate/final dose rate)
15. A radioactive source is sent from a vendor with a given strength. The physicist performed a well calibration on it and found that the current is 60 nA. What is the percent difference between his vale and the vendor value?
16. Question on TG-51. Determine K(Q). All other factors are given. **Measure %DD(10)x (radius corrected) for given photon energy (remember to measure with Pb foil for 10MV and above to remove e- contamination), then lookup Kq from %DD(10)x in Table I of TG-51**
17. Question on TG-51. Determine Ke(cal). All other factors are given. **Ke(cal) is given in Table III of TG-51. Dependent on chamber type**
18. What would be the dose at point 2 if the dose1 at point1 is given and also all of the following are given: d1, d2, TMR1, TMR2. D2=D1(TMR2/TMR1)(dist1/dist2)^2
19. 9 MeV electron beam, we want to treat at the line 80%, what you do? 9 MeV/2.8=3.2cm
20. Choose the right graph from 4 options that shows the relation between the e density and the CT number. From relative electron density vs. HU graphs I've constructed, they've generally increased near linearly with a y-intercept near 0, then continue to increase near linearly with a barely slightly lower slope.
21. In 4 D CT Helical, what is the pitch? Pitch=(table movement(mm) per 360 degree rotation of gantry)/collimator width(mm) at isocenter so if the table moves exactly the collimator width, then that is a pitch of one.
22. If the patient thickness is 22 cm, SAD=100 cm, source to film distance is 130 cm, d=11 cm if technique is changed from SAD to SSD, What is the new source to film distance. We want to keep the mag factor the same with both setups. (SFD1/SSD1)*SSD2 =146cm
23. Question on stem effect on the diode. Diodes shouldn't have a stem effect, right? They do have angular dependence, though. Stem effect

comes from the radiation changing the potential difference that is applied to the chamber (from the elctrometer). normally we operate them at -300V. so irradiating part of the cable or stem can slightly effect the observed potential (from the electrometer's point of view). A diode is not operated with a bias voltage so this should not have any effect on the reading. I have never tested this with a diode but have seen a maximum of a 0.75% stem effect using an ion chamber.

24. Where is the effective point of the parallel-plane chamber located? The center of the front (upstream) face of the chamber air cavity (just inside the thin window?)
25. More question on shielding.
26. Question on radiation protection.
27. Easy Question on for 2 opposed beams, calculate the dose at the midplane. All parameters are given.
28. Calculate the MU for a given dose and an other factors are given.
29. Easy Question about the best radioactive material used in PET to help in radiation oncology treatment planning.F18
30. What would be the effect of adding a wedge through a photon beam: Beam hardening, decrease fluence, profile gradient, increased scatter.
31. Using photon mode in the linear accelerator , which one from the following materials have the highest cross section for neutron production:pg 412, 3rd edition Khan
    high Z materials have a larger neutron cross section
32. When a thyratron fires what devices on the LINAC receive the power and/or signal?

electron gun + magnetron/klystron

13. A 5.4cc target in SRS has a conformity index of 2.3. How much normal tissue received the prescribed dose? 5.4*2.3-5.4=7.02cc agree
14. What is the duty cycle in respiratory gating? The percentage of time during the respiratory cycle when beam is being delivered.
15. Cross calibrate a parallel plane chamber with a farmer. Calculate correction factor with TG-51 type data given for the farmer.
16. (kecal*Nd,w) for plane parallel chamber = ((Dw/MU)cyl* MU)/(M*k'R50)pp
    k'R50 = 1.2239 - .145(R50)^.214
17. Where is the effect point of measurement for a parallel plane chamber? Half way between capacitor plates, 2/3 between, 1/3 between, just inside the thin window.
18. Best survey meter for lost I-125 seed? Cutie pie, GM tube, Thin window GM tube, Scintillation detector. According to P. Dendy Physics of Diagnostic Radiology the thin window GM tube is for beta emitters. I chose thin window for I-125 because of its low average photon energy of 28keV.
19. Given film densities and some other data you had to construct the OD vs dose curve and determine some parameter.

With the OD (y-axis) and the log(Dose) x-axis, the slope of the line will be the gamma value, which will indicate the speed of the film. The steeper the slope, the "quicker" the film

13. Calculate skin gap in CSI spine treatment one field at SSD 100 and the other with SAD treatment (SSD=90cm). (d/SSD1 * L1/2)+(d/SSD2 * L2/2)
14. Given PD-103 total dose calculate dose rate after 30days. T1/2: 17days, time: 30 days; Total dose= 1.44* Initial Dose rate*T1/2
    Dose after 30 days=D30=Dtot*(1-e^-lambda*t)
15. ^^^^True, but it is asking for "dose rate" after 30days. Total dose equation above to get initial dose rate. Dose rate(30d)=Initial dose rate * e^-(lambda t)
16. Total treatment time of 420s with A=3.34Ci. Source change 5days later and patient starts treatment 3 days after the source exchange. What is the new treatment time? seems like we don't need the 5 days later thing. assume 10Ci new source, decay 3 days, ratio of activities * TX time = 144.3s, agree, I double checked with the 1%/day rule and got very close. If answers more than 3s apart, I would feel comfortable using this rule.
17. What is the accepted leakage in amps for a chamber/electrometer setup? o.1 pA?

67. 60 degree universal wedge with a transmission factor of 0.5. What is the ratio of MU to get a 30 degree effective wedge? 1/1 ratio (wedged to open)

68. Time in seconds to get 340cGy 1cm beyond mammosite balloon surface (balloon has 4 cm diameter). Given air kerma strength
time = (340 cGy * 3cm^2) / Sk (cGy cm^2/hr)
Keep in mind this will be dependent on where Sk is defined. sometimes defined at 1m

69. 3 layers of tissue. layer 1 = 3cm, HU = 1; layer 2=4cm, HU = -800; layer 3=3cm, HU = -100.....effective depth question
use HU=1000(mu-mu(water))/mu(water), solve for mu (assume mu water =1), I get deff = 6.5 cm
agree

70. Given a drawing of an axial cut of the chest with lung in the field. CAX of beam goes through chest wall (2cm)-->lung(11cm)-->cord(1cm) to give 200 cGy to pt A. If the TPS did not do heterogeneity corrections to calculate MU, what would be the actual dose delivered to Pt A. compute equivalent depth (7.26) then need ratio TMR's or something for dose or can use rule of thumb (10 MV, tissue 2 %/cm, 6 MV tissue, 4%/cm)

71. Given 7mSv/hr at 1m from source. Wall thickness to get less than 0.02mSv/hr at 1m beyond wall?need HVL/TVL info

72. Dose associated with irrepairable kidney damage nephrosclerosia TD5/5 = 20Gy

73. BED if physician normally prescribes 1.8Gy/day in 30 fx, but wants to reduce the fx # to 20 fx, what's the new daily dose when according to the linear quadratic model alpha/beta = 10? BED = nD[1+D/(alpha/Beta)] = 63.72Gy

incorrect....need to solve for the daily dose

63.72 = 20d(1+d/10).....d = 2.54 Gy/fx
agree

74. Cord sits 5cm posterior to midplane of a 24 cm thick patient treated 180cGy/day AP/PA to 12cm. How many fractions can be treated to keep the cord below the 45Gy tolerance. TMR's for d=5, d=12, and d=19 given. ---> needed to use ratio of TMR's to solve.

75. Given a picture with 4 different tissue densities with their corresponding electron densities. Figure out dose using hetero corrections vs. without using hetero corrections.

76. Given 5mSv/hr, 300cGy/patient..3 patients that can be treated to keep the office (12 m away) to 0.02.

77. Retrofitting a machine to perform IMRT. What is the increase in workload? Given 65% IMRT, Ratio of MU IMRT/no IMRT = 4, average PDD = 60%, 200cGy/patient, 30 pt/day.

I find IMRT factor = 0.65*4+(1-.65)=2.95, so Wimrt=Wwithout*2.95

78. Dose rate at 30 days from a 0.46mCi Pd source (given t 1/2 = 17days) if the total dose delivered is 120Gy?

You can assume that the total dose is from a permanent implant and that 120Gy is the dose throughout the lifetime of the implant. You could assume that the 120Gy is the total dose delivered after 30 days. (I assumed that the 120 Gy was given through the lifetime of the implant)Since dose rate will be proportional to the activity at a certain time Dtot = 1.44*t1/2*Initial dose rate, solve for initial dose rate = 2.04 Gy/day; plug this into Dose rate(t)=Dose rate initial* e^-(.693*t/t1/2) =0.6 Gy/day = 8.51 cGy/hr

disagree with answer,but process is correct. I get initial dose rate of 4.9Gy/d, after 30days 1.44 Gy/d

did it again and got 1.44Gy/d

79. PA Spine field L=35 abuts a cranial field Ant/Post length = 24, sup/inf length = 18. What is the couch rotation needed to match the divergence? Needed to use the rotation = arc tan(1/2 * Length/SSD)
Just for kicks :P ---->I'm going to throw down my recent schooling on this to see if I remember correctly. Since cranial field is symmetric arctan((18/2)/100) assuming 100 SSD = 5.14 degrees. What if we wanted a collimator kick. We use the spine field correct? arctan((35/2)/100)

80. Collimator rotation needed to match the divergence on a craniospinal treatment. Φ(coll)=arc tan (1/2 * L1 * 1/SSD) where L1 is the length of the posterior spinal field.

81. According to TG-66....something about distance in mm an iso can be off in a simulator according to tg-40(!), 2mm for conventional sim. tg-66, 2mm for ct-sim

82. Total error if gantry is off 1.2mm, couch is off 1.4mm...sqrt[(1.2)^2+(1.4)^2] = 1.84

83. If you order seeds for an I-125 prostate seed implant, according to AAPM recommendations, what percentage off can your in-house measured activity be from the manufacturer's activity? 10% (not positive about this one, we check to w/in 5% or so)

3% investigated within your institution, 5% reported to manufacturer

84. What agent is used in PET imaging? FDG, F18

85. The seminal vesicles are located _____ and _____ to the prostate.
superior and posterior.

86. storage room 6m away from iso in primary direction reading 0.06mSv/hr for 6MV beam, if add 18MV beam and wanted the office next to storage room and 12m away from iso, if want the reading at office below 0.02mSv/hr, how many patient can treat everyday. Beam on time for each patient on this direction is 30 sec. No other data (like TVL, Occupation,etc.)was given.
Don't over complicate this question. The only way I can see to solve it is:

1st: calculate current dose rate at 12 meters: = (6/12)^2 * .06mSv/hr = .015mSv/hr

2nd: given a goal of .02 mSv/wk: (0.02mSv/wk)/[(0.0015mSv/hr)*(0.5 min/patient)]*(60min/hr) = 160 patients per week

disagree with above. I think this is a misremembered question, but working with what we have 0.06 mSv/hr * (1/4) = 0.015mSv/h, 0.02mSv/hr/0.015mSv/hr * (0.5min/pt) *(1h/60min)*(1day/8hr) = 1280 patients per day, this would be if the occupancy factor was the same. We are going from an occupancy factor of 1/16 to an of=1.......so this would take our value down to 80 patients per day.

I agree with GREEN. No need for new occupancy factor unless calcing shielding thickness since it already gives us our permissable dose in the office. Just find mSv/pt and then use permissible dose rate to find number of patients eligible for treatment.
I agree with other green person's answer.

87. If doctor want to change 30 fractions for 60Gy total priscription to 20 fractions, alpha/beta=10, old MU=200, what is the new MU?

BED = nD (1+ D/(alpha/beta)) = 30*2Gy(1+ 2Gy/(10)) = 72Gy for the original RX.
for the new RX, want BED to still be 72Gy in 20 FX. so 72 Gy = 20*D(1+D/10), solving for D gives D= 2.8Gy. compared to the 2Gy originally, the MU's would need to be boosted to 280 MU.

88. Sim film setup, SSD is 80cm with 167cm SFD(source to film distance), patient 22cm thick. If SSD change to 100cm, what's new SFD? 209cm; I used simple geometry which boils down to keeping the magnification factor the same. 80/167 = 100/x where x is new sfd. More technically M = SID/SOD = 167/80 = 2.09, New SID = 2.09 * 100

M= 167/80 = 2.09, 2.09*100 = 209cm ssd

89. For a 4 slice CT scanner with a slice thickness of 1mm a pitch 1.5 and a gantry rotation of 0.5 sec, how long will it take to sca n 100mm? 33.3s; for multi-slice ct scanners: Pitch = table movement / single slice collimation table movement = 1.5 x 1mm per rotation. Two rotations per sec = 3mm/sec 100mm/3mm/s \33.3s

100/ (1.5*4) * 0.5 seconds = 8.33 seconds

^^^^^^ This makes more sense. I don't think my calculation took into account the 4 slices per rotation. Which would yield 4 slices * 2 rotations per sec = 12mm/s 100mm / 12mm/s = 8.33s

90. For regular fractionated IMRT, what is the TD5/5 for the parotid gland? 25Gy, 32Gy, 50Gy, 60Gy? 32GY

91. What is the dose rate constant for a 2mCi Ir-192 source? 1.12 cGy hr-1 U-1 (TG43p215 table VI)

92. A universal wedge (60 degrees) with a 0.5WF. A 30 degree angle is desired. What is the ratio of wedged MUs to open MU? 1 to 1

93. What is the gamma index? The gamma index is a tool for dose distribution comparison. It combines both dose difference (DD) and distance to agreement (DTA) into a single quantity

94. How are inhomogeneity corrections handled in the superposition convolution algorithm? magic i agree ... also would accept "witchcraft"

95. What is the yearly exposure limit for the general public?

96. Which has a larger value for the radial function beyond 1cm I125 or Pd103? I-125

97. For which isotope do Monte Carlo calculations account that photoelectric interaction and Compton scatter cancel out so that only primaries are considered?

I think it is going to be something around the 500keV range and atomic number around 50. CS is my bet. atomic number 55, 660kev

98. Find the MU's to deliver 90cGy (isocentric) with a wedge (WF=0.77) and open field size of 17x17 and blocked field of 11x11. Machine calibrated at SSD, dmax=3.3cm, 1cGy/MU. Current SSD=88cm (so treating 12 cm depth), Sc, Sp, and TMR tables given for all field sizes and all depths.

MU= 90 / [TMR(11x11,12) * (103.3/100)^2 * Sc(17) * Sp(11(88/100)) * 0.77]
Agree, you my hero

Since we are doing TMR- type calc here, shouldn't Sp be defined at depth, just like the TMR? I would use Sp(11) not Sp(11(88/100))
Pretty sure you use TMR 11 since it is isocentric calc. If it were SAD calc, then do TMR of FS at depth.
I have always used Sp (blocked field@surface) Sc(open field@depth) TMR(blocked field, depth)
I agree with Mr. Orange. On pg 68-69 of "Study Guide for Radiation Oncology

Physics Board Exams" It clearly states in the example problems for both SSD and SAD calculations: "Sc applies to the field size defined at the SAD", and "Sp applies to the field size at the SSD"

I've always used Sp(blocked referenced at depth) when using TMR's. Khan does this in his example for Isocentric Technique on pg. 184 (3rd edition). He uses a 6x6 field and does not project it back to the SSD.

From what I understand, it depends on the type of calc you are doing (PDD vs TMR) not the setup. What I mean by this is, if you're using TMR method your TMR and Sp field sizes are evaluated at depth (using the blocked field sizes, of course). If you are using a PDD method (regardless of SAD or SSD setup) your PDD and Sp field sizes are referenced at surface. Sc is always the collimator jaw settings- this is never a question.
I went back and read kahn, it is clearly there. I agree with Sp(11x11), thanks for the pointer

99. Manufacturer calibration given as 6.3*10^5 Gy/hr. Two weeks later a reading of 71 nA is given, the calibration factor is X (Gy/C). How far off is the source from the manufacturer's stated calibration?

71nA=71nC/s = 71x10^-9 C/s = 2.56x10^-4 C/hr; 2.56x10^-4 C/hr * X Gy/C will give the Gy/hr reading necessary to compare to the manufacturers value. Remember, that it is two weeks later.

=====================

Sample "COMPLEX" questions previously posted on ABR website for Part 2:

1. A 4-MV linac beam, 10 cm x 10 cm with a 45° wedge, is used to deliver 200cGy 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 I'm going to say this, however, I'm not sure. I get 376 MU by doing the following. Your told the position in SAD, but I think that is for confusion. Given output for SSD geometry, PDD for 4MV 10cm depth. Use Mayneord F factor to change SSD. I get 200cGy / (output * F* PDD*WF*ISQ(1.23). I alos calculated the TMR from the PDD and got a similar result, which was much faster. .   SET ME STRAIGHT PEOPLE!
Would also pick this answer. I computed TMR of 0.71:
200/{1.04*.7*.71*(101.2/100)^2}= 378 MU

I get 368 MU using a TMR method...the key is that TMR = TAR/BSF...otherwise just straight forward TMR calc using (101.2/100)^2 for an inverse square correction. If you use PDD and Mayneord Factor there are a few issues in my mind, 1 - takes longer, 2 - MF correction is not precisely accurate, 3 - Scp is deinfed at surface for PDD calcs so actually need it for 9x9 field which isnt given...but either way gets a close answer to the options

I also get 368MU working it w/ TMR
> 5) 468

3. A lesion extending to 1-cm depth in tissue is to be treated with a 6-MeV electron beam with bolus. A dose of 1.5 Gy to 80% is prescribed. If the output is 1cGy/MU, the SSD is 104 cm and the cone factor is 0.97, 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 This
>agreed. 6 MeV/3 = 2cm (for 80%iso), so add 1cm bolus,
MU=150/(0.8*0.97*(101.5/104)^2)=203 MU

how do you get 101.5 SSD if bolus is only 1 cm ?
> 4) 1 cm, 270 MU
>
> 5) 2 cm, 302 MU

A single field 6-MV beam is used to deliver 200 cGy @ iso (100 cm SAD), which is at depth of 10cm. Patient thickness is 20 cm. Using the factors given below, calculate dose at 5cm depth

%DD for 100 cm SSD, 5 cm depth: 87%

%DD for 100 cm SSD, 10 cm depth: 68%

TMR 5-cm depth: 0.93

TMR 10cm depth: 0.79

TMR 15cm depth: 0.65

TMR 20cm depth: 0.53

1) 245 cGy

2) 255 cGy

3) 261 cGy

4) 268 cGy

5) 281 cGy

200*TMR(5)/TMR(10)*(100/95)^2 = 260.88 ANSWER: 3

Agree
Agree

In tissue from a 0.46 mCi permanent implant I-125 seed, what is the total dose to a 1cm distance?

1) 55 Gy

2) 10.5 Gy

3) 13.2 Gy

4) 30.5 Gy

5) 50.0 Gy

I'd say ANSWER #3...use the idea of Dose(total) = 1.44*Dose rate(inital)*half life

Exposure rate constant = 1.46 R-cm2/mCi-hr

I used a rough estimate of f-factor = 0.93...i think 0.93 to 0.98 is range for muscle from low to high energy

so get...Total dose = 1.44*1.46*0.46*0.93*59.4*24(conversion from hrs to days) = 12.8 Gy

I get ANSWER #2; I used dose rate constant .9 cGy/ h*U *1.27 U/mCi*.49mCi*59.4d*24h/day*.93*1.44= 10.7Gy

I used 0.93 rad/R, 1.48 R-cm2/mCi-hr and got 13.13 Gy

The answer on the ABR website is 3. link: http://www.theabr.org/ic/ic_rp/ic_rp_sample.html#thera

Thanks for posting this^^^^. I forgot the answers were on website.

An isocentric 10-MV oblique photon beam has depth of 12cm, of which 6cm is muscle tissue and 6cm is lung. Without lung correction, the actual delivered dose at the isocenter compared to the calculated dose at the same point would be ______.

1) 20% higher

2) 10% higher

3) 5% higher

4) 10% lower

5) 20% lower

I would say ANSWER #2...without lung correction, the dose would be higher due to the decreased photon attenuation. Out of the 3 remaining possibilities (5,10,20), Khan has a rule of thumb of 2%/cm for 10MV, thus 12% using that. I also think of it this way, the planned depth is 12, but the effective depth is 8 since lung is about 1/3 the density of tissue (6 + 6*0.333 = 8). So what is the ratio of TMRs for depth 12 and depth 8...roughly 2-2.5%/cm for 6-18 MV...thus 2.5% * 4 cm missing = 10%

agree

PART 2 SIMPLE questions previously posted on ABR website:

High energy photon beams from an accelerator require flattening filters in order to:

1) increase low-energy photons

2) correct for the pulsing of radiation

3) increase fluence along the central axis of the beam

4) increase depth dose

5) make the beam flat across the full field

5

Highest neutron flux in a therapy treatment room is produced by _____.

1) a Cobalt 60 source

2) a 10-MeV electron beam

3) a 10-MV photon beam

4) a 20-MV photon beam

5) a 20-MeV electron beam

4

According to TG-59, an ionization chamber reading is corrected to compensate for the temperature and pressure dependence of the _______.

1) air volume in the ionization chamber

2) mass of air in the ionization chamber

3) mass stopping power ratio for electrons in the ionization chamber

4) mass stopping power ratio for electrons of the phantom material

5) density of air in the monitor chamber

2

The equivalent square of a 10x20 field is:

1) 12x12

2) 13x13

3) 15x15

4) 18x18

5) 20x20

In IMRT treatment planning, critical organs are _______.

1) shielded with superflab

2) delivered the same dose as GTV

3) prescribed 0.5% of PTV

4) delivered organ tolerance

5) delivered skin tolerance dose