

ABR Oral Exam 2005 Therapeutic Radiological Physics Type

I think the test was pretty much what I expected. I was actually surprised at how much info I actually knew when put under the gun. I didn't feel strong in several subjects but you get SO many questions in total that 1 or 2 less than stellar answers won't kill you ... even if you flat out don't know the answers. I think they realize you can't possibly know everything ... the key being how you handle yourself when you don't.

I found all of the examiners to be very nice. Some were more helpful than others but all handled the questioning well. You get the feeling that they actually DO want you to do well. I may have just been lucky with my particular examiners. With each examiner, it seemed that once they found that I was on the right track and showed that I knew what I was talking about ... they just moved on to another question about the same subject. Any question I struggled with (and of course there were some) just seemed to make them probe deeper, some even taking you down to basic physics principles (this happened to me on a question about diodes where I just completely went blank). If you don't know the answer to a question it's best just to say it .. you simply can't BS any of these guys. If you are not familiar with a particular procedure or subject, admit to it, tell them what you do know based on study, and describe how you would go about educating yourself on the particular procedure in question. This would include stating the appropriate Task Group number or AAPM report. I also tried to state the specific reports in my answers throughout the exam.

In general I think it definitely helps to outline the major TG and AAPM reports. Some are absolutely essential to read in full (51, 21, 25, 61, 64, 40, 53, 50, 45, 53, 56 etc.) but some you just can't. I didn't read all of them in detail but for some of the ones I didn't, I at least outlined some key points about the report and a general overview and description. The key also is knowing what YOU actually do at your own center. This may seem obvious but when was the last time you actually read the instructions you give to your prostate patients, especially if you were not there when they were developed? Knowing what YOU do from a dosimetry standpoint is also important. Planning schemes you use, anatomical structure you draw for different sites, dose tolerances for each, etc. Other resources I found particularly helpful include:

- ** McGinley's Shielding book
- ** Karzmark Linac Primer (I also talked with my service guy to fill in any questions I had since this primer, though good, is very basic)
- ** IAEA review of Radiation Oncology Physics (you could get this free on the net for a while, now I believe they sell it on their website ... it really is a great book)
- ** Khan
- ** Ibbott and Hendee
- ** Various Papers including .. Cho (Comparison of TG-51 & TG-21) and Huq (Practical Implementation of TG-51) and Tailor (TG-51: Experience from 150 Institutions, common errors, and helpful hints)
- ** YOUR own actual calibration reports (If you are like me and do them in Excel, just make sure you know the guts of how to actually do it)
- ** YOUR own state (and/or federal) regulations
- ** The physics manual for YOUR particular treatment planning system

** A good imaging book (I used Sprawls)
** A good TD 5/5 table
** The brachytherapy section from Perez (written by Williamson)
** AAPM therapy review course notes (I took this review at the annual meeting and found it extremely helpful).
** The rosemark files (past 10 or so years)
** This email group

Examiner 1 -

(1) Shown picture of linac vault (with maze). Told it was designed for 6MV accelerator. What do you need to consider and what are the potential problems if you want to upgrade it to a High Energy accelerator? Went into maze design, door design, primary shielding, neutron production, different shielding materials, etc.

(2) Shown 3 isodose plans consisting of adjacent x and e- fields ... each plan had a varying gap distance between them. What is it? What are the energies of the beams? Other questions about e- and x-rays that I can't totally remember. Knowing how to estimate PDDs for different energy e-'s and photons helped here.

(3) Shown Figure 1 from TG-51 (just the e- curve). Asked what it was. Asked about finding beam quality of electron field and R50. How do you measure it?

(4) Enhanced Dynamic/Virtual Wedge questions. How do you measure factors for? Do you measure all possible angles? Are they field size dependent? Etc etc.

(5) Shown 2 DRR's which were of the same sight, but with different quality. How are they formed? Why is one better quality than the other? (got into slice thickness of CT's)

Examiner 2 -

(1) Shown classic "hourglass" isodose distribution for opposed field treatment. What is it? What energy are the beams (18MV, Co-60, 4 MV, 6 MV were choices given)? Why do you think that is the energy? Why do you have the hourglass shape? What is the ratio of dose isocenter (tumor) to dose at dmax? How does the dose change as the energies change? Asked me to graph it.

(2) Shown Figure 4 from TG-21 (Pion). Had to tell which curve was for pulsed scanning, pulsed, and continuous radiation. Why are they like that?

(3) Picture of front pointer and pointer affixed to table. What is this for? Several questions about mechanical and radiation isocenter. How do you find it? Spec? For table? For Gantry? For Collimator? What about the congruence of each to the other? Radiation iso of collimator vs. radiation isocenter of gantry? Etc, etc.

(4) Image of a CT/MRI fusion (brain). What does each image tell us? Why fuse? Disease to treat for the particular fusion he showed me? Why

can't you just use the MRI for planning?

(5) Shown I-125 implant. QA procedures? Survey meters (type) required? Instructions to patient? Can the patient hold a baby? Why or why not?

Examiner 3 -

(1) Shown CT, MRI and sagittal anatomic cutaway of H&N area (nasopharynx level). Point out some specific structures .. max sinus, nasopharynx region, etc. How to treat? Went into several questions about IMRT.

(2) Diode diagram and question I've mentally blocked out of my mind.

(3) Shown e- PDD curve (12 MeV). Questions about different details including build up, dmax, surface dose, range, etc.

(4) Question regarding linac acceptance testing vs. commissioning. Why? What do you do? Order you go in? ... safety, mechanical, dosimetry

(5) Question about dose equivalence and effective dose. Tissue weighting factors for different organs like skin, breast, gonads.

Examiner 4 -

(1) Shown picture of T&O isodose plan planned for an HDR unit. Asked what type of plan it was. Delivery type (HDR or LDR). How can you tell? What are the critical organs? Prescription point? Film orientation (AP, Lat)?

(2) Shown picture of pelvis DRR (prostate) and it's corresponding portal image. Asked what each was. The prostate had fiducial markers implanted in it. Asked why? What does it tell you? Got into IGRT and questions about localization including process and procedures.

(3) Question about film badges and radiation safety program. Who do you badge? How do you know if the readings are correct? How would you choose a vendor? Pregnant workers? Limits to fetus?

(4) Shown picture of klystron. Explain what it is, what the function is, and each part and process.

(5) Asked about differences in QA program for Ir-192 vs. Cs-137 vs. I-125. Half life of each. Questions about interstitial vs. intercatratry brachytherapy.

Examiner 5 -

(1) Shown absorbed dose and kerma curve. Asked all kinds of details including equations for each. Buildup region, dmax, why is kerma higher at surface, etc etc.

(2) Shown picture of accelerator (I believe it was the cutaway picture from the Varian sales brochure). Asked about each part from e- gun to accessory mount. DETAILED description and function of each (e- gun, accelerator structure, bending magnet, target, flattening filter,

primary and secondary collimators, etc).

(3) Shown picture of a orthovoltage treatment room. Questions regarding shielding including W, U, and T.

(4) Shown IMRT plan of base of tongue. Asked about cord and parotid tolerances. Margins, CTV, GTV, PTV type questions. Safety margins around cord. General planning criteria and process.

(5) Shown DRR (AP and Lat), Sagittal plane CT, and transverse plane CT of prostate plan. Define structures and dose limits.

Here is what I could remember from my exam:

- 1 Questions about DVH, what it depicts, ideal shapes for tumor and critical structures. Asked to comment on if it was a good method to evaluate plans.
- 2 Shown diagram of isodoses for 2 plans on the head. Asked to identify all contoured structures (GTV, PTV, and other critical structures). Asked to comment on which plan was better and tolerances for critical structures.
- 3 Shown two pictures of isodoses from two different from a Prostate Seed implant pre plans (ultra sound) and one picture of a CT isodose postplan. Asked to identify all the lines/ contours/ structures shown. Asked to comment on which of the preplans were better
- 4 Asked to identify parts of the accelerator (from Gun to Collimators) asked to discuss different materials and arrangements for each.
- 5 Dose monitor chambers in treatment head, - what was it for, how would you check its consistence, what factors affects its operation. Physical arrangement in the beam.
- 6 What is acceptance testing? What 5 things would you consider important to check during acceptance testing?
- 7 HDR: QA Procedures.
- 8 LDR: How you determine time limits for visitors and nursing staff. What are dose limits for public and workers? Would you consider a nurse a radiation worker in this case and why?
- 9 Shown diagram of a diagnostic X-ray tube, asked to identify it and its components. What are examples of target materials, what is the process of x-ray productions, why is the target angled? What is the wall material of the tube and why?
- 10 Shown pictures of a MR and CT image, asked to identify them. What are advantages and disadvantages of each?

- 11 Shown fusion images. Lead to discussion on benefits, principles of image registration and associated problems.
- 12 Shown PDD curves with depth correction for chamber radius. Lead to discussion of TG-51 including measurement of $%dd(10)$ – why, how is it done, effects of Pb filter. What are sources of electron contamination?
- 13 Define “workload” how is it determined. What is the range of values it. By how much would it change for a facility designed for IMRT?
- 14 Discuss consideration in designing a vault. What factors affect design? What is “skyshine” What considerations would be taken in building renovations (room additions) around a vault?
- 15 Shown a PDD curve, asked to identify it (electron). Discuss different parts of curve. What would happen to curve if the beam was incident at 45 and 60 degrees to phantom (with measurements still made perpendicular to phantom surface). When would such considerations be relevant in the clinic?
- 16 Shown a PDD curve for Photons (Note: curve started at origin). Discuss Buildup region and its occurrence. Discuss KERMA and how it varies from Dose. Comment on Surface dose being zero in the shown curve, what is a typical value in reality.

1st examiner:

1) How do you verify that the solid water phantom is water equivalent? Discussion and more questions about CT number, ion chamber measurement, density, electron density, atomic number.

2) StereoTactic Radiosurgery isodoses, axial, coronal, sagittal pictures. Where are the arcs, comparison of micro MLC and cones, description of procedures, comparisons, upper and lower limit on the cone sizes, accuracy issues

3) 2 Photon PDDs in same graph one is shifted for effective point of measurement. Why is it shifted? Explain underlying phenomena. Can you just start with shifted ion chamber and make no corrections?

4) Rooms with mR/hr readings. LDR room/instructions, nurse instructions.. Badging, ALARA, limits at different rooms, basic assumptions, etc..

5) H&N anatomy 1 sagittal illustration, 2 CT axial cuts; retropharyngeal space, maxillary sinuses, turbinates, nasopharynx, etc.. Extra questions like what is that structure? – brainstem, Where is maxillary sinuses with respect to eyes?

2nd examiner:

1) T1 T2 MR images, which one is which? What type of MR images used in

RT? How many different studies can you fuse for one patient. Asked why you tell this one is T1.

2) Bunker minimum dimensions, where would you put 18x? Where to put HVAC? why is there neutrons after 10MeV? Why is there polyethylene at door?

3) Bending magnet.. What are the functions of BM? Bending magnet current AC or DC? Wide range of basic questions about function of BM and BM current. 90 degree vs 270 degree

4) Cylindrical / pp chamber point of measurement questions, fluence entering the chamber at .. Is it the photon or electron fluence that counts?

5) Isodose distribution/ AP and wedged lats. What would happen if wedges are not there, what would happen if wedges are flipped? What would you do to reduce dose to eye? What is CAX dose of parallel opposed, what happens if wedged?

3rd examineer:

1) Checker board images MR-CT . Fusion questions. MR CT comparison.

2) Humidity effect, pressure effect. Airport pressure reading issue, why don't we have sealed chambers? What is the name of $PV=nRT$ equation?

3) 2 kernels shown with incident photon beam. One kernel is wide but does not penetrate as deep as the other. Based on this which phantom has higher atomic number and which one has higher density?

4) Daily morning check. Daily variation of output. Wide range of questions about the procedure, what to do if more than.. What is the TG-40 recommendations? Why are the 18x and 6x curves identical?

5) LDR room can you use for HDR? Can you use the Sim room for HDR? Limits for radiation exposure

4th examiner

1) 3 figures, with 2 electron fields side by side each. Each picture has different gap btw fields. The 2 electron fields are at different energies. Which one would you pick? Why did they use 2 different energies? Would you rotate the beam a little to make a better match?

2) GTV CTV PTV. Which one is which? Definitions.

3) How is ALARA implemented for Brachytherapy? What are the concerns for permanent implants and low dose rate patients?

4) TLD reader scheme - explain all parts. How do you perform TLD measurements in your department? Calibration of TLDs. Dose range.. Would you calibrate your TLD at 100cGy if the measurement will be around 300? (supralinearity)

5) Leakage of photon beams how to measure, how do you compare scatter? how about neutrons? Linear no threshold method.

5th examiner:

1)How to calibrate HDR, what do you do at morning for positioning?
Kinked tube scenario; what happens during delivery if kinked, what would you do?

2)Shown 2 HDR Tandem only images and asked what would be different if T&O. Identify structures on image.. Multiple artificial structures on the image that shows components around the tandem. Also rectum bladder..

3)Transport index and if some package is delivered to you and sits next to a secretary at child bearing age. Picture of 3 labels White I, Yellow II, Yellow III.

4)Electron gun - triode diode design and asked which one would be better for single and dual energy accelerators? Also identify all the parts of the gun (heating coils, grid, anode, cathode, etc.) that are marked, what is each one's purpose?

5)2 film H&D curves. Which one faster? Which one you'd use for portal verification, localization? Which one has higher contrast, what is speed of a film?

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1. Pencil beam algorithm
 2. Farmer chamber (picture from Kahn 2nd Ed. p107). What are the parts, what are they made of? Size of the chamber?
 3. CT-Pet Fusion image. What is it? What is it used for? Why is it useful? What are the limitations?
 4. LDR patient. Where do you put the patient? Any special precautions for adjacent rooms? Dose limits?
 5. Stochastic and non-stochastic definitions. Went into radiation safety, and whole body dose. Example, if person gets 10 Gy whole body dose, what effects? Will this cause death? Why/why not?
 6. Given a pelvis anatomy lateral view, and a 3 CTs, identify prostate, bladder, rectum, etc.
 7. Electron depth dose (Kahn 2nd. ed. p360, Figure 14.7a). What is it? Film dosimetry. Film vs. chamber. H&D curve. What type of film to you use? What affects the film image?
 8. CT use in radiation therapy.
 9. New treatment planning computer acceptance procedures, what protocols are used? Dicom RT transfer verification?
 10. Given a cross-section of a betatron (yes, I said betatron!). What dose it produce? How does it work? Went into linac questions, how is a beam produced? Standing vs. traveling waves? Klystron vs. Magnetron?
 11. HDR source daily QA
 12. Prostate implant patient. What do you tell the patient upon their release. Patient has a pregnant wife, what restrictions?
 13. TV-Camera EPID schematic, explain the parts? How dose it produce an image?
 14. Tandem and ovoid. Identify the critical structures. Where do you prescribe? Is this a good implant?
 15. Identify GTV, PTV, etc for a prostate IMRT.
 16. Conventional CT vs. RTP CT. Can you use a scout film for planning? QA of CT.

17. Vault diagram. Permissible limits at console and patient exam room adjacent to vault. Door question, what's it made of and why? Area survey, where do you survey? What do you survey with? Why don't you use an ion chamber that you calibrate your beam with to do an area survey?

18. 2 IMRT plans. Difference between the plans? What makes them different? How do you make one better?

19. Flatness and symmetry definition. Acceptance values. How often do you check flatness and symmetry? Where are flatness and symmetry measured at? How does flatness and symmetry differ with depth? Why does flatness and symmetry differ with depth?

20. Picture of a linac with light going through an MLC shape. What makes the shape? What are they made of? What's the transmission of a leaf? What's the transmission between leaves? Why are the leaves rounded?

21. A 6 MV vault going to be replaced with a 20 MV machine, what considerations need to be met?

22. TG-51 term k'_{R50} , define. Shown PP graph from TG-51, why are 3 chambers the same?

23. Breast patient anatomy, identify axillary nodes, axilla nodes, and IMN. How would you set this patient up to treat all the areas identified?

- 1) Diagram of ion pump. Asked to identify it, how it works, what's its use.
- 2) Asked about K_q (what it is, how is it determined, what are the K_q values for Co-60, 6 MV, 18 MV)
- 3) IMRT QA techniques
- 4) Identify components on an accelerator and state what components are also on a conventional simulator (collimator, target, filter, beam magnet, accessory mount)
- 5) Identify components on an accelerator and how to QA them (collimators, filter, target, beam magnet)
- 6) Fusion (shown a picture of CT/MRI fused axial. Identify which is CT which is MRI. Asked what types of fusion techniques there are. Asked what is the algorithm for point matching.
- 7) Asked about HDR source calibration (methods that can be used).
- 8) Shown a radiograph and DRR of same anatomy. Asked to explain what they are, what a DRR is, how it is made, limits of resolution, and which of the two images are better to use and why.
- 9) Given a diagram of a thimble chamber with 3 components of it being pointed to. Asked to state what the components are and the material they are made out of. Then

shown on a piece of paper an electrometer and the same chamber. Asked to draw the triaxial cable connections through the resistors, capacitor, etc. to the electrometer.

<p>You were hired as a consultant. You found that your machine is off by 9%. What do you do? Do you change the output or not?</p>
<p>MU Formula Calculation (Khan's Notation) for SAD and SSD setup) <i>(See pg 183-184 Khan new edition. Note formula without K)</i> SAD Setup SSD Setup</p>
<p>TLD Diagram from Khan's Book (see Khan new edition Fig.8.11) Explain the diagram Which TLDs are most common?</p>
<p>Photo of a Farmer and Parallel plate chamber side by side with build cap showing Explain where they work best and why?</p>
<p>Drawing of a Cylindrical chamber and a Parallel plate chamber at depth. Discuss cross calibration Which energy do you use for calibration?</p>
<p>LINAC Functional Block Diagram (Karzmark and Morton's Book pg. 35) How do you define energy? How do you change the dose rate on the LINAC</p>
<p>AP C-Arm Fluoroscopic View from a Prostate Seed Implant Discuss about it.</p>
<p>How do you calibrate ^{125}I, ^{103}Pd, and ^{137}Cs?</p>
<p>Overview Plant of a Department (Simulator room, Corridors, LINAC Room etc...) Discuss regulations Discuss shielding concerns. What's happen if outside this wall is a playground? Discuss Maximum Permitted dose</p>
<p>Same above drawing Write down the expression for B_x concerning the primary beam Discuss Workload (W), Use factor (U), Occupancy factor (T) Discuss shielding concerns for IMRT Discussed 0.1% leakage at machine isocenter</p>
<p>Electron Depth dose curve Discuss graph ("Rules of thumb") Photon contamination</p>
<p>Discuss Geometric and Dosimetric Penumbra How penumbra affects dose to the lung</p>
<p>CT Scout picture What is this? Is it a DRR? Discuss</p>
<p>Axial Pelvis Image fusion Discuss</p>
<p>Classic Surviving Curve from Eric Hall's book (Curve A – no shoulder, Curve B –with shoulder, and n) What is this graphic? Explain.</p>
<p>Photo of the new V2 Hdr Unit</p>

What your concerns to implement it in your facility? All concerns (Shielding, personnel, license)
Discuss HDR Calibration
Discuss REPORTABLE events in radiation therapy
Discuss Stereotatic LINAC therapy What it is called stereotatic How you check calibration
Anatomic male pelvis and a CT slice side-by-side Point out organs on both.
Discuss Grid for radiological image Why do you need one? Where do you place it? Brief explain about EPID
Photo of a Water Phantom Scanner What is this? What kind of care do you need on the setup? Discuss Flatness and Symmetry? (Horn at surface, Flat at 10cm etc...) Are you telling me that we have a energy spectrum in the beam?
Head and Neck treatment image Discuss wedge pair (hingle angle etc...) How much a wedge effects the MU hand calculation Show MU calc for a wedge field
Discuss Equivalent dose