T1. Tissue-Maximum Ratio (TMR) depends on:
- A. Energy, SAD, depth, and field size.
- B. Energy, SAD, and field size.
- C. SAD, depth, and field size.
- D. Energy, depth, and field size.
- E. SSD only.

T2. The definition of Fractional Depth Dose (PDD/100) is
- A. (dose rate at d_{max}) / (dose rate at depth) measured at the same SSD.
- B. (dose rate at depth) / (dose rate at d_{max}) measured at the same SSD.
- C. (dose rate for the field size at depth) / (dose rate for a 10×10 cm field at depth).
- D. (dose rate at depth, measured at SSD) / (dose rate at d_{max}, measured at SAD).

T3-T6. Match the following quantities with the units in which they are measured.
- A. Sievert
- B. Coulombs/kg
- C. Gray
- D. Bequerel
- E. cGy/hr

T3. Activity D
T4. Absorbed dose C
T5. Exposure B
T6. Dose equivalent A

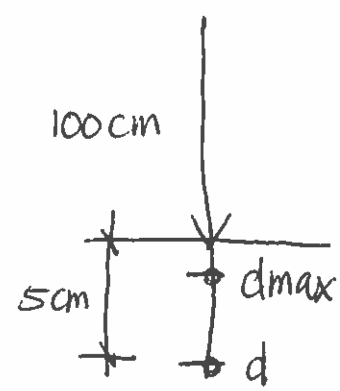
T7. A spine field delivers 250 cGy at 5 cm depth with a collimator setting of 8×14 cm at 100 cm SSD. The maximum tissue dose is _____ cGy.

Data:

Depth (cm)	PDD	TMR
1.6	100.0	1.0
5.0	87.1	0.928

Output = 1.000 cGy/MU at 100 cm SSD, d_{max}
1.032 cGy/MU at 100 cm SAD, d_{max}

- A. 303
- B. 298
- C. 287
- D. 269
- E. 255



Dose @ d=5cm = 250 cGy

PDD @ d=5cm = 87.1%

PDD = (1/Dose @ dmax) · Dose @ d=5cm

Dose @ dmax = Dose @ d=5cm / PDD = 250/(0.871) = 287 cGy

T8. A 6 MV anterior R supraclavicular field is set up at 100 cm SSD to the center. The prescribed dose is 200 cGy to the s'clav point (102 cm SSD), at depth 3 cm. Ignoring off-axis factors the MU setting is:

Data:

Depth (cm)	PDD	TMR
1.6	100.0	1.0
3.0	95.6	0.982
5.0	87.3	0.930

Output = 1.052 cGy/MU at 100 cm SAD, d_{max}
1.019 cGy/MU at 100 cm SSD, d_{max}

A. 213
B. 209
C. 205
D. 201
E. 194

* Assuming PDD changes from 100→102 are negligible *

MU = (dose/fx)/doserate @ 102 SSD, d=3

= 200/(SSD output × ISF × PDD)

$= 200/(1.019 \times (101.6/103.6)^2 \times 0.956) = 213$

T9. A pelvis is treated with parallel opposed isocentric fields. The AP thickness is 25 cm. If 90 cGy per field is delivered at the isocenter, at mid plane, the MU setting for each field is _____ MU.

Data:

Depth (cm)	PDD	TMR
2 (d_{max})	100.0	1.0
12	66.5	0.795
13	63.5	0.759
23	38.8	0.564

> 0.777 @ d = 12.5 cm

Output = 1.037 cGy/MU at 100 cm SSD, d_{max}
1.078 cGy/MU at 100 cm SAD, d_{max}

A. 134
B. 214
C. 268
D. 112
E. 107

MU = (dose/fx)/(SAD output × TMR)

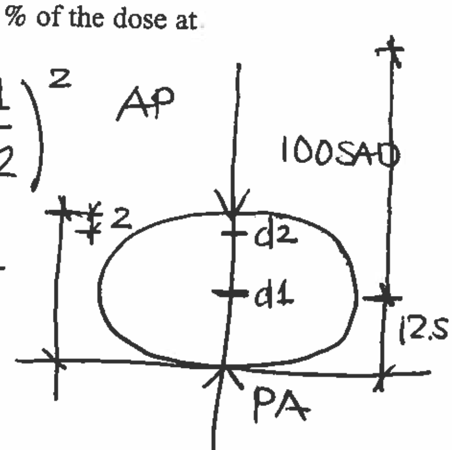
= 90/(1.078 × TMR @ 12.5 cm)

= 90/(1.078 × 0.777) = 107 MU

T10. The maximum tissue dose per fraction in question T9 above is _____ % of the dose at midplane.

A. 122
B. 110
C. 103
D. 100
E. 90

$$\frac{\text{Dose@d2}}{\text{Dose@d1}} = \frac{\text{TMR@d2}}{\text{TMR@d1}} \times \left(\frac{\text{dist1}}{\text{dist2}}\right)^2$$



Entrance Dose

$= 90 \times (1.0/0.777)(100/89.5)^2 = 144.6$

Exit Dose

$= 90 \times (0.564/0.777)(100/110.5)^2 = 53.5$

total dose @ d2 (dmax) = (Entr + Exit) = 198 cGy = 110% of midline dose

T11. A computer-generated treatment plan is checked with hand calculations. The plan is for an isocentric wedged pair. The minimum data necessary to check the MU by hand is:
1. TMR tables.
2. PDD tables.
3. Wedge factors.
4. Output at d_{max}, SAD.
5. Dose per beam at isocenter.

A. All of the above
B. 2,3,4,5
C. 2,3,4
D. 1,4,5
E. 1,3,4,5

T12. A 4-field pelvic plan delivers 200 cGy/fraction with 10 MV photons, each delivering 50 cGy at the isocenter. The depths to isocenter are 11 cm AP and PA, and 18 cm R Lateral and L Lateral. The MU settings are:

	AP	PA	RLAT	LLAT
A.	60	65	73	78
B.	62	62	62	62
C.	25	25	32	32
D.	73	73	65	65
E.	65	65	73	73

MU= 50/(output x TMR)

T13. A mantle field has a central axis separation of 18 cm. The separation at the neck is 10 cm. If the dose on the axis at midplane is 3600 cGy, the dose to the neck at midplane, ignoring off-axis factors, is _____ cGy.

Data:	Depth (cm)	TMR
	1.6	1.0
	5.0	0.937
	9.0	0.844
	16.4	0.664

A. 3605
B. 3752
C. 3833
D. 3997
E. 4065

@ the same distance (SSD+depth)

$$\frac{\text{Dose @d=9}}{\text{Dose @d=5}} = \frac{\text{TMR@d=9}}{\text{TMR@d=5}}$$

$$\text{Neck dose} = \text{Dose@d=5} = \text{Dose@d=9} \times \frac{\text{TMR@5}}{\text{TMR@9}} = 39$$

T14. For equally weighted parallel opposed 6 MV photon fields treating the mediastinum, AP thickness 22 cm, the maximum tissue dose occurs at:
A. The skin surface.
B. The isocenter.
C. A depth of 0.5 cm.
D. A depth of 1.5 cm.
E. A depth of 5.0.

T15. If the patient in question T14 above were treated with 18 MV photons, all of the following would be smaller, **except:**

A. MU.
~~B.~~ Skin dose.
C. Depth of maximum tissue dose.
D. Percent variation in dose across the treated volume.

T16. A patient's spinal axis is treated at an extended SSD of 130 cm to avoid splitting the field into two. By *approximately* what factor will the MU be increased over the same field treated at 100 cm SSD?

A. 1.3
~~B. 1.5~~
C. 1.7
D. 1.9
E. 2.1

ignore PDD change due to SSD change

$$\frac{MU2}{MU1} \doteq 1\Big/\left(\frac{Dis\,1}{Dis\,2}\right)^2 = \left(\frac{130+d}{100+d}\right)^2 = \left(130/100\right)^2 = 1.69$$

T17. The exit dose in question T16 above, compared to that for treatment at 100 cm SSD, is:

A. Larger.
B. Smaller.
C. The same.

T18. A field measuring 5 × 25 cm at SSD has an "equivalent square" field of side _____ cm.

A. 5.0
~~B. 6.2~~
C. 8.3
~~D. 11.2~~
E. 25.0

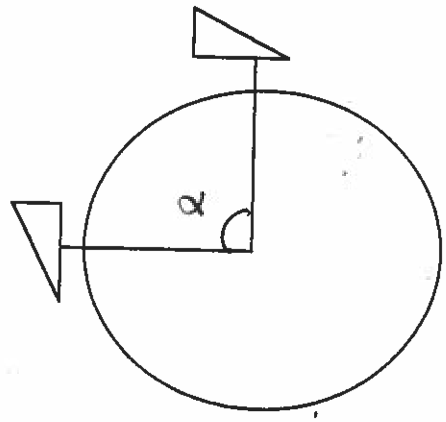
$$C = \frac{2ab}{a+b} = \frac{2\times5\times25}{5+25} = 8.3$$

T19. Comparing a 10 × 10 cm field and a 5 × 20 cm field, which has the greatest TMR?

A. 10 × 10
~~B.~~ 5 × 20
C. They are exactly equal.

$$C = \frac{2\times5\times20}{5+20} = 8$$

T20.



The wedge angle that would give the most homogeneous distribution in the above "wedged pair" is _____ degrees.

A. 10
B. 20
C. ~~30~~
D. 45
E. 60

Wedge angle $= (180 - \text{Hinge angle})/2$
$= (180 - \alpha)/2$
$= (180 - 90)/2 = 45$

T21. An effective wedge angle of 30 degrees could be achieved by all of the following **except:**

A. Combining open and 60 degree wedged fields for equal doses at the isocenter.
B. Combining open and 60 degree wedged fields for equal MUs.
C. A Universal wedge, combining wedged and open fields.
D. A dynamic wedge.
E. A custom compensator.

T22. The wedge transmission factor is 0.59. The MU setting for an open beam is 150 MU. The MU to ~~deliver the~~ same dose on the axis with the wedge in place is _____ MU.

A. 254
B. 203
C. 189
D. 150
E. 89

MU = Open beam MU/WF = 150/(0.59)
= 254

T23. Advantages of dynamic wedges over physical wedges include all of the following **except:**

A. Field height is usually not limited.
B. Less possibility of injury to patient or staff by handling heavy physical wedge.
C. No field size dependence for wedge transmission factor.
D. No change in depth dose data due to beam hardening, as with physical wedge.
E. For breast tangents, less dose to contralateral breast.