T38. The following are absolute dosimeters EXCEPT:

A. free-air ionization chamber
B. calorimeter
C. diode
D. ferrous sulfate (Fricke) dosimeter

T39. According to AAPM Task Group 176, which of the following is NOT recommended for MV photon surface dose measurements?

A. extrapolation chamber
B. plane-parallel chamber
C. cylindrical chamber
D. thermoluminescent diodes
E. optically stimulated luminescent diodes

T40. For PDD measurements with a cylindrical chamber, the effective point of measurement relative to the center of the chamber is:

A. at the center
B. shifted upstream
C. shifted downstream
D. offset laterally
E. variably shifted depending on beam energy

T41. A patient is prescribed to a depth of 5 cm using a single 6 MV x-ray beam. If 15 MV is prescribed instead:

A. max body dose will increase
B. entrance dose will increase
C. dose to the prescription point will increase
D. exit dose will increase
E. all of the above

T42. A 10 x 10 cm^2 6 MV photon field, calibrated to deliver 1 cGy/MU at $d_{max,}$ 100 cm SAD, is incident on a flat part of a patient's chest covered by 1 cm bolus. The isocenter is on the patient's skin under the bolus. If 200 MU are delivered, what is the approximate dose to the isocenter?

A. 50 cGy
B. 100 cGy
C. 150 cGy
D. 200 cGy
E. 250 cGy

T43. Traversing an immobilization device with a treatment field will result in _____ attenuation and _____ skin dose compared to not having the device in the field.

A. increased; increased
B. increased; no change in
C. no change in; increased
D. decreased; decreased
E. decreased; no change in

T44. What method(s) can be used to stop high-Z contrast from influencing a planned pelvic dose distribution that will be delivered in the absence of contrast?

A. Modify the HU value of the contrast to represent water in the treatment planning system.
B. Turn heterogeneity corrections off for the dose calculation.
C. Acquire a planning scan without contrast and register to a subsequent scan immediately acquired in the same position with contrast.
D. All of the above are true.
E. None of the above are true.

T45. A patient is treated on a linac (100 cm SAD) with a field adjacent to a previously treated field. The previous field has a collimator setting of 22 x 22 cm^2, 110 cm SSD. The current field has a collimator setting of 10 x 10 cm^2, 100 cm SSD. What gap is required at the skin for these fields to intersect at 5 cm depth?

A. 0.68
B. 0.70
C. 0.75
D. 0.80
E. 1.02

Use the table below for questions T46–T48.

Data Tables for 6 MV Photons (PPD are for 100 cm SSD)

	Depth (cm)	Field Size (cm^2) 5 x 5	10 x 10	15 x 15	20 x 20	25 x 25
PDD	5	85.6	87.1	87.6	87.9	88.2
	8	72.0	75.0	76.3	77.3	77.9
	10	64.2	67.6	69.2	70.3	71.1
	15	47.7	51.6	53.7	55.4	56.4
	20	36.7	39.2	41.5	43.4	44.5
TMR	5	0.912	0.928	0.934	0.937	0.941
	8	0.809	0.842	0.857	0.869	0.877
	10	0.745	0.784	0.804	0.818	0.828
	15	0.602	0.647	0.675	0.697	0.713
	20	0.487	0.530	0.560	0.586	0.605
S_c		0.970	1.000	1.015	1.024	1.027
S_p		0.975	1.000	1.017	1.029	1.031

Output (cGy/MU) = 1.0 at d_{max} (1.5 cm), 100 cm SAD, Field Size: 10 x10 cm^2

Output (cGy/MU) = 0.971 at d_{max} (1.5 cm), 100 cm SSD, Field Size: 10 x10 cm^2

T46. A patient is treated with isocentric AP/PA fields, 12 x 20 cm^2, 6 MV x-rays. The prescription is 150 cGy/field to the midplane depth of 10 cm. The treatment field is shaped to an equivalent field of 10 x 10 cm^2 with MLC. The MU setting per field is _____.

A. 183 MU
B. 188 MU
C. 194 MU
D. 222 MU
E. 233 MU

T47. A patient is treated to the thoracic spine with a single posterior field, 100 cm SSD setup, 8 x 20 cm, 6 MV x-rays. The prescription is 300 cGy/field to a depth of 5 cm. There is no blocking. The MU setting per field is _____.

A. 319 MU
B. 329 MU
C. 341 MU
D. 350 MU
E. 363 MU

T39. C Due to the fact that cylinders are not flat like the surface of a patient or phantom, these chambers would need large correction factors in order to accurately measure dose. The extrapolation chamber is the gold standard, but plane-parallel chambers are viable alternatives. TLDs and OSLDs, as long as they are sufficiently small, are often used for *in vivo* surface dose measurements.

T40. B According to AAPM Task Group 51, the effective point of measurement is shifted upstream by 0.6 multiplied by the radius of the cavity, since the forward peaked primary beam enters the chamber at various distances upstream.

T41. D The higher-energy photon beam will have a lower entrance dose and a decreased max dose. However, the dose beyond the prescription point, including exit dose, will increase.

T42. D The d_{max} is approximately 1.5 cm for 6 MV x-rays. However, 1 cm of bolus will remove much of the skin sparing, so if 200 MU are given, the skin will receive less than 200 cGy, but still much closer to 200 cGy than 150 cGy.

T43. A According to AAPM Task Group 176, immobilization devices generally add to the attenuation of a beam traversing them and increase the skin dose in the entrance area of the beam.

T44. D All of these methods would allow the bowel to be delineated with the help of contrast, while not allowing the presence of the contrast to affect the dose distribution. If turning heterogeneity off for the dose calculation, care must be taken to ensure that the beams do not traverse large air pockets or areas of dense bone.

T45. D Gap = (d/2) × (Coll1 + Coll2) / SAD = 0.80 cm.

T46. B FS_{eq} of 12 x 20 = 15, S_c = 1.015, FS_{eq} 10 x 10 S_p = 1.0,
TMR(d=10, 10.0) = 0.784
MU =150 / (1.0 × 1.015 × 1.0 × 0.784) = 188

T47. D FS_{eq} of 8 x 20 = 11.4 Sc = 1.004, Sp = 1.005, PDD(5,11.4) = 0.873
Output = 0.971 cGy/MU MU = 300 / (0.971 × 1.004 × 1.005 × 0.873) = 350

T48. D Maximum tissue dose will occur at d_{max} = 300 cGy / 0.873 = 344 cGy.

T49. C The dose to the fetus depends on the distance from the field edge and field size. For distances 10 to 20 cm from the field edge, the dose at 10 cm depth is between about 2% and 0.3% of the dose on the beam axis. (Ref: AAPM Report No. 50, "Fetal Dose from Radiotherapy with Photon Beams," AAPM Radiation Therapy Committee Task Group 36, Reprinted from *Med. Phys.* 22(1):63–82, 1995.) The dose is made up of patient scatter, head leakage, and radiation scattered from the collimators and MLC.