You may use following physical constant if needed.

Velocity of light = $3.0 \times 10^8\ m\ s^{-1}$

Plank Constant = $6.6 \times 10^{-34}\ J\ s$

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1. A body has a weight *W*, on the Earth's surface. If the body taken to a planet which has a half the radius of the Earth but twice its average density, the weight of the body will be,

   (1) W (2) $2W$ (3) $4W$ (4) $8W$ (5) $16W$

2. The current sensitivity of a moving coil galvanometer can be increased by,

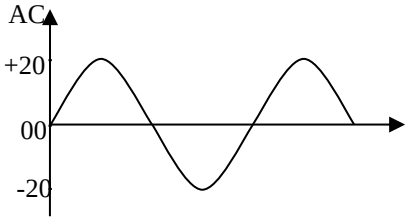
   (A) increasing the number of turns on the coil
   (B) reducing the torsional constant of the spiral spring.
   (C) reducing the area of the coil.

   Of the above statements

   (1) all A, B, C are correct (2) only A is correct (3) only A and B are correct
   (4) only C is correct (5) only B and C are correct

3. Alternating current shown in the graph is passed through a 50 Ω resistor. Power dissipated from the resistor is,

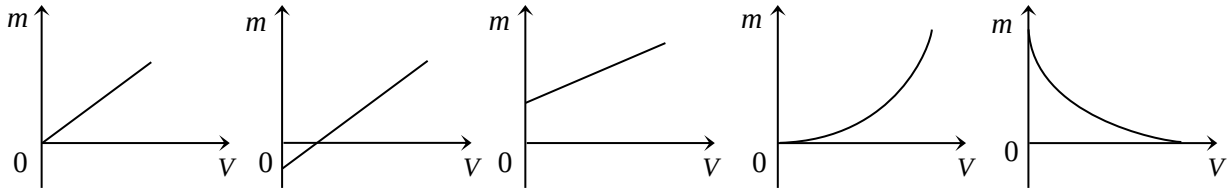
   (1) 2 kW (2) 10 kW (3) 20 kW
   (4) 40 kW (5) 50 kW



4. Beat frequency heard when a tuning fork is sounded with one end-closed tube at 51 °C is 4 Hz. Same beat frequency is heard when both are sounded together at 127 °C. Frequency of the tuning fork is,

   (1) 56 Hz (2) 76 Hz (3) 80 Hz (4) 100 Hz (5) 112 Hz

5. Variation of linear magnification *m* of real images formed by a convex lens with the image distance *V* is given by the graph,



   (1) (2) (3) (4) (5)

6. A liquid of density ρ flowing along a tube of cross-sectional area *A* with speed 3*V* strikes a wall perpendicularly and destroys its speed fully. The force excreted on the wall is,

   (1) $9A\rho\ V^2$ (2) $18A\rho\ V^2$ (3) $3A^2\rho^2\ V^2$ (4) $9A^2\rho^2\ V^2$ (5) $18A^2\rho^2\ V^2$

7. Consider the following statements regarding a transformer.

   (A) Of a step-up transformer, current in the secondary coil is less than that of primary coil.
   (B) Of a step-down transformer, the secondary coil is made from a thick wire.
   (C) A solid soft iron core is used to wind the coil in order to strengthen the eddy current.

   Of the above statements

   (1) A is true (2) B is true (3) A and B are true (4) A and C are true (5) A, B and C all are true

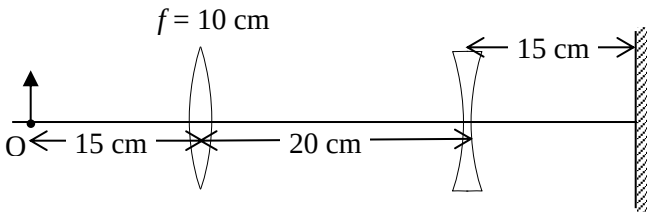
8. A flywheel of moment of inertia 0.4 kg m^2 is run by a motor of power 100 W. The flywheel rotates with uniform speed of 10 rad s^{-1}. When the motor is switched off, its deceleration is,

   (1) 1 rad s^{-2} (2) 20 rad s^{-2} (3) 25 rad s^{-2} (4) 200 rad s^{-2} (5) 400 rad s^{-2}

9. Consider the following statements regarding the speed of sound in a gas.
   (A) Directly proportional to absolute temperature of gas.
   (B) Inversely proportional to the square root of molecular mass of gas.
   (C) Directly proportional to the square root of the pressure of gas.
   Which of the above statements is/are true,
   (1) A (2) B (3) C (4) A and B (5) B and C

10. A small object is kept at limiting equilibrium on the internal surface of a hollow vertical cylinder rotating about its axis. Internal radius of the cylinder is r and coefficient of friction of the surface is μ. The frequency of rotation is,
   (1) $\sqrt{\frac{g}{\mu r}}$ (2) $2\pi\sqrt{\frac{g}{\mu r}}$ (3) $\frac{1}{2\pi}\sqrt{\frac{g}{\mu r}}$ (4) $2\pi\sqrt{\frac{\mu r}{g}}$ (5) $\sqrt{\frac{\mu r}{g}}$

11. Convex lens of focal length 10 cm, concave lens and a mirror are aligned to have same principal axis as shown in the diagram. The object O placed on the principal axis coincides with its image formed by the refraction and reflection from the lenses and the plane mirror respectively. The numerical value of the power of the concave lens is



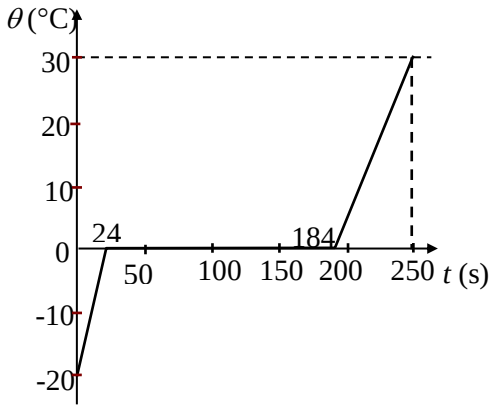
   (1) 0.1 D (2) 1 D (3) 2 D (4) 5 D (5) 10 D

12. There is a small hole of radius 1 mm on the base of a vessel filled with water. What is the maximum height the beaker can be filled with water without leak from the hole? Surface tension of water is 7.0×10^{-2} N m^{-1}
   (1) 1.4 cm (2) 2.8 cm (3) 7.0 cm (4) 14 cm (5) 28 cm

13. The breaking strain of an aluminum rod of young's modules 7.0×10^{10} N m^{-2} is 0.2 %. What is the minimum cross-sectional area for the rod to withstand force 10^4 N?
   (1) 1.1×10^{-3} m^2 (2) 1.4×10^{-4} m^2 (3) 1.0×10^{-4} m^2 (4) 7.1×10^{-5} m^2 (5) 1×10^{-5} m^2

14. Resistance of a galvanometer coil is 100 Ω. It is modified by connecting a resistance 4900 Ω in series to make a voltmeter to read from 0 to 5 V. What additional resistance should be connected series to double the range?
   (1) 3000 Ω (2) 3500 Ω (3) 4000 Ω (4) 4500 Ω (5) 5000 Ω

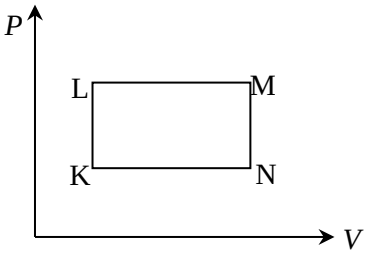
15. 200 g of ice is heated in an insulated container at the rate of 4200 J s^{-1}. The temperature variation of the system is shown in the diagram. What is the specific latent heat of ice (in J kg^{-1})?



   (1) 1.26×10^6 (2) 2.46×10^6 (3) 3.36×10^6
   (4) 4.32×10^6 (5) 4.76×10^6

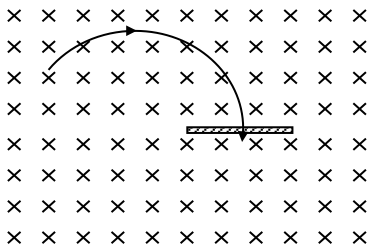
16. Magnetic field is applied perpendicular to a rectangular coil of dimension 10 cm × 5 cm. The magnetic flux density changes from 0.01 T to 0.005 T in time 0.05 s. Induced EMF in the frame is,
   (1) 0.5 mV (2) 0.75 mV (3) 1 mV (4) 1.25 mV (5) 1.5 mV

17. The variation of pressure P with volume V of a fixed mass of gas is shown in the figure. If the gas is taken from K to M through L heat absorbed and work done during the process is 8 J and 3 J respectively. If the change from K to M is done through N, the work done by the gas is 1 J. During this second process



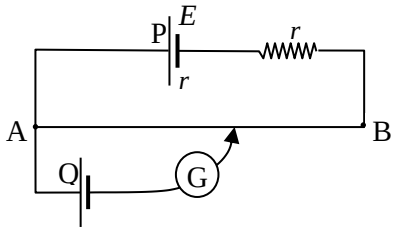
(1) 4 J heat is released (2) 6 J heat is absorbed
(3) 9 J heat is absorbed (4) 10 J heat is absorbed
(5) 11 J heat is released

18. A charge particle moving perpendicular to magnetic field penetrates through the block of lead as shown in the figure. Half of the kinetic energy is lost. Radius of the path after penetration is,



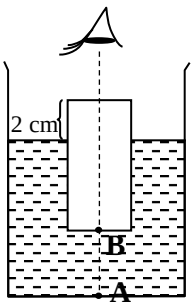
(1) Equal to the radius before (2) $\sqrt{2}$ times the radius before
(3) Twice the radius before (4) $\frac{1}{\sqrt{2}}$ times the radius before
(5) Half of the radius before

19. EMF and the internal resistance of the battery P are E and r respectively. The resistance of the potentiometer wire is R and its length is l. The battery Q is connected as shown in the diagram. The balance length obtained is $\frac{l}{3}$. EMF of the battery Q is?



(1) $\frac{E}{3}$ (2) $\frac{ER}{3(R+r)}$ (3) $\frac{Er}{3(R+2r)}$ (4) $\frac{ER}{3(R+2r)}$ (5) $\frac{E(R+2r)}{3r}$

20. An ice block is floating in water with 2 cm height in air as shown in the figure. When the two points A and B are viewed through the block, they are displaced by the 5 cm and 2 cm respectively from the real distance. Refractive index of water and ice are 1.5 and 1.4 respectively. The height of water in the beaker is,



(1) 14 cm (2) 15 cm (3) 16 cm
(4) 20 cm (5) 22 cm

21. A drilling machine of power P is used to drill a hole in copper block of mass M kg. If the specific heat capacity of copper is S J kg^{-1} C^{-1} and 40% of energy is lost due to heating of the machine. The rise in the temperature of the block in time T is,

(1) $\frac{0.6PT}{MS}$ (2) $\frac{0.6P}{MST}$ (3) $\frac{0.4PT}{MS}$ (4) $\frac{0.6P}{MST}$ (5) $\frac{PT}{MS}$

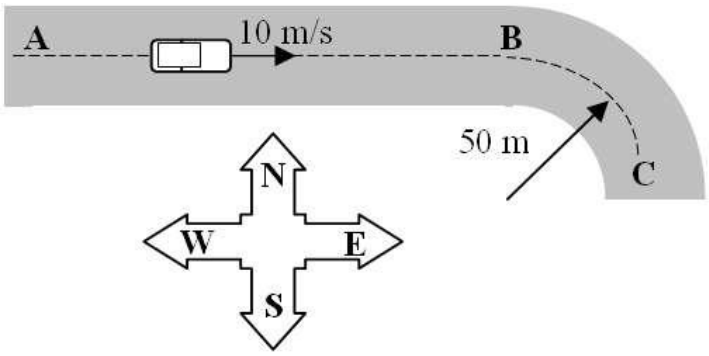
22. A 5V Zener diode in a circuit is used for voltage regulation with a supply voltage of 12 V. If the series resistance is 1 kΩ. what is the current through the Zener diode?

(1) 3 mA (2) 5 mA (3) 7 mA (4) 10 mA (5) 12 mA

23. An operational amplifier in a non-inverting configuration has a feedback resistor of 100 kΩ and an input resistor of 10 kΩ. If the input voltage is 1 V, what is the output voltage?

(1) 9 V (2) 8 V (3) 10 V (4) 11 V (5) 12 V

24. A 1800 kg Jeep travels along a straight 500 m portion of highway (from **A** to **B**) at a constant speed of 10 m s^{-1}. At **B**, the Jeep encounters an unbanked curve of radius 50 m. The Jeep follows the road from **B** to **C** traveling at a constant speed of 10 m s^{-1} while the direction of the Jeep changes from east to south.



The magnitude of the acceleration of the Jeep as it travels from B to C and the magnitude of the frictional force between the tires and the road as the Jeep negotiates the curve from B to C, are respectively given by

(1) 2 m s^{-2}, 3600 N (2) 5 m s^{-2}, 9600 N (3) 10 m s^{-2}, 7200 N
(4) 20 m s^{-2}, 1800 N (5) 0 m s^{-2}, 1000 N

25. Two spheres, labeled A and B, have identical masses, but are made of different substances. The specific heat capacity of sphere A is 645 J kg^{-1} $C^{\circ-1}$ and that of sphere B is 240 J kg^{-1} $C^{\circ-1}$. The spheres are initially at 21 °C; and the same quantity of heat is added to each sphere. If the final temperature of sphere A is 74 °C, what is the approximate final temperature of sphere B?

(1) 39 °C (2) 53 °C (3) 110 °C (4) 140 °C (5) 163 °C

26. Which one of the following statements best explains why gases are not commercially sold by volume?

(1) Gas volume is negligible (2) Gas volume is difficult to measure
(3) Gas volume depends on the type of gas (4) Gases have comparatively low densities
(5) Gas volume depends on temperature and pressure

27. A rocket is launched vertically from rest; and it burns fuel at a constant rate of 136 kg s^{-1}. Exhaust gases are expelled with a speed of 5.25×10^3 m s^{-1} relative to the rocket. What is the magnitude of the thrust?

(1) 2.59×10^{-2} N (2) 38.6 N (3) 808 N (4) 7.14×10^5 N (5) 3.64 × 106 N

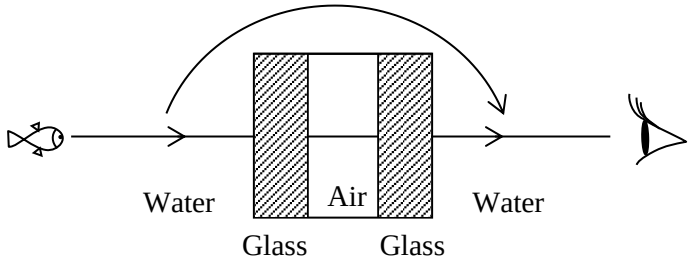
28. A physics student is asked to determine the length of a long, slender, copper bar by measuring the time required for a sound pulse to travel the length of the bar. The Young's modulus of copper is 1.1×10^{11} N m^{-2}; and its density is 8890 kg m^{-3}. The student finds that the time for the pulse to travel from one end to the other is 5.6×10^{-4} s. How long is the rod?

(1) 0.45 m (2) 2.0 m (3) 5.5 m (4) 7.8 m (5) 11.0 m

29. When two resistances R_1 and R_2 are connected across a battery separately, the powers generated by the resistance are equal. The internal resistance of the battery is,

(1) $\frac{R_1+R_2}{2}$ (2) $\sqrt{(R_1+R_2)R_1}$ (3) $\sqrt{(R_1+R_2)R_2}$ (4) $R_1 - R_2$ (5) $\sqrt{R_1R_2}$

30.



A glass block which has a layer of air inside is kept in water as shown in the figure. A man in water observes a fish through the block. Refractive index of glass and water are 3/2 and 4/3 respectively. The fish disappears as seen by the man when the block is rotated about a horizontal axis by an angle,

(1) $\sin^{-1}\left(\frac{2}{3}\right)$ (2) $\sin^{-1}\left(\frac{4}{3}\right)$ (3) $\sin^{-1}\left(\frac{9}{8}\right)$ (4) $\sin^{-1}\left(\frac{4}{9}\right)$ (5) $\sin^{-1}\left(\frac{3}{4}\right)$

31. An alpha particle and a proton start motion from rest and acquire equal momentum at equal displacements. The ratio between their accelerations,
(1) 1:1 (2) 2 :1 (3) 1: 4 (4) 4: 1 (5) 1:16

32. In pair annihilation, $e^+ + e^-$ results in,
(1) 2 e^+ (2) 2 e^- (3) 2 γ (4) γ (5) is zero

33. From the quark compositions of the hadrons shown below
(A) $p \rightarrow uud$ (B) $\bar{p} \rightarrow \bar{u}\bar{u}\bar{d}$ (C) $n \rightarrow u\bar{d}\bar{d}$

(1) A, B and C are all true (2) A, B and C are all false (3) Only A and B are true
(4) Only A and C are true (5) Only B and C are true

34. A light source produces 6.0 W of light that has a wavelength of 660 nm. How many photons per second are produced by the light source
(1) 6.0×10^{17} (2) 2.0×10^{18} (3) 5.0×10^{18} (4) 1.0×10^{19} (5) 2.0×10^{19}

35. White light consisting of wavelengths 400 nm ≤ λ ≤ 700 nm is incident on a lead surface. For which one of the following ranges of wavelengths will photoelectrons be emitted from the lead surface? (Assume work function of lead $W_0 = 6.6 \times 10^{-19}$ J)
(1)400 nm ≤ λ ≤ 650 nm (2) 400 nm ≤ λ ≤ 540 nm (3) 400 nm ≤ λ ≤ 490 nm
(4)400 nm ≤ λ ≤ 410 nm (5) None of the above ranges

36. What is the de Broglie wavelength of a neutron moving at a speed of 5.0 m s^{-1}. (Assume that the mass of a neutron is 1.6×10^{-27} kg).
(1)52.8 nm (2) 82.5 nm (3) 105.6 nm (4) 110.0 nm (5) 320.0 nm

37. Which one of the following types of nuclear radiation is not affected by a magnetic field?
(1) alpha particles (2) β^- rays (3) gamma rays
(4)β^+ rays (5)helium nuclei

38. Which particle(s) is(are) emitted when $^{40}_{19}\mathrm{K}$ decays into $^{40}_{20}\mathrm{Ca}$?
(1) a photon (2) a proton (3) an alpha particle (4) a positron and a neutrino
(5)an electron and an antineutrino

39. A sample contains 2000 nuclei of a radioactive isotope of barium. If the half-life of barium is 12 s, find the number of nuclei that has decayed by 48 s later,

(1)1750 (2) 1875 (3) 1936 (4) 1972 (5) 1999

40. Which process is involved in determining the age of a prehistoric object?

(1) alpha decay (2) beta decay (3) gamma decay
(4) X-ray absorption (5) proton absorption

41. Which electronic device is most commonly used in radiation detection?

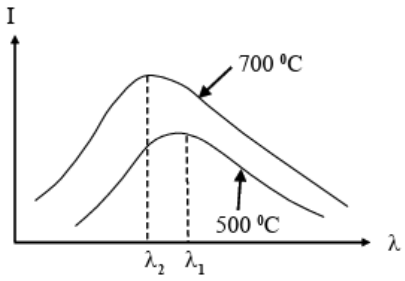
(1) Photodiode (2) Geiger-Müller tube (3) Light-Emitting Diode (LED)
(4) Bipolar Junction Transistor (BJT) (5)Operational Amplifier

42. What is the incorrect statement about the particles in the lepton family

A. Muon neutrino is a member of lepton family
B. They cannot be separated
C. A muon neutrino has zero charge
D. There are no anti-leptons for leptons

(1) A and B (2) A and C (3) B and D (4) B and D (5) All four statements are false

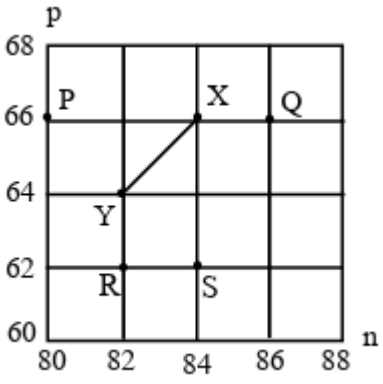
43. Figure shows the black body radiation curves for two temperatures.



The $\frac{\lambda_1}{\lambda_2}$ ratio is equal to,

(1) 7/5 (2) 973/773 (3) 5/7
(4) 773/973 (5) 660

44. Figure shows the proton number (p) and neutron number (n) of several nuclei.



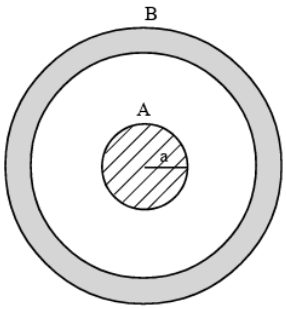
Here, if X decay into Y which other particles will be released

(1) n (2) α (3) β
(4) α and n (5) α and β

45. A proton initially at rest accelerate due to a potential difference V. To achieve the same de Broglie wavelength as of the above proton, under what potential difference an alpha particle should be accelerated?

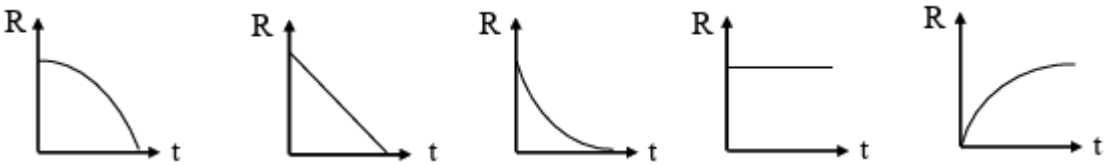
(1)8V (2) 4V (3) $\frac{V}{2}$ (4) $\frac{V}{4}$ (5) $\frac{V}{8}$

46. A is a solid conducting sphere and B is a hollow conducting sphere concentric with A. When A is given a charge of +6 C and B is charged -2 C and A and B are connected by a conducting wire, the charge on surface A and surface B respectively,



(1) +6, -2 (2) 0, +4 (3) 0, 0 (4) +4, 0 (5) +5, +5

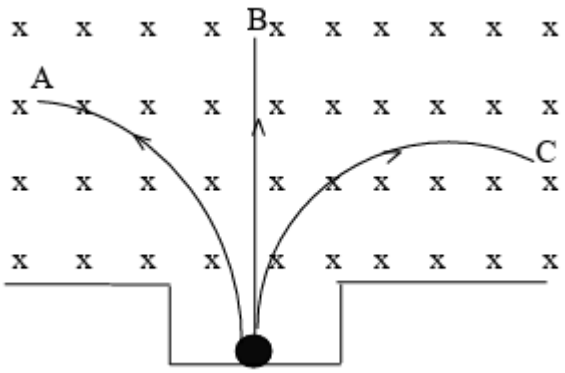
47. For an unstable nucleus, the rate of disintegration (R) against time (t) is shown in is given by,



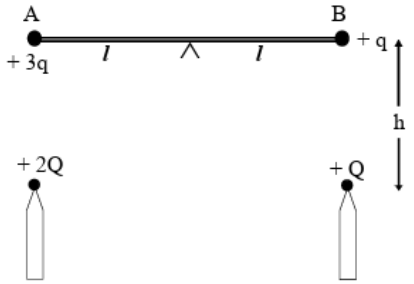
(1) . (2) (3) (4) (5)

48. When A, B, C moving in a magnetic field are identified separately as α, β, and γ particles, it is correctly represented by,

	A	B	C
(1)	α	β	γ
(2)	α	γ	β
(3)	β	γ	α
(4)	β	α	γ
(5)	γ	α	β



49. A very large rod with negligible weight of length 2*l* has two charges +3q and +q at the two ends and two other charges +2Q and +Q are at a distance *h* below the rod as shown in figure.

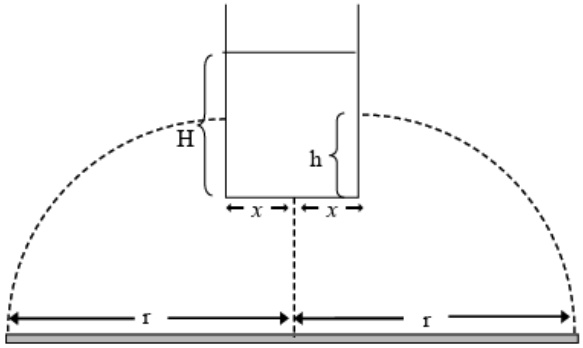


The distance from the knife edge, which a mass ***m*** must hang to maintain equilibrium is,

(1) $\frac{5Qql}{4\pi\epsilon_0 mgh^2}$ towards A (2) $\frac{5Qql}{4\pi\epsilon_0 mgh^2}$ towards B (3) $\frac{Qql}{4\pi\epsilon_0 mgh^2}$ towards A

(4) $\frac{Qql}{4\pi\epsilon_0 mgh^2}$ towards B (5) No need of additional weight because it's already in equilibrium.

50. A metal vessel is filled with a liquid to a height H and a hole is made at a height h from its bottom. If the material coming out of that hole is placed on the ground in a circle of radius r, the height of the bottom of the pot from the ground level will be,



(1) $H + 2h$ (2) $h\frac{r^2}{4(H+h)}$ (3) $\frac{(r-x)^2}{4(H-h)} - h$ (4) $\frac{(r-x)^2}{(H-h)} + H$ (5) $\frac{r^2}{4(H-h)}$

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