NEET MOCK TEST 1- PHYSICS

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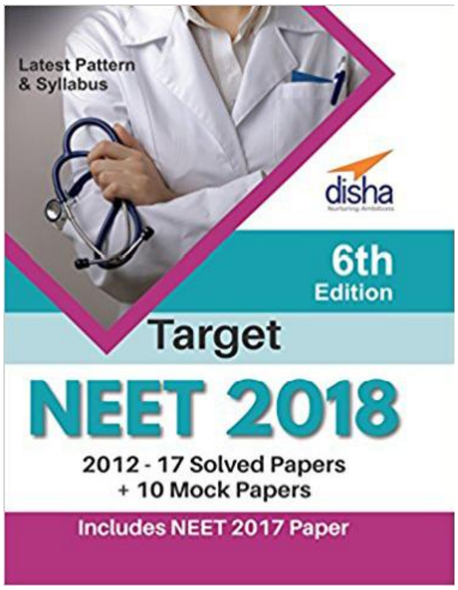


ISBN : 9789386629234

Product Name : Target NEET 2018 (2012-17 Solved Papers + 10 Mock Papers)

Product Description : Table of Contents:

PART A – PHYSICS

DIRECTIONS : There are 45 multiple choice questions numbered 1 to 45. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE is correct.

1. An automobile travelling with a speed of 60 km/h, can brake to stop within a distance of 20m. If the car is going twice as fast i.e., 120 km/h, the stopping distance will be

(1) 60m (2) 40m (3) 20m (4) 80m

2. Out of the following quantities, which one has dimensions different from the remaining three?

(1) Energy per unit volume
(2) Force per unit area
(3) Product of voltage and charge per unit volume
(4) Angular momentum

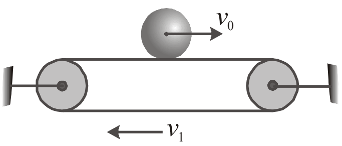
3. A sphere of radius *r* and mass *m* has a velocity v_0 directed to the left and no angular velocity as it is placed on a belt moving to the right with a constant velocity v_1. If after sliding on the belt the sphere is to have no linear velocity relative to the ground as it starts rolling on the belt without sliding. In terms of v_1, the velocity v_0 is

(1) $v_0 = \frac{2}{5}v_1$

(2) $v_0 = \frac{3}{5}v_1$

(3) $v_0 = \frac{1}{5}v_1$

(4) $v_0 = 3v_1$



4. Three concentric spherical shells have radii a, b and c (a < b < c) and have surface charge densities σ, $-\sigma$ and σ respectively. If V_A, V_B and V_C denotes the potentials of the three shells, then for c = a + b, we have

(1) $V_C = V_B \neq V_A$ (2) $V_C \neq V_B \neq V_A$
(3) $V_C = V_B = V_A$ (4) $V_C = V_A \neq V_B$

5. A body of mass M is kept on a rough horizontal surface (friction coefficient μ). A person is trying to pull the body by applying a horizontal force but the body is not moving. The force by the surface on the body is F, then

(1) F = Mg (2) F = μMg
(3) $Mg \le F \le Mg\sqrt{1+\mu^2}$ (4) $Mg \ge F \ge Mg\sqrt{1+\mu^2}$

6. The ratio between the values of acceleration due to gravity at a height 1 km above and at a depth of 1 km below the Earth's surface is (radius of Earth is R)

(1) $\frac{R-2}{R-1}$ (2) $\frac{R}{R-1}$ (3) $\frac{R-2}{R}$ (4) 1

7. The moment of inertia of a body about a given axis is 1.2 kg/m^2. Initially, the body is at rest. In order to produce a rotational kinetic energy of 1500 joule, an angular acceleration of 25 radian/sec^2 must be applied about that axis for a duration of

(1) 4 seconds (2) 2 seconds
(3) 8 seconds (4) 10 seconds

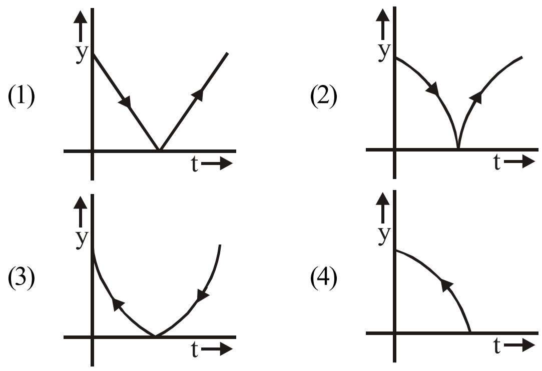
8. A metal ball of mass 2 kg moving with a velocity of 36 km/h has a head on collision with a stationary ball of mass 3 kg. If after the collision, the two balls move together, the loss in kinetic energy due to collision is

(1) 140 J (2) 100 J (3) 60 J (4) 40 J

9. The length of a given cylindrical wire is increased by 100%. Due to the consequent decrease in diameter the change in the resistance of the wire will be

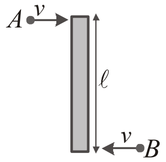
(1) 200% (2) 100% (3) 50% (4) 300%

10. A ball is dropped on a floor and bounces back to a height somewhat less than the original height. Which of the curves depicts its motion correctly?



SPACE FOR ROUGH WORK

11. Two particles A and B of mass m each and moving with velocity v, hit the ends of a rigid bar of the same mass m and length l simultaneously and stick to the bar as shown in the figure. The bar is kept on a smooth horizontal plane. The linear and angular speed of the system (bar + particle) after the collision are



(1) $v_{cm} = 0, \omega = \frac{12}{7}\frac{v}{l}$ (2) $v_{cm} = 0, \omega = \frac{4v}{l}$

(3) $v_{cm} = 0, \omega = \frac{5v}{l}$ (4) $v_{cm} = 0, \omega = \frac{v}{5l}$

12. When the angular velocity of a uniformly rotating body is increased thrice, the resultant force applied to it increases by 60 N. If mass of body = 3 kg, the initial and final accelerations are

(1) 2.5 m/s^2, 7.5 m/s^2 (2) 7.5 m/s^2, 22.5 m/s^2

(3) 5 m/s^2, 45 m/s^2 (4) 2.5 m/s^2, 22.5 m/s^2

13. The escape velocity of a rocket launched from the surface of the earth

(1) depends on the mass of rocket

(2) depends on the mass of planet towards which, it is moving

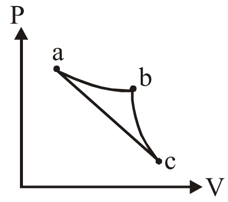
(3) does not depend on the mass of earth

(4) does not depend on the mass of rocket

14. A conducting circular loop is placed in a uniform magnetic field, B = 0.025 T with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of 1 mm s^{-1}. The induced e.m.f. when the radius is 2 cm, is

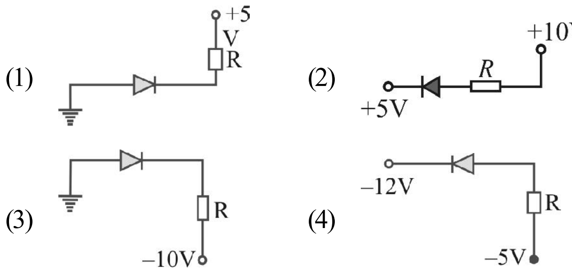
(1) $2\pi\mu V$ (2) $\pi\mu V$ (3) $\frac{\pi}{2}\mu V$ (4) $2\mu V$

15. In the P-V diagram shown, the gas does 5J of work along isothermal ab and 4J along adiabatic bc. What is the change in the internal energy of the gas if the gas traverse the straight path from a to c?

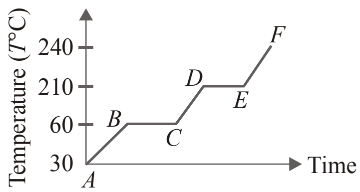


(1) 1J (2) – 4J (3) 5J (4) 9J

16. In the given figure, which of the following is reversed biased?



17. A solid substance is at 30°C and heat energy is supplied to it at a constant rate. Then temperature versus time graph is as shown in the figure. The substance is in liquid state for the portion (of the graph)



(1) BC (2) CD (3) ED (4) EF

18. The sunlight reaches us as white light and not as its components because

(1) air medium is dispersive

(2) air medium is non-dispersive

(3) air medium scatter the sunlight

(4) air medium absorbs the sunlight

19. In a room where the temperature is 30°C, a body cools from 61°C to 59°C in 4 minutes. The time (in minutes) taken by the body to cool from 51°C to 49°C will be :

(1) 8 (2) 5 (3) 6 (4) 4

SPACE FOR ROUGH WORK

20. A transistor is operated in common emitter configuration at constant collector voltage $V_c = 1.5$V such that a change in the base current from 100 μA to 150 μA produces a change in the collector current from 5 mA to 10 mA. The current gain (β) is
(1) 75 (2) 100 (3) 50 (4) 67

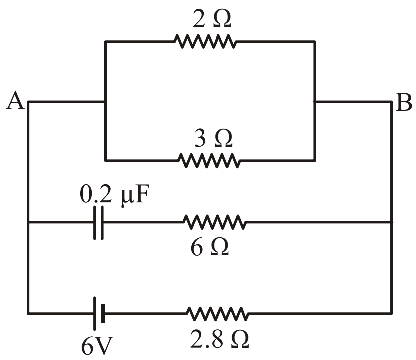
21. The intensity of gamma radiation emitted from a given source is I. On passing through 36 mm of lead, it is reduced to $\frac{I}{8}$. The thickness of lead which will reduce the intensity to $\frac{I}{2}$ will be
(1) 9mm (2) 6mm (3) 12mm (4) 18mm

22. A particle executing simple harmonic motion has a kinetic energy $K_0 \cos^2 \omega t$. The maximum values of the potential energy and the total energy are respectively
(1) $K_0/2$ and K_0 (2) K_0 and $2K_0$
(3) K_0 and K_0 (4) 0 and $2K_0$

23. A sonometer wire supports a 4 kg load and vibrates in fundamental mode with a tuning fork of frequency 416 Hz. The length of the wire between the bridges is now doubled. In order to maintain fundamental mode, the load should be changed to
(1) 1 kg (2) 2 kg (3) 4 kg (4) 16 kg

24. The value of power factor in a circuit connected to an A.C. is
(1) unity when the circuit contians an ideal inductance only
(2) unity when the circuit contians an ideal resistance only
(3) zero when the circuit contains an ideal resistance only
(4) unity when the circuit contains an ideal capacitance only

25. Taking the internal resistance of the battery negligible, the steady state current in the 2Ω resistor shown in the figure will be



(1) 1.8 A (2) 2.9 A (3) 0.9 A (4) 2.8 A

26. Tension in the cable supporting an elevator, is equal to the weight of the elevator. From this, we can conclude that the elevator is going up or down with a
(1) uniform velocity (2) uniform acceleration
(3) variable acceleration (4) either (2) or (3)

27. A projectile is thrown in the upward direction making an angle of 60° with the horizontal direction with a velocity of 147 m s^{-1}. The time after which its inclination with the horizontal is 45°, is
(1) 15 s (2) 10.98 s (3) 5.49 s (4) 2.745 s

28. Two short bar magnets of length 1 cm each have magnetic moments 1.20 Am^2 and 1.00 Am^2 respectively. They are placed on a horizontal table parallel to each other with their N poles pointing towards the South. They have a common magnetic equator and are separated by a distance of 20.0 cm. The value of the resultant horizontal magnetic induction at the mid-point O of the line joining their centres is close to (Horizontal component of earth's magnetic induction is 3.6×10^{-5} Wb/m^2)
(1) 3.6×10^{-5} Wb/m^2 (2) 2.56×10^{-4} Wb/m^2
(3) 3.50×10^{-4} Wb/m^2 (4) 5.80×10^{-4} Wb/m^2

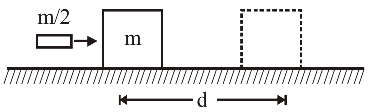
29. The supply voltage to room is 120V. The resistance of the lead wires is 6Ω. A 60 W bulb is already switched on. What is the decrease of voltage across the bulb, when a 240 W heater is switched on in parallel to the bulb?
(1) zero (2) 2.9 Volt
(3) 13.3 Volt (4) 10.04 Volt

SPACE FOR ROUGH WORK

30. A thin ring of radius R meter has charge q coulomb uniformly spread on it. The ring rotates about its axis with a constant frequency of f revolutions/s. The value of magnetic induction in Wb/m^2 at the centre of the ring is

(1) $\frac{\mu_0 q f}{2\pi R}$ (2) $\frac{\mu_0 q}{2\pi f R}$ (3) $\frac{\mu_0 q}{2 f R}$ (4) $\frac{\mu_0 q f}{2R}$

31. A block of mass m rests on a rough horizontal surface (Coefficient of friction μ). When a bullet of mass m/2 strikes horizontally, and get embedded in it, the block moves a distance d before coming to rest. The initial velocity of the bullet is $k\sqrt{2\mu g d}$, then the value of k is



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

32. The magnetic field of earth at the equator is approximately 4×10^{-5} T. The radius of earth is 6.4×10^6 m. Then the dipole moment of the earth will be nearly of the order of:

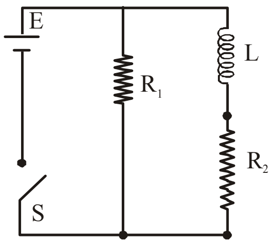
(1) 10^{23} A m^2 (2) 10^{20} A m^2

(3) 10^{16} A m^2 (4) 10^{10} A m^2

33. A galvanometer of resistance 50 Ω is connected to battery of 3V along with a resistance of 2950 Ω in series. A full scale deflection of 30 divisions is obtained in the galvanometer. In order to reduce this deflection to 20 divisions, the resistance in series should be

(1) 5050 Ω (2) 5550 Ω (3) 6050 Ω (4) 4450 Ω

34. An inductor of inductance L = 400 mH and resistors of resistance $R_1 = 2\Omega$ and $R_2 = 2\Omega$ are connected to a battery of emf 12 V as shown in the figure.

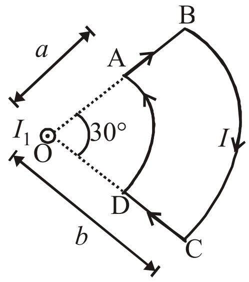


The internal resistance of the battery is negligible. The switch S is closed at $t = 0$. The potential drop across L as a function of time is

(1) $\frac{12}{t} e^{-3t}$ V (2) $6(1 - e^{-t/0.2})$V

(3) $12e^{-5t}$ V (4) $6e^{-5t}$ V

35. A current loop $ABCD$ is held fixed on the plane of the paper as shown in the figure. The arcs BC (radius = b) and DA (radius = a) of the loop are joined by two straight wires AB and CD. A steady current I is flowing in the loop. Angle made by AB and CD at the origin O is 30°. Another straight thin wire with steady current I_1 flowing out of the plane of the paper is kept at the origin.



The magnitude of the magnetic field (B) due to the loop $ABCD$ at the origin (O) is :

(1) $\frac{\mu_o I(b-a)}{24ab}$

(2) $\frac{\mu_0 I}{4\pi}\left[\frac{b-a}{ab}\right]$

(3) $\frac{\mu_o I}{4\pi}[2(b-a)+\pi/3(a+b)]$

(4) zero

36. A polished metal plate with a rough black spot on it is heated to about 1400 K and quickly taken into a dark room. Which one of the following statements will be true?

(1) The spot will appear brighter than the plate

(2) The spot will appear darker than the plate

(3) The spot and plate will appear equally bright

(4) The spot and the plate will not be visible in the dark room

37. The angular dispersion produced by a prism
(1) increases if the average refractive index increases
(2) increases if the average refractive index decreases
(3) remains constant whether the average refractive index increases or decreases
(4) has no relation with average refractive index.

38. The tempertaure of equal masses of three different liquids A, B and C are 12°C, 19°C and 28°C respectively. The temperature when A and B are mixed is 16°C and when B and C are mixed is 23°C. The temperature when A and C are mixed is
(1) 18.2°C (2) 22°C (3) 20.2°C (4) 25.2°C

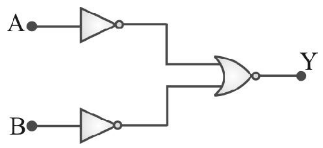
39. Two sources of light of wavelengths 2500 Å and 3500 Å are used in Young's double slit expt. simultaneously. Which orders of fringes of two wavelength patterns coincide?
(1) 3rd order of 1st and 5th of the 2nd
(2) 7th order of 1st and 5th order of 2nd
(3) 5th order of 1st and 3rd order of 2nd
(4) 5th order of 1st and 7th order of 2nd

40. An ideal gas is initially at P_1, V_1 is expanded to P_2, V_2 and then compressed adiabatically to the same volume V_1 and pressure P_3. If W is the net work done by the gas in complete process, which of the following is true ?
(1) $W > 0; P_3 > P_1$ (2) $W < 0; P_3 > P_1$
(3) $W > 0; P_3 < P_1$ (4) $W < 0; P_3 < P_1$

41. A photoelectric surface is illuminated successively by monochromatic light of wavelength λ and $\frac{\lambda}{2}$. If the maximum kinetic energy of the emitted photoelectrons in the second case is 3 times that in the first case, the work function of the surface of the material is :
(h = Planck's constant, c = speed of light)
(1) $\frac{hc}{\lambda}$ (2) $\frac{2hc}{\lambda}$ (3) $\frac{hc}{3\lambda}$ (4) $\frac{hc}{2\lambda}$

42. An ideal gas confined in an isolated closed chamber. As the gas undergoes an adiabatic expansion, the average time of collision between molecules increases as V^q, where V is the volume of the gas. The value of q is : $\left(\gamma = \frac{C_p}{C_v}\right)$
(1) $\frac{\gamma+1}{2}$ (2) $\frac{\gamma-1}{2}$ (3) $\frac{3\gamma+5}{6}$ (4) $\frac{3\gamma-5}{6}$

43. Which logic gate is represented by the following combination of logic gates



(1) OR (2) NAND (3) AND (4) NOR

44. If T is the surface tension of a liquid, the energy needed to break a liquid drop of radius R into 64 drops is
(1) $6\pi R^2T$ (2) πR^2T
(3) $12\pi R^2T$ (4) $8\pi R^2T$

45. In the Bohr model an electron moves in a circular orbit around the proton. Considering the orbiting electron to be a circular current loop, the magnetic moment of the hydrogen atom, when the electron is in n^{th} excited state, is :
(1) $\left(\frac{e}{2m}\right)\frac{n^2h}{2\pi}$ (2) $\left(\frac{e}{m}\right)\frac{nh}{2\pi}$
(3) $\left(\frac{e}{2m}\right)\frac{nh}{2\pi}$ (4) $\left(\frac{e}{m}\right)\frac{n^2h}{2\pi}$

Hints and Solutions

PART A – PHYSICS

1. **(4)** Speed, $u = 60 \times \frac{5}{18}\text{m/s} = \frac{50}{3}\text{m/s}$

$d = 20\text{m}, u' = 120 \times \frac{5}{18} = \frac{100}{3}\text{m/s}$

Let declaration be a then $(0)^2 - u^2 = -2ad$

or $u^2 = 2ad$ ...(i)

and $(0)^2 - u'^2 = -2ad'$

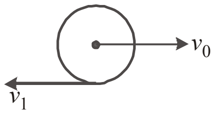
or $u'^2 = 2ad'$ ...(ii)

(ii) divided by (i) gives,

$4 = \frac{d'}{d} \Rightarrow d' = 4 \times 20 = 80\text{m}$

2. **(4)** For angular momentum, the dimensional formula is $[ML^2T^{-1}]$. For other three, it is $[ML^{-1}T^{-2}]$.

3. **(1)**



With respect to ground it has only rotation, so

$$v_1 = \omega r$$

Now using conservation of angular momentum about a fixed point at the level of bottom of the sphere,

$$mv_0 r = I\omega = \frac{2}{5}mr^2 \times \frac{v_1}{r}$$

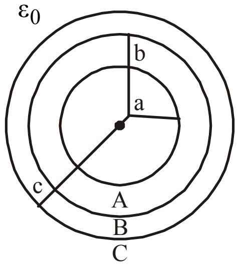
$$\therefore \quad v_0 = \frac{2}{5}v_1.$$

4. **(4)** c = a + b.

$$V_A = \frac{\sigma a}{\varepsilon_0} - \frac{\sigma b}{\varepsilon_0} + \frac{\sigma c}{\varepsilon_0} = \frac{\sigma}{\varepsilon_0}[c-(b-a)]$$

$$V_B = \frac{-\sigma b}{\varepsilon_0} + \frac{1}{4\pi\varepsilon_0} \cdot \frac{\sigma \times 4\pi a^2}{b} + \frac{\sigma c}{\varepsilon_0}$$

$$= \frac{\sigma}{\varepsilon_0}\left[c - \frac{(b^2-a^2)}{b}\right]$$



$$V_C = \frac{\sigma c}{\varepsilon_0} - \frac{1}{4\pi\varepsilon_0} \cdot \frac{\sigma \times 4\pi b^2}{c} + \frac{1}{4\pi\varepsilon_0} \cdot \frac{\sigma \times 4\pi a^2}{c}$$

$$= \frac{\sigma}{\varepsilon_0}\left[c - \frac{(b^2-a^2)}{c}\right] = \frac{\sigma}{\varepsilon_0}[c-(b-a)]$$

$V_C = V_A \neq V_B$

5. **(3)** Maximum force by surface when friction works

$$F = \sqrt{f^2 + R^2} = \sqrt{(\mu R)^2 + R^2} = R\sqrt{\mu^2 + 1}$$

Minimum force = R when there is no friction

Hence ranging from R to $R\sqrt{\mu^2+1}$

[where, R = Mg]

6. **(1)** Acceleration due to gravity at a height h above the earth's surface is

$$g_h = g\left(1 - \frac{2h}{R}\right)$$

Acceleration due to gravity at a depth d below the earth's surface is

$$g_d = g\left(1 - \frac{d}{R}\right)$$

Now, $\frac{g_h}{g_d} = \frac{\left(1-\frac{2h}{R}\right)}{\left(1-\frac{d}{R}\right)} = \frac{(R-2h)}{(R-d)}$

As h = 1 km, d = 1 km

$$\therefore \quad \frac{g_h}{g_d} = \frac{R-2}{R-1}$$

7. **(2)** $I = 1.2\ \text{kg m}^2, E_r = 1500\text{ J}$,

$\alpha = 25\ \text{rad/sec}^2, \omega_1 = 0, t = ?$

As E_r

$$= \frac{1}{2}I\omega^2, \omega = \sqrt{\frac{2E_r}{I}} = \sqrt{\frac{2 \times 1500}{1.2}} = 50\ \text{rad/sec}$$

From $\omega_2 = \omega_1 + \alpha t$

$50 = 0 + 25t, \quad \therefore \quad t = 2$ seconds

8. **(3)** Applying conservation of momentum,

$m_1 v_1 = (m_1 + m_2)v$

$$v = \frac{m_1 v_1}{(m_1 + m_2)}$$

Here, $v_1 = 36\text{ km/hr} = 10\text{ m/s}$

$m_1 = 2\text{ kg}, m_2 = 3\text{ kg}$

$$v = \frac{10 \times 2}{5} = 4\text{ m/s}$$

$$\text{K.E. (initial)} = \frac{1}{2} \times 2 \times (10)^2 = 100\text{ J}$$

$$\text{K.E. (Final)} = \frac{1}{2} \times (3+2) \times (4)^2 = 40\text{ J}$$

Loss in K.E. = 100 – 40 = 60 J

9. **(4)** The total volume remains the same before and after stretching.

Therefore $A \times \ell = A' \times \ell'$

Here $\ell' = 2\ell$

$$\therefore \quad A' = \frac{A\times \ell}{\ell'} = \frac{A\times\ell}{2\ell} = \frac{A}{2}$$

Percentage change in resistance

$$= \frac{R_f - R_i}{R_i}\times 100 = \frac{\rho\left(\frac{\ell'}{A'} - \frac{\ell}{A}\right)}{\rho\frac{\ell}{A}}\times 100$$

$$= \left[\left(\frac{\ell'}{A'}\times\frac{A}{\ell}\right) - 1\right]\times 100 \quad = \left[\left(\frac{2\ell}{A/2}\times\frac{A}{\ell}\right) - 1\right]\times 100$$

$= 300\%$

10. (2) When a ball is dropped on a floor,

$$y = \frac{1}{2}gt^2 \qquad \text{..... (i)}$$

So the graph between y and t is a parabola. Here as time increases, y decreases.

When the ball bounces back, then

$$y = ut + \frac{1}{2}gt^2 \qquad \text{..... (ii)}$$

The graph between y and t will be a parabola. But here as time increases, y also increases. So (2) represents the graph.

11. (1) By conservation of linear momentum, we have

$$mv - mv = (m+m+m)v_{cm}$$

or $\quad v_{cm} = 0$

Now using conservation of angular momentum, we get

$$mv\ell = I\omega$$

$$= \left[\frac{m\ell^2}{12} + 2m(\ell/2)^2\right]\omega$$

$$\therefore \quad \omega = \frac{12v}{7\ell}$$

12. (4) Given, $\quad F = m\omega^2 r \qquad$ ...(i)

and $F + 60 = m(3\omega)^2 r$

$$= 9(m\omega^2 r) \qquad \text{...(ii)}$$

From above equations, we get

$F + 60 = 9F$

or $\quad F = 7.5$ N

Initial acceleration $= \omega^2 r$

$= F/m$

$$= \frac{7.5}{3} = 2.5 \text{ m/s}^2$$

Final acceleration $= (3\omega)^2 r$

$= 9\times\omega^2 r$

$= 9\times 2.5 = 22.5 \text{ m/s}^2$

13. (4) The velocity to escape earth's gravitational field, $v_e = \sqrt{2gR}$, it is independent of mass of rocket.

14. (2) Magnetic flux linked with the loop is $\phi = B\pi r^2$

$$|e| = \frac{d\phi}{dt} = B\pi\cdot 2r\frac{dr}{dt}$$

When $r = 2$ cm, $\frac{dr}{dt} = 1 \text{ mm } s^{-1}$

$e = 0.025\times\pi\times 2\times 2\times 10^{-2}\times 10^{-3}$

$= 0.100\times\pi\times 10^{-5} = \pi\times 10^{-6}\text{ V} = \pi\mu\text{V}$

15. (2) Along ab, $Q = 0 + 5 = 5$. $\Delta U_{ab} = 0$

Along bc, $0 = \Delta U_{bc} + 4, \quad \therefore \quad \Delta U_{bc} = -4$J

In cyclic process $abca$,

$\Delta U_{ab} + \Delta U_{bc} + \Delta U_{ca} = 0$

or, $\quad 0 - 4 + \Delta U_{ca} = 0$

$\therefore \quad \Delta U_{ca} = +4$J

Thus, $\quad \Delta U_{ac} = -4$ J

16. (1) In figure, (2, 3, 4) the potential difference across diode is greater than zero (V > 0) and so these are in forward bias.

17. (2) At *CD* solid will completely convert into liquid.

18. (2) Air medium is non-dispersive in nature.

19. (3) From Newtwon's law of cooling

$$\frac{dQ}{dt} = -KA\frac{dT}{dx}$$

Area of cross-section A and thickness dx is the same.

Also $dQ = mCd\theta$

Thus in first case

$$\frac{m\times C\times(61° - 59°)}{4} = \frac{-KA}{dx}\left[\left(\frac{61° + 51°}{2}\right) - 30°\right] \quad \text{(i)}$$

In second case,

$$\frac{m\times C\times(51° - 49°)}{t} = \frac{-KA}{dx}\left[\left(\frac{51° + 49°}{2}\right) - 30°\right] \quad \text{(ii)}$$

Dividing equation (i) by equation (ii)

$$\frac{t}{4} = \frac{30}{20}$$

or $\quad t = 6$ minutes.

20. (2) $\Delta I_b = +50\mu A, \Delta I_c = 5\times 10^{-3} A$

$$\beta = \frac{\Delta I_c}{\Delta I_b} = \frac{5\times 10^{-3}}{50\times 10^{-6}} = \frac{5\times 1000}{50} = 100$$

21. (3) Intensity $I = I_0 . e^{-\mu d}$,

Applying logarithm on both sides,

$$-\mu d = \log\left(\frac{I}{I_0}\right)$$

$$-\mu \times 36 = \log\left(\frac{I/8}{I}\right) \quad ....(i)$$

$$-\mu \times d = \log\left(\frac{I/2}{I}\right) \quad ....(ii)$$

Dividing (i) by (ii),

$$\frac{36}{d} = \frac{\log\left(\frac{1}{8}\right)}{\log\left(\frac{1}{2}\right)} = \frac{3\log\left(\frac{1}{2}\right)}{\log\left(\frac{1}{2}\right)} = 3 \text{ or } d = \frac{36}{3} = 12 \text{ mm}$$

22. (3) We have, $U + K = E$

where, U = Potential energy, K = Kinetic energy, E = Total energy.

Also, we know that, in S.H.M., when potential energy is maximum, K.E. is zero and vice-versa.

$\therefore U_{max} + 0 = E \Rightarrow U_{max} = E$

Further,

$$K.E. = \frac{1}{2}m\omega^2 a^2 \cos^2 \omega t$$

But by question, $K.E. = K_0 \cos^2 \omega t$

$$\therefore K_0 = \frac{1}{2}m\omega^2 a^2$$

Hence, total energy, $E = \frac{1}{2}m\omega^2 a^2 = K_0$

$\therefore U_{max} = K_0$ & $E = K_0$.

23. (4) Load supported by sonometer wire = 4 kg

Tension in sonometer wire = 4 g

If μ = mass per unit length

then frequency $\upsilon = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$

$$\Rightarrow 416 = \frac{1}{2l}\sqrt{\frac{4g}{\mu}}$$

When length is doubled, i.e., $l' = 2l$

Let new load = L

As, $\upsilon' = \upsilon$

$$\therefore \frac{1}{2l'}\sqrt{\frac{Lg}{\mu}} = \frac{1}{2l}\sqrt{\frac{4g}{\mu}}$$

$$\Rightarrow \frac{1}{4l}\sqrt{\frac{Lg}{\mu}} = \frac{1}{2l}\sqrt{\frac{4g}{\mu}}$$

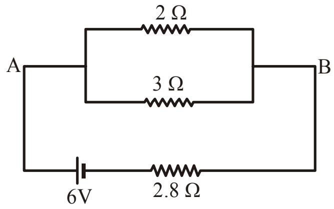
$$\Rightarrow \sqrt{L} = 2 \times 2 \Rightarrow L = 16 \text{ kg}$$

24. (2) $\cos\phi = \frac{R}{Z}$, where Z is the impedance &

$Z = \sqrt{R^2 + (X_L - X_C)^2}$, if there is only resistance then $Z = R \Rightarrow \cos\phi = 1$

25. (3) No current flows through 6 Ω resistor as a capacitor offers infinite resistance to a D.C.

The equivalent circuit is thus as shown below in which 2Ω and 3Ω are in parallel



$$\therefore \frac{1}{2} + \frac{1}{3} = \frac{1}{R'} \text{ or } R' = \frac{6}{5}\Omega = 1.2\Omega$$

Current drawn from the battery

$$I = \frac{E}{R} = \frac{6}{4} = 1.5 \text{ Ampere } [R = 1.2 + 2.8 = 4\Omega]$$

Potential difference between A and B

$$V = IR' = 1.5 \times 1.2 = 1.8\text{V}$$

$\therefore$ Current through 2Ω resistor

$$= \frac{V}{2} = \frac{1.8}{2} = 0.9 \text{ A}$$

26. (1) When tension in the cable is equal to the weight of cable, the system is in equilibrium. It means the system is at rest or moving with uniform velocity.

27. (3) At the two points of the trajectory during projection, the horizontal component of the velocity is the same.

$\Rightarrow$ ucos 60° = vcos 45°

$$\Rightarrow 147 \times \frac{1}{2} = v \times \frac{1}{\sqrt{2}} \Rightarrow \frac{147}{\sqrt{2}} \text{m/s}$$

Vertical component of u = u sin 60°

$$= \frac{147\sqrt{3}}{2} \text{m}$$

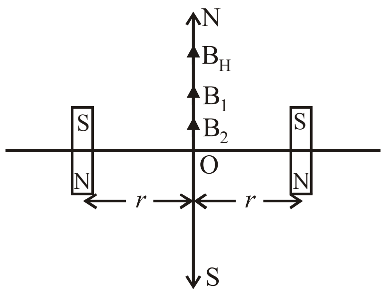
Vertical component of v = v sin 45°

$$= \frac{147}{\sqrt{2}} \times \frac{1}{\sqrt{2}} = \frac{147}{2} \text{m}$$

but $v_y = u_y + a_y t \Rightarrow \frac{147}{2} \times \frac{147\sqrt{3}}{2} - 9.8t$

$$\Rightarrow 9.8t = \frac{147}{2}(\sqrt{3} - 1) \Rightarrow t = 5.49\text{s}$$

28. (2) Given : $M_1 = 1.20\,Am^2$



$M_2 = 1.00\ Am^2$

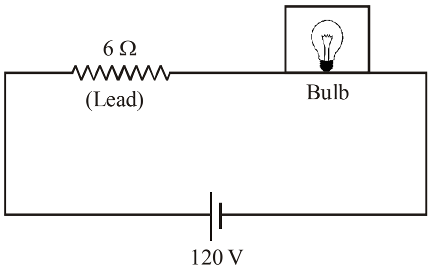
$$r = \frac{20}{2} cm = 0.1 \text{m}$$

$B_{net} = B_1 + B_2 + B_H$

$$B_{net} = \frac{\mu_0}{4\pi} \frac{(M_1 + M_2)}{r^3} + B_H$$

$$= \frac{10^{-7}(1.2+1)}{(0.1)^3} + 3.6 \times 10^{-5} = 2.56 \times 10^{-4} \text{ wb/m}^2$$

29. (4)



Power of bulb = 60 W (given)

$$\text{Resistance of bulb } = \frac{120 \times 120}{60} = 240\Omega$$

$$\left[\because P = \frac{V^2}{R}\right]$$

Power of heater = 240W (given)

$$\text{Resistance of heater } = \frac{120 \times 120}{240} = 60\Omega$$

Voltage across bulb before heater is switched on,

$$V_1 = \frac{240}{246} \times 120 = 117.73 \text{ volt}$$

Voltage across bulb after heater is switched on,

$$V_2 = \frac{48}{54} \times 120 = 106.66 \text{ volt}$$

Hence decrease in voltage

$V_1 - V_2 = 117.073 - 106.66 = 10.04$ Volt (approximately)

30. (4) Current in the ring due to rotation,

$$I = \frac{q}{T} = \frac{q\omega}{2\pi} = \frac{q \cdot 2\pi f}{2\pi}$$

Therefore, magnetic field at the centre of the ring is

$$B = \frac{\mu_0 I}{2R} = \frac{\mu_0}{2R} \frac{q\, 2\pi f}{2\pi} = \frac{\mu_0 q f}{2R}$$

31. (3) Let initial velocity of the bullet be v.

By linear momentum conservation

$$\frac{m}{2} v = \left(\frac{m}{2} + m\right) v_1$$

(v_1 = combined velocity)

$$v_1 = \frac{v}{3} \qquad \text{.........(1)}$$

retardation = μg

$$0 = \left(\frac{v}{3}\right)^2 - 2\mu g d \Rightarrow v = 3\sqrt{2\mu g d}$$

32. (1) Given, $B = 4 \times 10^{-5}$ T

$R_E = 6.4 \times 10^6$ m

Dipole moment of the earth M = ?

$$B = \frac{\mu_0}{4\pi} \frac{M}{d^3}$$

$$4 \times 10^{-5} = \frac{4\pi \times 10^{-7} \times M}{4\pi \times \left(6.4 \times 10^6\right)^3}$$

$\therefore$ $M \cong 10^{23}\ Am^2$

33. (4) Total internal resistance = (50+2950) Ω

= 3000 Ω

Emf of the cell, $\varepsilon = 3V$

$$\therefore \text{Current} = \frac{\varepsilon}{R} = \frac{3}{3000} = 1 \times 10^{-3} A = 1.0 \text{ mA}$$

$\therefore$ Current for full scale deflection of 30 divisions is 1.0 mA.

$\therefore$ Current for a deflection of 20 divisions,

$$I = \left(\frac{20}{30} \times 1\right) \text{mA} \text{ or } I = \frac{2}{3} \text{mA}$$

Let the resistance be x Ω. Then

$$x = \frac{\varepsilon}{I} = \frac{3V}{\left(\frac{2}{3} \times 10^{-3} A\right)} = \frac{3 \times 3 \times 10^3}{2} \Omega$$

= 4500 Ω

But the resistance of the galvanometer is 50Ω.

$\therefore$ Resistance to be added

= (4500 – 50) Ω = 4450 Ω

34. (3) Growth in current in LR_2 branch when switch is closed is given by

$$i = \frac{E}{R_2}[1 - e^{-R_2 t/L}]$$

$$\Rightarrow \frac{di}{dt} = \frac{E}{R_2} \cdot \frac{R_2}{L} . e^{-R_2 t/L} = \frac{E}{L} e^{-\frac{R_2 t}{L}}$$

Hence, potential drop across

$$L = \left(\frac{E}{L} e^{-R_2 t/L}\right) L = E e^{-R_2 t/L}$$

$$= 12 e^{-\frac{2t}{400 \times 10^{-3}}} = 12 e^{-5t} V$$

35. (1) The magnetic field at O due to current in DA is

$$B_1 = \frac{\mu_o}{4\pi} \frac{I}{a} \times \frac{\pi}{6} \qquad \text{(directed vertically upwards)}$$

The magnetic field at O due to current in BC is

$$B_2 = \frac{\mu_o}{4\pi}\frac{I}{b} \times \frac{\pi}{6} \quad \text{(directed vertically downwards)}$$

The magnetic field due to current AB and CD at O is zero.

Therefore the net magnetic field is

$$B = B_1 - B_2 \quad \text{(directed vertically upwards)}$$

$$= \frac{\mu_o}{4\pi}\frac{I}{a}\frac{\pi}{6} - \frac{\mu_o}{4\pi}\frac{I}{b} \times \frac{\pi}{6}$$

$$= \frac{\mu_o I}{24}\left(\frac{1}{a} - \frac{1}{b}\right) = \frac{\mu_o I}{24ab}(b-a)$$

36. (1) According to Kirchhoff law, good absorbers are good emitters. Since black spot is good absorber so it is also a good emitter & will be brighter than plate.

37. (1) The angular dispersion θ i.e., the angle between the extreme rays of light,
$\theta = (\delta_V - \delta_R)$ where $\delta_V = (\mu_V - 1)A$, $\delta_R = (\mu_V - 1)A$ & A is angle of prism.
So if refractive index increases, then δ increases & hence θ increases.

38. (3) Heat gain = heat lost

$$C_A(16-12) = C_B(19-16) \Rightarrow \frac{C_A}{C_B} = \frac{3}{4}$$

and $C_B(23-19) = C_c(28-23) \Rightarrow \frac{C_B}{C_C} = \frac{5}{4}$

$$\Rightarrow \frac{C_A}{C_C} = \frac{15}{16} \quad \text{...(i)}$$

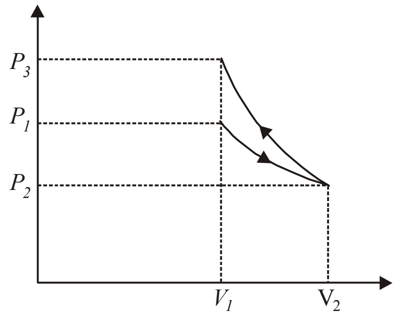
If θ is the temperature when A and C are mixed then,

$$C_A(\theta - 12) = C_C(28-\theta) \Rightarrow \frac{C_A}{C_C} = \frac{28-\theta}{\theta - 12} \quad \text{...(ii)}$$

On solving equations (i) and (ii) θ = 20.2°C

39. (2) Let nth fringe of 2500 Å coincide with (n – 2)th fringe of 3500Å.
∴ 3500 (n – 2) = 2500 × n
1000 n = 7000, n = 7
∴ 7th order fringe of 1st source will coincide with 5th order fringe of 2nd source.

40. (2) In the first process W is + ve as ΔV is positive, in the second process W is – ve as ΔV is – ve and area under the curve of second process is more
∴ Net Work < 0 and also $P_3 > P_1$.



41. (4) Photoelectric equations

$$Ek_{1max} = \frac{hc}{\lambda} - \phi \quad \text{...(i)}$$

and $Ek_{2max} = \frac{hc}{\lambda/2} - \phi$

$$EK_{2max} = \frac{2hc}{\lambda} - \phi \quad \text{...(ii)}$$

From question, $Ek_{2max} = 3Ek_{1max}$
Multiplying equation (i) by 3

$$3Ek_{1max} = 3\left(\frac{hc}{\lambda} - \phi\right) \quad \text{...(iii)}$$

From equation (*ii*) and (*iii*)

$$\frac{3hc}{\lambda} - 3\phi = \frac{2hc}{\lambda} - \phi$$

$$\therefore \phi \text{ (work function)} = \frac{hc}{2\lambda}$$

42. (1) $\tau = \dfrac{1}{\sqrt{2}\pi d^2 \left(\frac{N}{V}\right)\sqrt{\frac{3RT}{M}}}$

$$\tau \propto \frac{V}{\sqrt{T}}$$

As, $TV^{\gamma-1} = K$
So, $\tau \propto V^{\gamma + 1/2}$

Therefore, $q = \dfrac{\gamma + 1}{2}$

43. (3)

A	B	$\bar{A}$	$\bar{B}$	$\bar{Y} = \bar{A} + \bar{B}$	$\bar{Y}$
0	0	1	1	1	0
0	1	1	0	1	0
1	0	0	1	1	0
1	1	0	0	0	1

This table is of AND gate.

44. (3) Let r be the radius of each small drop.
Volume of big drop = 64 × Volume of each small drop

$$\frac{4}{3}\pi R^3 = 64 \times \frac{4}{3}\pi r^3$$

∴ R = 4r

Surface area of big drop = $4\pi R^2$
Surface area of 64 small droplets = $64 \times 4\pi r^2$
$\therefore$ Increase in surface area = $64 \times 4\pi r^2 - 4\pi R^2$
$= 4\pi[64r^2 - R^2]$

$$= 4\pi\left[64\left(\frac{R}{4}\right)^2 - R^2\right]$$

$= 4\pi[4R^2 - R^2] = 12\pi R^2$
Energy needed = Surface tension × Increase in surface area
$= T \times 12\pi R^2 = 12\pi R^2 T$

45. (3) Magnetic moment of the hydrogen atom, when the electron is in n^{th} excited state, i.e., $n' = (n + 1)$
As magnetic moment $M_n = I_n A = i_n (\pi r_n^2)$

$$i_n = eV_n = \frac{mz^2e^5}{4\varepsilon_0^2 n^3 h^3}$$

$$r_n = \frac{n^2h^2}{4\pi^2 kzme^2}\left(k = \frac{1}{4\pi \in_0}\right)$$

Solving we get magnetic moment of the hydrogen atom for n^{th} excited state

$$M_{n'} = \left(\frac{e}{2m}\right)\frac{nh}{2\pi}$$