FIITJEE
SOLUTION TO AIEEE-2005

PHYSICS

1. A projectile can have the same range R for two angles of projection. If t_1 and t_2 be the times of flights in the two cases, then the product of the two time of flights is proportional to

(1) R^2 (2) $1/R^2$
(3) $1/R$ (4) R

1. **(4)**

$$t_1t_2 = \frac{2u^2 \sin 2\theta}{g^2} = \frac{2R}{g}$$

2. An annular ring with inner and outer radii R_1 and R_2 is rolling without slipping with a uniform angular speed. The ratio of the forces experienced by the two particles situated on the inner and outer parts of the ring, F_1/F_2 is

(1) $\frac{R_2}{R_1}$ (2) $\left(\frac{R_1}{R_2}\right)^2$
(3) 1 (4) $\frac{R_1}{R_2}$

2. **(4)**

$$\frac{F_1}{F_2} = \frac{R_1\omega^2}{R_2\omega^2} = \frac{R_1}{R_2}$$

3. A smooth block is released at rest on a 45° incline and then slides a distance d. The time taken to slide is n times as much to slide on rough incline than on a smooth incline. The coefficient of friction is

(1) $\mu_k = 1 - \frac{1}{n^2}$ (2) $\mu_k = \sqrt{1 - \frac{1}{n^2}}$
(3) $\mu_s = 1 - \frac{1}{n^2}$ (4) $\mu_s = \sqrt{1 - \frac{1}{n^2}}$

3. **(1)**

$$d = \frac{1}{2}\frac{g}{\sqrt{2}}t_1^2$$

$$d = \frac{1}{2}\frac{g}{\sqrt{2}}(1 - \mu_k)t_2^2$$

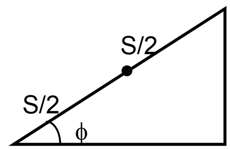
$$\frac{t_2^2}{t_1^2} = n^2 = \frac{1}{1 - \mu_k}$$

4. The upper half of an inclined plane with inclination ϕ is perfectly smooth while the lower half is rough. A body starting from rest at the top will again come to rest at the bottom if the coefficient of friction for the lower half is given by

(1) $2\sin\phi$ (2) $2\cos\phi$
(3) $2\tan\phi$ (4) $\tan\phi$

4. **(3)**

$mg\, s \sin\phi = \mu mg\cos\phi . \frac{s}{2}$



5. A bullet fired into a fixed target loses half of its velocity after penetrating 3 cm. How much further it will penetrate before coming to rest assuming that it faces constant resistance to motion?

(1) 3.0 cm (2) 2.0 cm
(3) 1.5 cm (4) 1.0 cm

5. **(4)**

$F.3 = \frac{1}{2}mv^2 - \frac{1}{2}m\frac{v^2}{4}$

$F(3+x) = \frac{1}{2}mv^2$

x = 1 cm

6. Out of the following pair, which one does NOT have identical dimensions is

(1) angular momentum and Planck's constant
(2) impulse and momentum
(3) moment of inertia and moment of a force
(4) work and torque

6. **(3)**

Using dimension

7. The relation between time t and distance x is $t=ax^2+bx$ where a and b are constants. The acceleration is

(1) $-2abv^2$ (2) $2bv^3$
(3) $-2av^3$ (4) $2av^2$

7. **(3)**

$t = ax^2 + bx$

by differentiating acceleration = $-2av^3$

8. A car starting from rest accelerates at the rate f through a distance S, then continues at constant speed for time t and then decelerates at the rate f/2 to come to rest. If the total distance traversed is 15 S, then

(1) S=ft (2) S = 1/6 ft^2
(3) S = 1/2 ft^2 (4) S = 1/4 ft^2

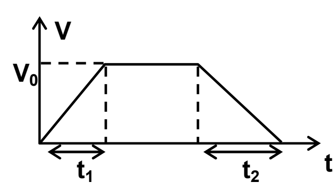
8. **(none)**

$S = \frac{ft_1^2}{2}$

$v_0 = \sqrt{2Sf}$

During retardation

$S_2 = 2S$



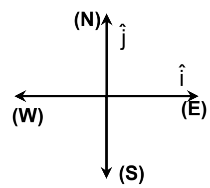
During constant velocity
15S -3S = 12S = $v_o t$

$$\Rightarrow S = \frac{ft^2}{72}$$

9. A particle is moving eastwards with a velocity of 5 m/s in 10 seconds the velocity changes to 5 m/s northwards. The average acceleration in this time is

(1) $\frac{1}{\sqrt{2}}$ m/s^2 towards north-east
(2) $\frac{1}{2}$ m/s^2 towards north.
(3) zero
(4) $\frac{1}{\sqrt{2}}$ m/s^2 towards north-west

9. (4)



$$\vec{a} = \frac{\vec{V}_f - \vec{V}_i}{t}$$

$$= \frac{5\hat{j} - 5\hat{i}}{10} = \frac{1}{2}\left(\hat{j} - \hat{i}\right)$$

$$\therefore a = \frac{1}{\sqrt{2}} ms^{-2} \text{ towards north west}$$

10. A parachutist after bailing out falls 50 m without friction. When parachute opens, it decelerates at 2 m/s^2. He reaches the ground with a speed of 3 m/s. At what height, did he bail out?

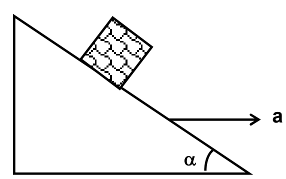
(1) 91 m
(2) 182 m
(3) 293 m
(4) 111 m

10. (3)

$$s = 50 + \left(\frac{3^2 - (2 \times 10 \times 50)}{2(-2)}\right)$$

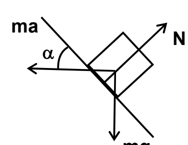
= 293 m.

11. A block is kept on a frictionless inclined surface with angle of inclination α. The incline is given an acceleration a to keep the block stationary. Then a is equal to



(1) g/tanα
(2) g cosecα
(3) g
(4) g tanα

11. (4)



mg sinα = ma cos α
$\therefore a = g \tan\alpha$

12. A spherical ball of mass 20 kg is stationary at the top of a hill of height 100 m. It rolls down a smooth surface to the ground, then climbs up another hill of height 30 m and finally rolls down to a horizontal base at a height of 20 m above the ground. The velocity attained by the ball is

(1) 40 m/s
(2) 20 m/s
(3) 10 m/s
(4) $10\sqrt{30}$ m/s

12. **(1)**

mgh = ½ mv^2

$$v = \sqrt{2gh}$$

$$= \sqrt{2 \times 10 \times 80} = 40 \text{ m/s}$$

13. A body A of mass M while falling vertically downwards under gravity breaks into two parts; a body B of mass 1/3 M and a body C of mass 2/3 M. The centre of mass of bodies B and C taken together shifts compared to that of body A towards

(1) depends on height of breaking
(2) does not shift
(3) body C
(4) body B

13. **(2)**

No horizontal external force is acting

$$\therefore a_{cm} = 0$$

since $v_{cm} = 0$

$$\therefore \Delta x_{cm} = 0$$

14. The moment of inertia of a uniform semicircular disc of mass M and radius r about a line perpendicular to the plane of the disc through the centre is

(1) $\frac{1}{4}Mr^2$
(2) $\frac{2}{5}Mr^2$
(3) Mr^2
(4) $\frac{1}{2}Mr^2$

14. **(4)**

$$2I = 2M\frac{R^2}{2}$$

$$\therefore I = \frac{MR^2}{2}$$

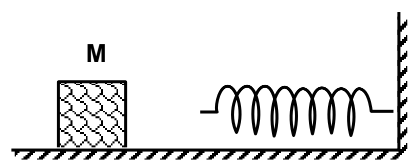
15. A particle of mass 0.3 kg is subjected to a force F=–kx with k=15 N/m. What will be its initial acceleration if it is released from a point 20 cm away from the origin?

(1) 3 m/s^2
(2) 15 m/s^2
(3) 5 m/s^2
(4) 10 m/s^2

15. **(4)**

$$a = \frac{kx}{m} = 10 \, m/s^2$$

16. The block of mass M moving on the frictionless horizontal surface collides with a spring of spring constant K and compresses it by length L. The maximum momentum of the block after collision is

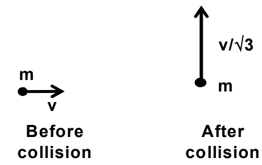


(1) $\sqrt{MK}\,L$
(2) $\frac{KL^2}{2M}$
(3) zero
(4) $\frac{ML^2}{K}$

16. **(1)**

$$\frac{1}{2}KL^2 = \frac{P^2}{2m} \quad \therefore P = \sqrt{MK}\,L$$

17. A mass 'm' moves with a velocity v and collides inelastically with another identical mass. After collision the 1st mass moves with velocity v/√3 in a direction perpendicular to the initial direction of motion. Find the speed of the 2nd mass after collision



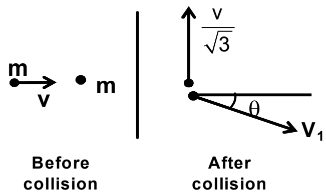
(1) v
(2) √3 v
(3) 2v/√3
(4) v/√3

17. (3)

$$mv = mv_1 \cos\theta$$

$$0 = \frac{mv}{\sqrt{3}} - mv_1 \sin\theta$$

$$\therefore v_1 = \frac{2}{\sqrt{3}} v$$



18. A 20 cm long capillary tube is dipped in water. The water rises up to 8 cm. If the entire arrangement is put in a freely falling elevator the length of water column in the capillary tube will be

(1) 8 cm
(2) 10 cm
(3) 4 cm
(4) 20 cm

18. (4)

Water will rise to the full length of capillary tube

19. If S is stress and Y is Young's modulus of material of a wire, the energy stored in the wire per unit volume is

(1) $2S^2Y$
(2) $S^2/2Y$
(3) $2Y/S^2$
(4) $S/2Y$

19. (2)

$$U = \frac{1}{2} \text{stress} \times \text{strain} = \frac{S^2}{2Y}$$

20. Average density of the earth

(1) does not depend on g
(2) is a complex function of g
(3) is directly proportional to g
(4) is inversely proportional to g

20. (3)

$$g = \frac{G4\pi}{3} \rho_{av} R$$

21. A body of mass m is accelerated uniformly from rest to a speed v in a time T. The instantaneous power delivered to the body as a function time is given by

(1) $\frac{mv^2}{T^2} \cdot t$
(2) $\frac{mv^2}{T^2} \cdot t^2$
(3) $\frac{1}{2}\frac{mv^2}{T^2} \cdot t$
(4) $\frac{1}{2}\frac{mv^2}{T^2} \cdot t^2$

21. (1)

P= (ma).v

$= m\,a^2\,t$

$= m\,\dfrac{V^2}{T^2}t$

22. Consider a car moving on a straight road with a speed of 100 m/s. The distance at which car can be stopped is $[\mu_k = 0.5]$

(1) 800 m (2) 1000 m
(3) 100 m (4) 400 m

22. (2)

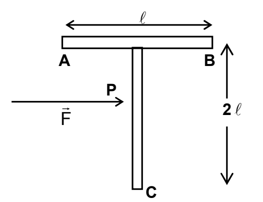
$$\mu_k mgs = \frac{1}{2}mu^2$$

$$s = \frac{u^2}{2\mu_k g} = 1000m$$

23. Which of the following is incorrect regarding the first law of thermodynamics?
(1) It is not applicable to any cyclic process
(2) It is a restatement of the principle of conservation of energy
(3) It introduces the concept of the internal energy
(4) It introduces the concept of the entropy

23. (none)
More than one statements are incorrect

24. A 'T' shaped object with dimensions shown in the figure, is lying on a smooth floor. A force F is applied at the point P parallel to AB, such that the object has only the translational motion without rotation. Find the location of P with respect to C



(1) $\frac{2}{3}\ell$ (2) $\frac{3}{2}\ell$
(3) $\frac{4}{3}\ell$ (4) ℓ

24. (3)
P will be the centre of mass of system

25. The change in the value of g at a height 'h' above the surface of the earth is the same as at a depth 'd' below the surface of earth. When both 'd' and 'h' are much smaller than the radius of earth, then which one of the following is correct?

(1) $d = \frac{h}{2}$ (2) $d = \frac{3h}{2}$
(3) $d = 2h$ (4) d = h

25. (3)

$$\frac{GM}{(R+h)^2} = \frac{GM}{R^3}(R-d)$$

$\Rightarrow$ d = 2h

26. A particle of mass 10 g is kept on the surface of a uniform sphere of mass 100 kg and radius 10 cm. Find the work to be done against the gravitational force between them to take the particle far away from the sphere
(you may take G = 6.67×10^{-11} Nm^2 / kg^2)
(1) 13.34×10^{-10} J (2) 3.33×10^{-10} J
(3) 6.67×10^{-9} J (4) 6.67×10^{-10} J

26. (4)
w = GMm / R = 6.67×10^{-10} J

27. A gaseous mixture consists of 16 g of helium and 16 g of oxygen. The ratio $\frac{C_P}{C_v}$ of the mixture is
(1) 1.59 (2) 1.62
(3) 1.4 (4) 1.54

27. (2)

$$c_v = \frac{n_1 c_{v1} + n_2 c_{v2}}{n_1 + n_2} = \frac{29R}{18}$$

$$c_P = \frac{47R}{18}, \qquad \frac{c_P}{c_v} = 1.62$$

28. The intensity of gamma radiation 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) 6 mm (2) 9 mm
(3) 18 mm (4) 12 mm

28. (4)
Use $I = I_0 e^{-\mu x}$

29. The electrical conductivity of a semiconductor increases when electromagnetic radiation of wavelength shorter than 2480 nm is incident on it. The band gap in (eV) for the semiconductor is
(1) 1.1 eV (2) 2.5 eV
(3) 0.5 eV (4) 0.7 eV

29. (3)

$$E_g = \frac{hc}{\lambda} = 0.5\,eV$$

30. A photocell is illuminated by a small bright source placed 1 m away. When the same source of light is placed $\frac{1}{2}$ m away, the number of electrons emitted by photo cathode would
(1) decrease by a factor of 4 (2) increase by a factor of 4
(3) decrease by a factor of 2 (4) increase by a factor of 2

30. **(2)**

$I \propto \frac{1}{r^2}$

31 Starting with a sample of pure ^{66}Cu, 7/8 of it decays into Zn in 15 minutes. The corresponding half-life is

(1) 10 minutes (2) 15 minutes
(3) 5 minutes (4) $7\frac{1}{2}$ minutes

31. **(3)**

$N_0 \xrightarrow{t_{1/2}} \frac{N_0}{2} \xrightarrow{t_{1/2}} \frac{N_0}{4} \xrightarrow{t_{1/2}} \frac{N_0}{8}$

$3t_{1/2} = 15 \;\therefore t_{1/2} = 5$

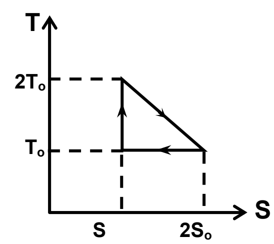
32. If radius of $^{27}_{13}Al$ nucleus is estimated to be 3.6 Fermi then the radius $^{125}_{52}Te$ nucleus be nearly

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

32. **(1)**

$\frac{R}{3.6} = \left(\frac{125}{27}\right)^{\frac{1}{3}} \Rightarrow R = 6 \text{ fermi}$

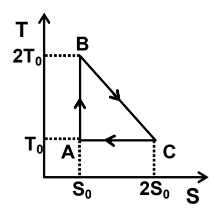
33. The temperature-entropy diagram of a reversible engine cycle is given in the figure. Its efficiency is



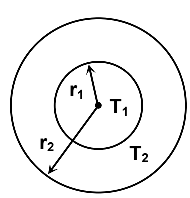
(1) 1/2 (2) 1/4
(3) 1/3 (4) 2/3

33. **(3)**

$$\eta = \frac{\Delta W}{Q_{BC}} = \frac{\frac{S_0T_0}{2}}{\frac{3S_0T_0}{2}} = 1/3$$



34. The figure shows a system of two concentric spheres of radii r_1 and r_2 and kept at temperatures T_1 and T_2 respectively. The radial rate of flow of heat in a substance between the two concentric sphere is proportional to



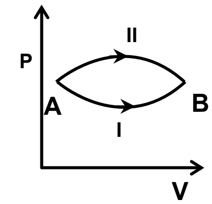
(1) $\frac{r_2 - r_1}{r_1 r_2}$ (2) $\ln\left(\frac{r_2}{r_1}\right)$

(3) $\frac{r_1 r_2}{r_2 - r_1}$ (4) $\ln(r_2 - r_1)$

34. **(3)**

$$\left(\frac{dQ}{dt}\right) = \left(T_1 - T_2\right)\frac{4\pi r_1 r_2 K}{\left(r_2 - r_1\right)}$$

35. A system goes from A to B via two processes I and II as shown in the figure. If ΔU_1 and ΔU_2 are the changes in internal energies in the processes I and II respectively, the



(1) $\Delta U_1 = \Delta U_2$
(2) relation between ΔU_1 and ΔU_2 can not be determined
(3) $\Delta U_2 > \Delta U_1$
(4) $\Delta U_2 < \Delta U_1$

35. **(1)**
Internal energy is state function

36. The function $\sin^2(\omega t)$ represents
(1) a periodic, but not simple harmonic motion with a period $2\pi/\omega$
(2) a periodic, but not simple harmonic motion with a period π/ω
(3) a simple harmonic motion with a period $2\pi/\omega$
(4) a simple harmonic motion with a period π/ω.

36. **(4)**

$$y = \frac{\left(1 - \cos 2\omega t\right)}{2}$$

37. A Young's double slit experiment uses a monochromatic source. The shape of the interference fringes formed on a screen is
(1) hyperbola
(2) circle
(3) straight line
(4) parabola

37. **(3)**
Straight line
Note: If instead of young's double slit experiment, young's double hole experiment was given shape would have been hyperbola.

38. Two simple harmonic motions are represented by the equation $y_1 = 0.1 \sin\left(100\pi t + \frac{\pi}{3}\right)$ and $y_2 = 0.1 \cos\pi t$. The phase difference of the velocity of particle 1 w.r.t. the velocity of the particle 2 is
(1) $-\pi/6$
(2) $\pi/3$
(3) $-\pi/3$
(4) $\pi/6$

38. **(1)**
Phase difference $(\phi) = 99\pi t + \pi/3 - \pi/2$
at $t = 0$ $\phi = -\pi/6$.

39. A fish looking up through the water sees the outside world contained in a circular horizon. If the refractive index of water is 4/3 and the fish is 12 cm below the surface, the radius of this circle in cm is
(1) $36\sqrt{7}$
(2) $36/\sqrt{7}$
(3) $36\sqrt{5}$
(4) $4\sqrt{5}$

39. **(2)**

$$r = \frac{h}{\sqrt{\mu^2 - 1}} = \frac{36}{\sqrt{7}}$$

40. Two point white dots are 1 mm apart on a black paper. They are viewed by eye of pupil diameter 3 mm. Approximately, what is the maximum distance at which these dots can be resolved by the eye? [Take wavelength of light = 500 nm]

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

40. **(1)**

$$\frac{1.22\lambda}{(3mm)} = \text{Resolution limit} = \frac{(1mm)}{R}$$

$\therefore$ R = 5 m

41. A thin glass (refractive index 1.5) lens has optical power of – 5D in air. Its optical power in a liquid medium with refractive index 1.6 will be

(1) 1 D (2) -1D
(3) 25 D (4) – 25 D

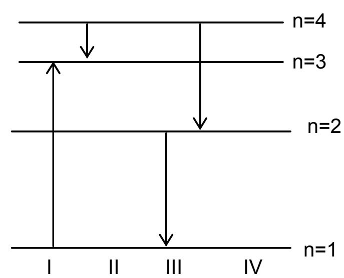
41. **(none)**

$$\frac{P_m}{P_{air}} = \frac{\left(\frac{\mu_\ell}{\mu_a} - 1\right)}{\left(\frac{\mu_\ell}{\mu_m} - 1\right)}$$

P_m=5/8 D

42. The diagram shows the energy levels for an electron in a certain atom. Which transition shown represents the emission of a photon with the most energy ?

(1) III (2) IV
(3) I (4) II



42. **(1)**

$$\Delta E \propto \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

43. If the kinetic energy of a free electron doubles. Its deBroglie wavelength changes by the factor

(1) $\frac{1}{2}$ (2) 2

(3) $\frac{1}{\sqrt{2}}$ (4) $\sqrt{2}$

43. **(3)**

$$\lambda = \frac{h}{\sqrt{2Km}}$$

44. In a common base amplifier, the phase difference between the input signal voltage and output voltage is

(1) $\frac{\pi}{4}$ (2) π

(3) 0 (4) $\frac{\pi}{2}$

44. (3)
No phase difference between input and output signal.

45. In a full wave rectifier circuit operating from 50 Hz mains frequency, the fundamental frequency in the ripple would be
(1) 50 Hz (2) 25 Hz
(3) 100 Hz (4) 70.7 Hz

45. (3)
frequency = 2 (frequency of input signal).

46. A nuclear transformation is denoted by X(n, α) $^{7}_{3}\mathrm{Li}$. Which of the following is the nucleus of element X ?
(1) $^{12}C_6$ (2) $^{10}_{5}B$
(3) $^{9}_{5}B$ (4) $^{11}_{4}Be$

46. (2)
$X+^{1}_{0}n \rightarrow ^{4}_{2}He+^{7}_{3}Li$

47. A moving coil galvanometer has 150 equal divisions. Its current sensitivity is 10 divisions per milliampere and voltage sensitivity is 2 divisions per millivolt. In order that each division reads 1 volt, the resistance in ohms needed to be connected in series with the coil will be
(1) 10^3 (2) 10^5
(3) 99995 (4) 9995

47. (4)
I_g=15mA Vg = 75mV
$R=\frac{V}{I_g}-\frac{V_g}{I_g}$

48. Two voltameters one of copper and another of silver, are joined in parallel. When a total charge q flows through the voltameters, equal amount of metals are deposited. If the electrochemical equivalents of copper and silver are z_1 and z_2 respectively the charge which flows through the silver voltameter is

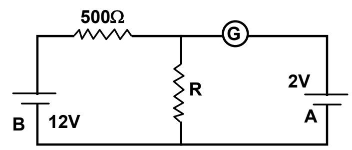
(1) $\frac{q}{1+\frac{z_1}{z_2}}$ (2) $\frac{q}{1+\frac{z_2}{z_1}}$

(3) $q\frac{z_1}{z_2}$ (4) $q\frac{z_2}{z_1}$

48. (2)
$q_1Z_1=q_2Z_2$
$q=q_1+q_2$

$$\therefore\ q_2 = \frac{q}{1+\frac{Z_2}{Z_1}}$$

49. In the circuit, the galvanometer G shows zero deflection. If the batteries A and B have negligible internal resistance, the value of the resistor R will be



(1) 200 Ω (2) 100 Ω
(3) 500 Ω (4) 1000 Ω

49. (2)

$$\frac{12R}{500+R} = 2$$

50. Two sources of equal emf are connected to an external resistance R. The internal resistance of the two sources are R_1 and R_2 ($R_2 > R_1$). If the potential difference across the source having internal resistance R_2 is zero, then

(1) $R = R_2 \times (R_1 + R_2)/R_2 - R_1)$ (2) $R = R_2 - R_1$
(3) $R = R_1R_2 / (R_1 + R_2)$ (4) $R = R_1R_2 / (R_2 - R_1)$

50. (2)

$$I = \frac{2E}{R_1 + R_2 + R}$$

$$E - R_2 I = 0$$

$$\Rightarrow R = R_2 - R_1$$

51. A fully charged capacitor has a capacitance 'C' it is discharged through a small coil of resistance wire embedded in a thermally insulated block of specific heat capacity 's' and mass 'm'. If the temperature of the block is raised by 'ΔT'. The potential difference V across the capacitance is

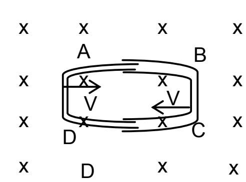
(1) $\sqrt{\frac{2mC\Delta T}{s}}$ (2) $\frac{mC\Delta T}{s}$

(3) $\frac{ms\Delta T}{C}$ (4) $\sqrt{\frac{2ms\Delta T}{C}}$

51. (4)

Dimensionally only 4th option is correct.

52. One conducting U tube can slide inside another as shown in figure, maintaining electrical contacts between the tubes. The magnetic field B is perpendicular to the plane of the figure. if each tube moves towards the other at a constant speed V, then the emf induced in the circuit in terms of B, ℓ and V where ℓ is the width of each tube will be



(1) $B\ell V$ (2) $-B\ell V$
(3) zero (4) $2B\ell V$

52. (4)

$$\left|\frac{d\phi}{dt}\right| = 2B\ell v$$

53. A heater coil is cut into two equal parts and only one part is now used in the heater. The heat generated will now be

(1) doubled (2) four times
(3) one fourth (4) halved

53. (1)

$$H = \frac{V^2 \Delta t}{R}$$

$$H' = \frac{V^2}{R'} \Delta t \qquad \text{Given } R' = R/2$$

54. Two thin, long parallel wires separated by a distance 'd' carry a current of 'i' A in the same direction. They will

(1) attract each other with a force of $\mu_0 i^2/(2\pi d)$
(2) repel each other with a force of $\mu_0 i^2 / (2\pi d)$
(3) attract each other with a force of $\mu_0 i^2(2\pi d^2)$
(4) repel each other with a force of $\mu_0 i^2/(2\pi d^2)$

54. (1)

Using the definition of force per unit length due to two long parallel wires carrying currents.

55. When an unpolarized light of intensity I_0 is incident on a polarizing sheet, the intensity of the light which does not get transmitted is

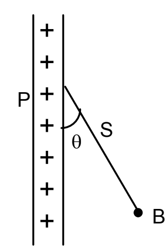
(1) $\frac{1}{2} I_o$ (2) $\frac{1}{4} I_o$
(3) zero (4) I_0

55. (1)

When unpolarised light of intensity I_o is incident on a polarizing sheet, only $I_o/2$ is transmitted.

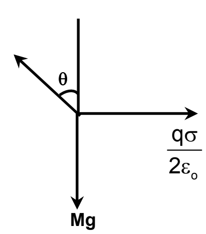
56. A charged ball B hangs from a silk thread S which makes an angle θ with a large charged conducting sheet P, as show in the figure. The surface charge density σ of the sheet is proportional to

(1) $\cos\theta$ (2) $\cot\theta$
(3) $\sin\theta$ (4) $\tan\theta$



56. (4)

$$\tan\theta = \frac{q\sigma}{(2\varepsilon_o)mg}$$



57. Two point charges + 8q and – 2q are located at x = 0 and x = L respectively. The location of a point on the x axis at which the net electric field due to these two point charges is zero is

(1) 2L (2) L/4

(3) 8L (4) 4L

57. **(1)**

$$-\frac{k2q}{(x-L)^2}+\frac{k8q}{x^2}=0$$

$\Rightarrow x = 2L$

58. Two thin wires rings each having a radius R are placed at a distance d apart with their axes coinciding. The charges on the two rings are +q and –q. The potential difference between the centres of the two rings is

(1) $QR/4\pi\varepsilon_0 d^2$

(2) $\frac{Q}{2\pi\varepsilon_0}\left[\frac{1}{R}-\frac{1}{\sqrt{R^2+d^2}}\right]$

(3) zero

(4) $\frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{R}-\frac{1}{\sqrt{R^2+d^2}}\right]$

58. **(2)**

$$v_1=\frac{kq}{R}-\frac{kq}{\sqrt{R^2+d^2}}$$

$$v_2=\frac{-kq}{R}+\frac{kq}{\sqrt{R^2+d^2}}$$

59. A parallel plate capacitor is made by stacking n equally spaced plates connected alternatively. If the capacitance between any two adjacent plates is C then the resultant capacitance is

(1) (n – 1)C (2) (n + 1)C
(3) C (4) nC

59. **(1)**

C_{eq}=(n–1) C ($\because$ all capacitors are in parallel)

60. When two tuning forks (fork 1 and fork 2) are sounded simultaneously, 4 beats per second are heard. Now, some tape is attached on the prong of the fork 2. When the tuning forks are sounded again, 6 beats per seconds are heard. If the frequency of fork 1 is 200 Hz, then what was the original frequency of fork 2?

(1) 200 Hz (2) 202 Hz
(3) 196 Hz (4) 204 Hz

60. **(3)**

$|f_1-f_2| = 4$

Since mass of second tuning fork increases so f_2 decrease and beats increase so $f_1>f_2$

$\Rightarrow f_2=f_1-4 = 196$

61. If a simple harmonic motion is represented by $\frac{d^2x}{dt^2}$ + αx = 0, its time period is

(1) $\frac{2\pi}{\alpha}$

(2) $\frac{2\pi}{\sqrt{\alpha}}$

(3) $2\pi\alpha$

(4) $2\pi\sqrt{\alpha}$

61. **(2)**

$\omega^2=\alpha$

$\omega = \sqrt{\alpha}$

$$T = \frac{2\pi}{\sqrt{\alpha}}$$

62. The bob of a simple pendulum is a spherical hollow ball filled with water. A plugged hole near the bottom of the oscillation bob gets suddenly unplugged. During observation, till water is coming out, the time period of oscillation would
(1) first increase and then decrease to the original value.
(2) first decreased then increase to the original value.
(3) remain unchanged.
(4) increase towards a saturation value.

62. **(1)**

First CM goes down and then comes to its initial position.

63. An observer moves towards a stationary source of sound, with a velocity one fifth of the velocity of sound. What is the percentage increase in the apparent frequency?
(1) zero. (2) 0.5%
(3) 5% (4) 20%

63. **(4)**

$$f = \frac{v + v/5}{v} f = \frac{6f}{5}$$

% increase in frequency = 20%

64. If I_0 is the intensity of the principal maximum in the single slit diffraction pattern, then what will be its intensity when the slit width is doubled?
(1) $2I_0$ (2) $4I_0$
(3) I_0 (4) $I_0/2$

64. **(3)**

Maximum intensity is independent of slit width.

65. Two concentric coils each of radius equal to 2π cm are placed at right angles to each other. 3 Ampere and 4 ampere are the currents flowing in each coil respectively. The magnetic induction in Weber/m^2 at the centre of the coils will be ($\mu_0 = 4\pi \times 10^{-7}$ Wb/A-m)
(1) 12×10^{-5} (2) 10^{-5}
(3) 5×10^{-5} (4) 7×10^{-5}

65. **(3)**

$$B = \frac{\mu_o}{2r}\sqrt{I_1^2 + I_2^2}$$

$$B = \frac{4\pi \times 10^{-7}}{2 \times 2\pi \times 10^{-2}} \times 5$$

$B = 5\times10^{-5}$

66. A coil of inductance 300 mH and resistance 2Ω is connected to a source of voltage 2V. The current reaches half of its steady state value in
(1) 0.05 s (2) 0.1 s

(3) 0.15 s (4) 0.3 s

66. (2)

$$I = I_o\left(1 - e^{-\frac{R}{L}t}\right)$$

$$0.693 = \frac{R}{L}t$$

$$t = \frac{.3 \times 0.693}{2} = 0.1\text{sec}$$

67. The self inductance of the motor of an electric fan is 10 H. In order to impart maximum power at 50 Hz, it should be connected to a capacitance of

(1) 4μF (2) 8μF
(3) 1μF (4) 2μF

67. (3)

$$f = \frac{1}{2\pi\sqrt{LC}}$$

$$C = \frac{1}{4 \times \pi^2 f^2 \times 10}$$

C = 1μF

68. An energy source will supply a constant current into the load of its internal resistance is

(1) equal to the resistance of the load.
(2) very large as compared to the load resistance.
(3) zero.
(4) non-zero but less than the resistance of the load.

68. (2)

$$I = \frac{E_o}{R + r} \approx \frac{E}{r} \text{ if } R << r$$

69. A circuit has a resistance of 12 Ω and an impedance of 15 Ω. The power factor of the circuit will be

(1) 0.8 (2) 0.4
(3) 1.25 (4) 0.125

69. (1)

$$\cos\phi = \frac{R}{Z} = \frac{12}{15} = \frac{4}{5} = 0.8$$

70. The phase difference between the alternating current and emf is π/2. Which of the following cannot be the constituent of the circuit?

(1) C alone (2) R.L
(3) L. C (4) L alone

70. (2)

0<phase difference for R-L circuit < π/2

71. A uniform electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected along the direction of the fields with a certain velocity then
(1) its velocity will decrease. (2) its velocity will increase.
(3) it will turn towards right of direction of motion. (4) it will turn towards left of direction of motion.

71. (1)

$$\vec{F} = -e\left[\vec{E} + \vec{v} \times \vec{B}\right] = -e\vec{E}$$

$$\vec{a} = -\frac{e\vec{E}}{m}$$

$$v(t) = v_o - \frac{eE}{m}t$$

72. A charged particle of mass m and charge q travels on a circular path of radius r that is perpendicular to a magnetic field B. The time taken by the particle to complete one revolution is

(1) $\frac{2\pi mq}{B}$ (2) $\frac{2\pi q^2 B}{m}$

(3) $\frac{2\pi qB}{m}$ (4) $\frac{2\pi m}{qB}$

72. (4)

$m\omega^2 r = Bq\omega r$

ω = Bq/m

$$T = \frac{2\pi m}{qB}$$

73. In a potentiometer experiment the balancing with a cell is at length 240 cm. On shunting the cell with a resistance of 2Ω the balancing length becomes 120 cm. The internal resistance of the cell is
(1) 1 Ω (2) 0.5 Ω
(3) 4 Ω (4) 2 Ω

73. (4)

$$r = R\left[\frac{\ell_1}{\ell_2} - 1\right] = 2\left[\frac{240}{120} - 1\right] = 2\Omega$$

74. The resistance of hot tungsten filament is about 10 times the cold resistance. What will be the resistance of 100 W and 200 V lamp when not in use?
(1) 40 Ω (2) 20 Ω
(3) 400 Ω (4) 200 Ω

74. (1)

$$R_{hot} = \frac{V^2}{P} = \frac{200 \times 200}{100} = 400\Omega$$

cold resistance = R_{hot}/10 = 400/10 = 40 Ω

75. A magnetic needle is kept in a non-uniform magnetic field. It experiences
(1) a torque but not a force (2) neither a force nor a torque
(3) a force and a torque. (4) a force but not a torque.

75. **(3)**

In non uniform magnetic field, dipole experiences both force and torque.