

1. The time period of a simple pendulum is given by

$$T = k l^a g^b$$

where k , a and b are constants. By using dimensional analysis, the values of a and b are :
(l is the length of pendulum and g is the acceleration due to gravity)

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

2. Two statements are given below, one is labelled as **Assertion (A)** and other as **Reason (R)**.

Assertion (A) : Expression : $\sqrt{\frac{\text{Young modulus}}{\text{Density}}}$ has units m/s

Reason (R) : Acceleration has dimensions as that of $\frac{1}{(\sqrt{\mu_0 \epsilon_0})t}$

Select the correct answer using code below.

- (a) **(A)** and **(R)** both are true and **(R)** is the correct explanation of **(A)**.
(b) **(A)** and **(R)** both are true and **(R)** is not the correct explanation of **(A)**.
(c) **(A)** is true but **(R)** is false.
(d) **(A)** is false but **(R)** is true.
- (1) (a)
(2) (b)
(3) (c)
(4) (d)

3. Physical quantity, which have neither units nor dimensions is :

- (1) Pressure
(2) Stress
(3) Poisson's ratio
(4) Bulk modulus

4. A small ball is moving with uniform speed v in a circle of radius R . If T is the time period of its motion, its acceleration is given by :

- (1) $\left(\frac{2\pi}{T}\right)^2 R$
(2) $\left(\frac{\pi}{T}\right)^2 R$
(3) $\left(\frac{2\pi}{T}\right)^2 R^2$
(4) $\left(\frac{\pi}{T}\right)^2 R^2$

5. The position x (in meter) of four objects A, B, C and D are given by following equations where time t is in second :

$$A : x = 3.0 + 4.0 t + 5.0 t^2$$

$$B : x = -4.0 + 5.0 t$$

$$C : x = 5.0 t + 6.0 t^2$$

$$D : x = 6.0 t^3$$

Which of them is moving with a uniform speed ?

- (1) A
- (2) B
- (3) C
- (4) D

6. The velocity v (in m/s) of an object changes with time t (in second) as :

$$v = 2.0 + 1.0 t^2.$$

The average acceleration of the object for the duration $t = 1.0$ s to $t = 3.0$ s is :

- (1) 4.0 m/s^2
- (2) 7.0 m/s^2
- (3) 9.0 m/s^2
- (4) 11.0 m/s^2

7. Consider two vectors $\vec{A}$ and $\vec{B}$, as given below :

$$\vec{A} = 2\hat{i} + 2\hat{j}$$

$$\vec{B} = 1\hat{i} + 3\hat{j}$$

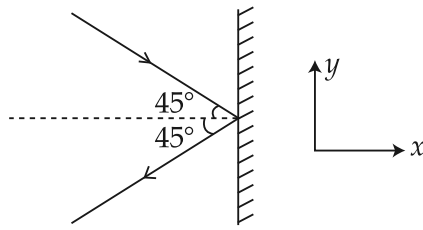
Where $\hat{i}$ and $\hat{j}$ are unit vectors along x - axis and y - axis respectively.

The angle between $\vec{A}$ and $\vec{B}$, when their tails coincide is equal to :

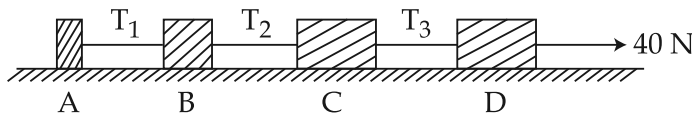
- (1) $\cos^{-1}\left(\sqrt{\frac{2}{5}}\right)$
- (2) $\cos^{-1}\left(\sqrt{\frac{3}{5}}\right)$
- (3) $\cos^{-1}\left(\sqrt{\frac{4}{5}}\right)$
- (4) $\cos^{-1}\left(\frac{2}{5}\right)$

8. A small ball is projected from (0 m, 0 m) in $x - y$ plane at $t = 0$ s. Its velocity $\vec{v}$ (in m/s) at $t = 1.0$ s is $\vec{v} = 32\hat{i} + 14\hat{j}$. Here $\hat{i}$ and $\hat{j}$ are unit vectors along x - axis and y - axis respectively. The time of flight of the ball is : (take $g = 10 \text{ m/s}^2$)
- (1) 2.4 s
 - (2) 4.8 s
 - (3) 6.0 s
 - (4) 7.2 s
9. Komal is cycling on a level circular road of radius 16.0 m. The coefficient of static friction between the tyres and the road is 0.1. The maximum speed with which she can cycle without slipping is : (take $g = 10 \text{ m/s}^2$)
- (1) 2.0 m/s
 - (2) 4.0 m/s
 - (3) 6.0 m/s
 - (4) 8.0 m/s
10. A man (mass 65 kg) stands on a weighing scale in a lift which is moving upwards with a uniform acceleration of 2 m/s^2 . The reading in the weighing scale will be : (take $g = 10 \text{ m/s}^2$)
- (1) 26 kg
 - (2) 39 kg
 - (3) 52 kg
 - (4) 78 kg
11. Two forces $\vec{F}_1$ and $\vec{F}_2$, given by :
- $\vec{F}_1 = (6.0 \text{ N}) \hat{i}$ and $\vec{F}_2 = (8.0 \text{ N}) \hat{j}$, act simultaneously on a ball of mass 1.0 kg. Here $\hat{i}$ and $\hat{j}$ are unit vectors along x -axis and y -axis respectively. The acceleration of the ball has a magnitude _____ and it makes an angle of _____ with the x - axis.
- (1) $5.0 \text{ m/s}^2, \tan^{-1}\left(\frac{3}{4}\right)$
 - (2) $5.0 \text{ m/s}^2, \tan^{-1}\left(\frac{4}{3}\right)$
 - (3) $10 \text{ m/s}^2, \tan^{-1}\left(\frac{3}{4}\right)$
 - (4) $10 \text{ m/s}^2, \tan^{-1}\left(\frac{4}{3}\right)$

12. A ball of mass 0.28 kg strikes a rigid wall with a speed of 4.0 m/s and is reflected with the same speed, as shown in the figure. The magnitude of impulse imparted to the ball by the wall is close to :



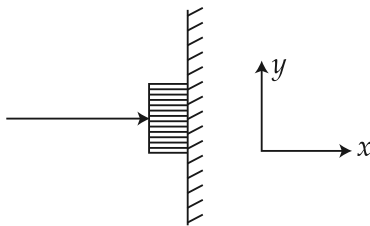
- (1) 0.8 Ns
 (2) 1.6 Ns
 (3) 3.1 Ns
 (4) 0
13. Four boxes A(1.0 kg), B(2.0 kg), C(3.0 kg) and D(4.0 kg) are lying on a smooth horizontal surface and are connected by light strings, as shown in the figure.



Box D is pulled by a force of 40 N applied horizontally. T_1 , T_2 and T_3 are tensions in the strings, as

shown. The ratio $\left(\frac{T_3}{T_2}\right)$ is :

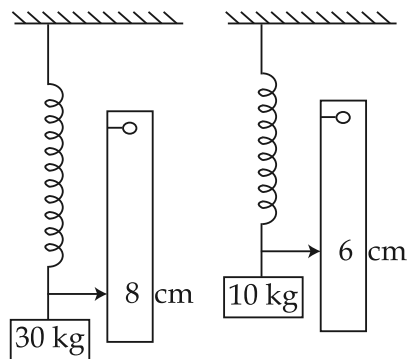
- (1) 1
 (2) 2
 (3) 3
 (4) 4
14. A box of mass 0.30 kg is pressed against a wall by a force of 9.0 N, as shown in the figure. The coefficient of static friction between the wall and the block is 0.5. The magnitude of net force exerted by the wall on the box is close to : (take $g = 10 \text{ m/s}^2$)



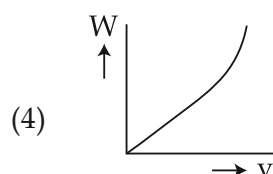
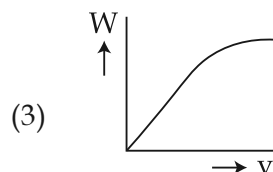
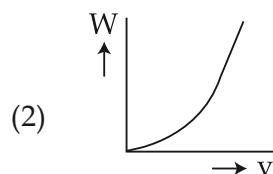
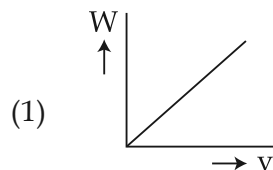
- (1) 3.0 N
 (2) 6.0 N
 (3) 9.0 N
 (4) 9.5 N
15. A ball is made to uniformly move on a horizontal circular path. The work done by the agency providing necessary force for one complete revolution of the ball is zero because :
- (1) the average force for each revolution is zero.
 (2) there is no friction.
 (3) the force is perpendicular to the velocity of ball throughout the motion.
 (4) there is no gravitational force acting on the ball.

16. As shown in the two figures below the pointer attached to springs indicate different extensions in two identical springs.

Which one of the following values correctly gives the mass that need to be hunged through either of the two springs to produce an extension of 10 cm ? ($g = 10 \text{ m/s}^2$)

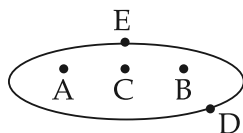


- (1) 8 kg
(2) 18 kg
(3) 42 kg
(4) 50 kg
17. An object starts moving on a frictionless surface under the application of a uniform horizontal force. Which one of the following graph correctly depicts, the work(W) done by the force as a function of object speed (v) ?



18. An object moves along a straight line from position $x=0$ m to $x=5$ m under a variable force $(6x^2 - 3x + 9)$ N. What is the work done by the force in moving the object from $x=0$ m to $x=4$ m ?
- (1) 515 N.m
 - (2) 257.5 N.m
 - (3) 280 N.m
 - (4) 140 N.m
19. A motor delivers a power of 30 kW to a lift of 900 kg mass to uniformly carry 600 kg load in upward direction. If the frictional force that opposes the motion of lift is 6000 N, what is the speed of the lift ? (The acceleration due to gravity = 10 m/s^2)
- (1) about 2.0 m/s
 - (2) about 1.8 m/s
 - (3) about 1.4 m/s
 - (4) about 1.0 m/s
20. Two bodies A and B of masses 10 kg and 2 kg respectively are moving in space. Their position are changing with time as :
- $$\vec{r}_A = (5\hat{i} - 7\hat{j} - 3\hat{k}) t \text{ (m)}$$
- $$\vec{r}_B = (-13\hat{i} + 35\hat{j} - 9\hat{k}) t \text{ (m)}$$
- (The symbols carry their usual meanings). What is the velocity of their centre of mass ?
- (1) $(6\hat{i} + 3\hat{j} - 4\hat{k}) \text{ m/s}$
 - (2) $(-7\hat{i} + 28\hat{j} - 12\hat{k}) \text{ m/s}$
 - (3) $(2\hat{i} - 4\hat{k}) \text{ m/s}$
 - (4) $2(\hat{i} - \hat{k}) \text{ m/s}$
21. A flywheel which is rotating initially has an angular speed of 18 rad/s . It is brought down to rest at a rate of 2.0 rad/s^2 . What is the appropriate number of turns the flywheel might have made before it stops ?
- (1) 13
 - (2) 26
 - (3) 39
 - (4) 52

22. A light inextensible cord is wound round the rim of a frictionless pulley of mass 10 kg and radius 15 cm mounted on a horizontal axis with frictionless bearings. The free end of the cord is pulled by a steady force of 20 N. What is the value of angular acceleration of the pulley ?
- (1) $\left(\frac{80}{3}\right) \text{ N/kg}$
 - (2) $\left(\frac{80}{3}\right) \text{ rad s}^{-2}$
 - (3) $\left(\frac{12\pi}{9}\right) \text{ rad s}^{-2}$
 - (4) $\left(\frac{24\pi}{5}\right) \text{ rad s}^{-2}$
23. An electron having mass $9.0 \times 10^{-31} \text{ kg}$ is revolving around a nucleus of an atom in an approximate circular orbit of radius 0.25 m. The linear speed of the electron is 10^7 m/s . The kinetic energy and the angular momentum of the electron are respectively :
- (1) $45 \times 10^{-17} \text{ J}$; $22.5 \times 10^{-34} \text{ kg m}^2/\text{s}$
 - (2) $4.5 \times 10^{-17} \text{ J}$; $2.25 \times 10^{-34} \text{ kg m}^2/\text{s}$
 - (3) 280 eV; $2.25 \times 10^{-33} \text{ kg m}^2/\text{s}$
 - (4) 280 eV; $22.5 \times 10^{-33} \text{ kg m}^2/\text{s}$
24. Assuming the earth is a uniform sphere of radius R, the variation in the value of acceleration due to gravity with respect to height (h) and with respect to depth d above and below the surface of earth are approximately :
- [g is the acceleration due to gravity on the surface of the earth.]
- (1) $g\left(1 - \frac{2h}{R}\right)$ and $g\left(1 - \frac{2d}{R}\right)$ respectively
 - (2) $g\left(1 - \frac{h}{R}\right)$ and $g\left(1 - \frac{d}{R}\right)$ respectively
 - (3) $g\left(1 - \frac{2h}{R}\right)$ and $g\left(1 - \frac{d}{R}\right)$ respectively
 - (4) $g\left(1 - \frac{h}{R}\right)$ and $g\left(1 - \frac{2d}{R}\right)$ respectively
25. The figure given below shows an elliptical orbit of a planet around the Sun.



Which letters, labels the correct positions of the Sun and planet respectively ?

- (1) A and C
- (2) A and B
- (3) A and D
- (4) C and E

26. A 1000 kg satellite is orbiting about the earth in a circular orbit of radius twice the radius of earth. It now needs to be transferred to another circular orbit of radius four times the radius of earth. The acceleration due to gravity at the surface of the earth is 9.8 m/s^2 and the radius of the earth is 6400 km. The amount of energy needed to transfer the satellite; the changes in its kinetic and potential energies, respectively are close to :

- (1) $2.6 \times 10^9 \text{ J}$; 0 ; $2.6 \times 10^9 \text{ J}$
- (2) $2.6 \times 10^9 \text{ J}$; $1.3 \times 10^9 \text{ J}$; $1.3 \times 10^9 \text{ J}$
- (3) $2.6 \times 10^9 \text{ J}$; $-2.6 \times 10^9 \text{ J}$; $5.2 \times 10^9 \text{ J}$
- (4) $2.6 \times 10^9 \text{ J}$; $+2.6 \times 10^9 \text{ J}$; 0

27. Two cylindrical metallic wires A and B of same material having cross-sectional area A and 2A, and lengths L and 2L respectively are stretched within the proportional elastic limits by the same force F. If the wire A is stretched by 1 cm, the stretch in the wire B would be :

- (1) 0.25 cm
- (2) 0.50 cm
- (3) 1.00 cm
- (4) 2.50 cm

28. Match the List I and List II.

List I (Physical quantity)	List II (Expression)
(A) Speed of sound in air	(p) $\sqrt{\frac{\gamma RT}{M}}$
(B) r.m.s. speed of gas molecules	(q) $\sqrt{\frac{8RT}{\pi M}}$
(C) Average speed of gas molecules	(r) $\sqrt{\frac{3RT}{M}}$
(D) Most probable speed of gas molecules	(s) $\sqrt{\frac{2RT}{M}}$

- | | | | |
|---------|-----|-----|-----|
| (A) | (B) | (C) | (D) |
| (1) (p) | (r) | (q) | (s) |
| (2) (r) | (p) | (q) | (s) |
| (3) (p) | (q) | (r) | (s) |
| (4) (q) | (r) | (s) | (p) |

29. Two gases are at absolute temperatures 300 K and 350 K respectively. Ratio of average kinetic energy of their molecule is :

- (1) 6 : 7
- (2) 7 : 6
- (3) 36 : 49
- (4) 49 : 36

30. Two temperature scales A and B are related by

$$\frac{A - 42}{110} = \frac{B - 72}{220}$$

At which temperature the two scales would show same readings :

- (1) -42°C
 - (2) $+40^{\circ}\text{C}$
 - (3) -40°C
 - (4) 12°C
31. The length of a uniform aluminium rod is 1.0 m and its area of cross-section is $5.0 \times 10^{-4} \text{ m}^2$. It's one end is kept at 300°C and the other end at 100°C . The thermal conductivity of the aluminium is $205 \text{ Js}^{-1}\text{m}^{-1} \text{ K}^{-1}$. If the heat loss through the sides of rod by convection and radiation are negligible and the heat flow is normal to the faces of the rod, the amount of approximate heat flow in 5 minutes would be :
- (1) 600 J
 - (2) 3000 J
 - (3) 1500 J
 - (4) 6000 J
32. If molecular density of a gas is n and the diameter of its molecules is d . Then mean free path of its molecules is :
- (1) $\frac{\pi}{d^2 n}$
 - (2) $\frac{1}{\sqrt{2} \pi d^2 n}$
 - (3) $\frac{1}{\pi d n}$
 - (4) $\frac{1}{3\sqrt{2} \pi d n}$
33. A gas for which $\gamma = 1.5$ is suddenly compressed to $\frac{1}{4}$ of initial volume, then what is the ratio of final to initial pressures ? (γ is the ratio of specific heat of the gas at constant pressure and at constant volume)
- (1) 1 : 16
 - (2) 1 : 8
 - (3) 1 : 4
 - (4) 8 : 1
34. Which one of the following thermodynamic process may lead to a zero change in entropy ?
- (1) A non - cyclic isobaric process
 - (2) A non - cyclic isochoric process
 - (3) A non - cyclic isothermal process
 - (4) A closed cycle

35. A Carnot engine working between 0°C to 100°C takes up nearly 1120 J of heat from the source per cycle. The amount of heat rejected per cycle to the sink is close to :
- (1) 0 J
 - (2) 560 J
 - (3) 900 J
 - (4) 1020 J
36. The mass of 1 mole of air is 29.0×10^{-3} kg. Considering the air as an ideal gas, the speed of sound in air at standard temperature and pressure is close to :
- (1) 342 m/s
 - (2) 330 m/s
 - (3) 300 m/s
 - (4) 280 m/s
37. Two travelling sinusoidal sound waves have same amplitudes and frequencies. They can produce a fully constructive interference only if :
- (1) they travel in the same direction and are 180° out of phase.
 - (2) they travel in the same direction and are in phase.
 - (3) they travel in opposite directions and are in phase.
 - (4) they travel in opposite directions and are 180° out of phase.
38. A source producing sound of frequency 1280 Hz is moving with a speed of 36 km/h towards a distant observer. The speed of sound in air is 330 m/s. The observer moves towards the source with a speed of 72 km/h . The frequency of sound as heard by the observer is :
- (1) 1400 Hz
 - (2) 1317 Hz
 - (3) 1297 Hz
 - (4) 1240 Hz
39. A spring having spring constant of 90 N/m is attached with a block of mass 200 g. It oscillates in a surrounding viscous medium having 40 g/s damping constant. The time period of oscillation and the time taken for its mechanical energy to drop to half of its initial value are respectively about :
- (1) 3 s, 3.5 s
 - (2) 3 s, 7 s
 - (3) 0.3 s, 7 s
 - (4) 0.3 s, 3.5 s
40. A pendulum bob executes simple harmonic motion. Which one of the following statements is true for the bob's motion ? (Air resistance can be neglected)
- (1) It has constant speed throughout a complete cycle.
 - (2) It has varying time period throughout a complete cycle.
 - (3) It has varying acceleration throughout a complete cycle.
 - (4) It has varying weight throughout a complete cycle.

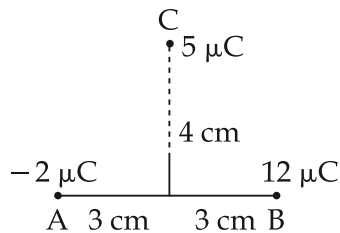
41. Amplitude of a damped harmonic oscillator :
- (1) decreases linearly
 - (2) decreases exponentially
 - (3) increases linearly
 - (4) remains constant
42. The phase difference (ϕ) and the path difference (χ) of a progressive wave of wavelength ' λ ' are related as :
- (1) $\phi = \frac{2\pi\chi}{\lambda}$
 - (2) $\phi = \frac{\chi}{2\pi\lambda}$
 - (3) $\phi = 2\pi\lambda\chi$
 - (4) $\phi = \frac{\lambda}{2\pi\chi}$
43. Two charges A($1.0 \mu\text{C}$) and B($-5.0 \mu\text{C}$) are located at points (0 cm, 0 cm) and (4 cm, -3cm) respectively. The force exerted by charge A on charge B is : ($\hat{i}$ and $\hat{j}$ are unit vectors along x - axis and y - axis respectively and $\left[\frac{1}{4\pi\epsilon_0} \right] = 9 \times 10^9 \text{ N m}^2/\text{C}^2$)
- (1) $-(10.8 \text{ N})\hat{i} + (14.4 \text{ N})\hat{j}$
 - (2) $(10.8 \text{ N})\hat{i} - (14.4 \text{ N})\hat{j}$
 - (3) $-(14.4 \text{ N})\hat{i} + (10.8 \text{ N})\hat{j}$
 - (4) $(14.4 \text{ N})\hat{i} - (10.8 \text{ N})\hat{j}$
44. The magnitudes of electric fields due to an electric dipole (consisting of charges q and $-q$, separated by distance $2a$) at a distance $r \gg a$, on its axis and on its equatorial plane are E_1 and E_2 respectively. The ratio $\left(\frac{E_2}{E_1} \right)$ is :
- (1) $\frac{1}{2}$
 - (2) 1
 - (3) 2
 - (4) $\frac{1}{4}$

45. Four charges A ($18 \mu\text{C}$), B ($27 \mu\text{C}$), C ($-18 \mu\text{C}$) and D ($-27 \mu\text{C}$) are located at points (0 cm, 0 cm, 0 cm), (0 cm, 5 cm, 0 cm), (0 cm, 7 cm, 0 cm) and (0 cm, 10 cm, 0 cm) respectively. A sphere of radius 6 cm is drawn with its centre at (0 cm, 0 cm, 0 cm). The electric flux through this sphere is :

(take $\epsilon_0 = 9 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$)

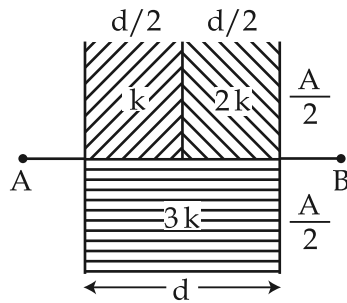
- (1) 0 Vm
 - (2) $2.0 \times 10^6 \text{ Vm}$
 - (3) $5.0 \times 10^6 \text{ Vm}$
 - (4) $10 \times 10^6 \text{ Vm}$
46. A capacitor is connected to a 50 V battery. The magnitude of charge on each plate is 10 mC. The energy stored in the capacitor is :
- (1) 0.25 J
 - (2) 0.30 J
 - (3) 0.35 J
 - (4) 0.50 J
47. Three charges of $-2 \mu\text{C}$, $12 \mu\text{C}$ and $5 \mu\text{C}$ are placed at points A, B and C respectively, as shown

in figure. The potential energy of this system of charges is : (take $\left[\frac{1}{4\pi\epsilon_0} \right] = 9 \times 10^9 \text{ N m}^2/\text{C}^2$)

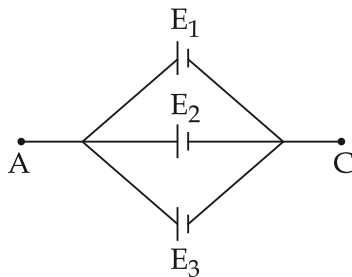


- (1) 0.54 J
- (2) 1.62 J
- (3) 5.4 J
- (4) 16.2 J

48. A parallel plate capacitors with plate area A and plate separation d is filled with three dielectric slabs of dielectric constants k , $2k$ and $3k$, as shown in figure. The area and thickness of three slabs are $\left(\frac{A}{2}, \frac{d}{2}\right)$, $\left(\frac{A}{2}, \frac{d}{2}\right)$ and $\left(\frac{A}{2}, d\right)$ respectively. C_0 and C are the capacitances of the capacitor without slabs and with slabs. Then $\left(\frac{C}{C_0}\right)$ is :

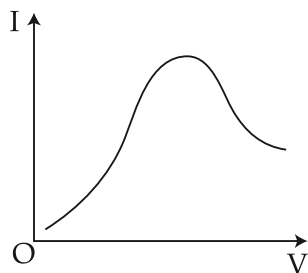


- (1) $\left(\frac{9}{6}\right)k$
- (2) $\left(\frac{11}{6}\right)k$
- (3) $\left(\frac{13}{6}\right)k$
- (4) $\left(\frac{15}{6}\right)k$
49. Three cells E_1 , E_2 and E_3 , having emfs 6 V , 3 V and 2 V and internal resistances $1\ \Omega$, $0.5\ \Omega$ and $\left(\frac{2}{3}\right)\ \Omega$ respectively are connected as shown in figure. The equivalent emf of the combination, between points A and C is :



- (1) 11 V
- (2) 7 V
- (3) $\left(\frac{10}{3}\right)\text{ V}$
- (4) 3 V

50. Which one of the statements is true for carbon resistors ?
- They are large in size and usually have resistance values in higher range.
 - They are compact in size and usually have resistance values in higher range.
 - They are compact in size and usually have resistance values in lower range.
 - They are compact in size, expensive and made of different colours.
51. Two bulbs of 40 W and 60 W are connected with a 220 V main line. The ratio of their resistances are :
- 3 : 4
 - 4 : 3
 - 2 : 3
 - 3 : 2
52. A wire of resistance R is divided in 10 equal parts. These parts are connected in parallel. The equivalent resistance of such combination will be :
- 0.01 R
 - 0.1 R
 - 10 R
 - 100 R
53. In an electric circuit, a device is connected with a variable power source. The voltage - current graph for the device is seen to be as shown below.



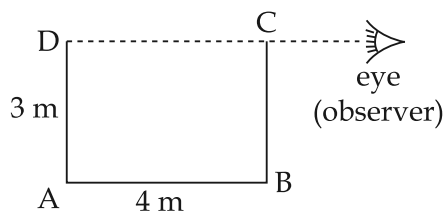
This device could be a :

- Nichrome wire
 - Si - device
 - Ga As device
 - Copper wire
54. Pieces of Al and Ge are placed at room temperature before they are heated. Which one of the following statements is true for their resistances in this context ?
- Resistance will increase in each case
 - Resistance will decrease in each case
 - Resistance of Al will increase while that of Ge will decrease
 - Resistance of Al will decrease while that of Ge will increase
55. Which of the following is a ferromagnetic substance ?
- Sodium
 - Water
 - Sodium chloride
 - Cobalt

56. A current of 6.0 A is maintained in a long straight wire. The magnitude of magnetic field at a distance of 30 cm from the wire is : ($\mu_0 = 4\pi \times 10^{-7} \text{ Tm/A}$)
- (1) 2.0 μT
 - (2) 4.0 μT
 - (3) 12.6 μT
 - (4) 25.1 μT
57. A rectangular coil of sides 8.0 cm and 10 cm, with 100 closely wound turns, carries a current of 2.0 A. It is suspended vertically in a uniform magnetic field of 0.5 T such that the plane of the coil makes an angle of 30° with the field. The magnitude of torque experienced by the coil is close to :
- (1) 0.20 Nm
 - (2) 0.40 Nm
 - (3) 0.69 Nm
 - (4) 1.39 Nm
58. Two long straight parallel conductors A and B, separated by 12 cm, carry currents of 6 A and 12 A respectively in the same direction. The force exerted by conductor B on 1 cm segment of conductor A is : ($\mu_0 = 4\pi \times 10^{-7} \text{ Tm/A}$)
- (1) attractive with a magnitude of 0.6 μN
 - (2) repulsive with a magnitude of 0.6 μN
 - (3) attractive with a magnitude of 1.2 μN
 - (4) repulsive with a magnitude of 1.2 μN
59. A 2.0 cm straight segment of a wire (part of a circuit), centred at (0 cm, 0 cm) lies along y - axis. It carries a current of 10 A along y - axis. The magnetic field at a point $(-20 \text{ cm}, 0 \text{ cm})$ is ($\hat{i}$, $\hat{j}$ and $\hat{k}$ are unit vectors along x - axis, y - axis and z - axis respectively and $\mu_0 = 4\pi \times 10^{-7} \text{ Tm/A}$)
- (1) $-(1.0 \mu\text{T}) \hat{k}$
 - (2) $(1.0 \mu\text{T}) \hat{k}$
 - (3) $-(0.5 \mu\text{T}) \hat{k}$
 - (4) $(0.5 \mu\text{T}) \hat{k}$
60. The energy required to build up a current I in a coil of self - inductance L is given by :
- (1) $\left(\frac{1}{4}\right) LI^2$
 - (2) $\left(\frac{1}{2}\right) LI^2$
 - (3) LI^2
 - (4) $4LI^2$

61. A Solenoid of cross-sectional area $5 \times 10^{-4} \text{ m}^2$ and length 1.5 m consists of 100 turns per unit length. The self inductance of the solenoid is : ($\mu_0 = 4\pi \times 10^{-7} \text{ Tm/A}$)
- (1) $1.5\pi \text{ } \mu\text{H}$
 - (2) $3.0\pi \text{ } \mu\text{H}$
 - (3) $0.15\pi \text{ } \mu\text{H}$
 - (4) $0.30\pi \text{ } \mu\text{H}$
62. A 1.0 m long metallic rod is rotated with a frequency of 30 rev/s about an axis perpendicular to the rod passing through its one end. The other end of the rod is in contact with a circular metallic ring. A constant and uniform magnetic field of 0.8 T exists in the region parallel to the axis. The emf developed between the centre and the ring is :
- (1) 6 V
 - (2) $6\pi \text{ V}$
 - (3) 24 V
 - (4) $24\pi \text{ V}$
63. A sinusoidal voltage of peak value 282 V and frequency 50 Hz is applied to a series LCR circuit ($R=16 \text{ } \Omega$, $X_L=32 \text{ } \Omega$, $X_C=20 \text{ } \Omega$, symbols have their usual meanings). The power dissipated in the circuit and the power factor are respectively :
- (1) 3.2 kW, 0.4
 - (2) 3.2 kW, 0.8
 - (3) 1.6 kW, 0.4
 - (4) 1.6 kW, 0.8
64. A parallel beam of monochromatic light in air is incident on a plane glass slab. Which one of the following statements is true in this context ?
- (1) The beam remains parallel inside the glass slab but its direction may change.
 - (2) The beam undergoes dispersion inside the glass slab.
 - (3) The beam becomes diverging inside the glass slab.
 - (4) The parallel beam would always pass through the plane glass slab undeviated.
65. The radius of curvature of a convex spherical surface is 10 cm. Light from a point source is incident on this surface and it gets refracted into a medium whose refractive index is 1.5. If the beam is expected to travel parallel to the principal axis after refraction, where should be the light source be placed on the principal axis ? (The light source is placed in air.)
- (1) 6.7 cm from the surface
 - (2) 10 cm from the surface
 - (3) 15 cm from the surface
 - (4) 20 cm from the surface

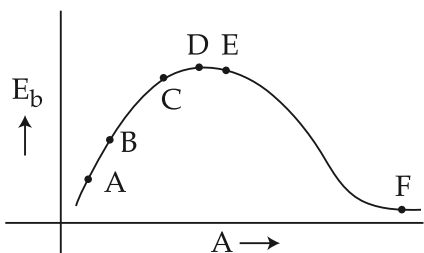
66. A metallic tank as shown in the figure is filled with a liquid whose properties are not known. An observer, whose eyes are in level with the top of this rectangular tank, is just able to see the corner point A. What could be the refractive index of the liquid ?



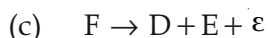
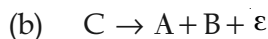
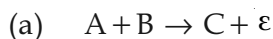
- (1) 1.75
 - (2) 1.67
 - (3) 1.50
 - (4) 1.25
67. Which one of the following is related with the prediction of the electromagnetic wave nature of light ?
- (1) Huygens principle
 - (2) Newton's corpuscular model
 - (3) Snell's law
 - (4) Maxwell theory
68. A refracting telescope whose objective lens has focal length 1500 cm, is used to view the moon. The eye - piece of the telescope has 1.0 cm focal length. The diameter of moon is 3.5×10^6 m and the average distance of moon from the telescope is about 3.8×10^8 m. What is the radius of the image of the moon formed by the objective lens ?
- (1) 138 cm
 - (2) 69 cm
 - (3) 13.8 cm
 - (4) 6.9 cm
69. Two polaroids are so placed in air that the intensity of light ($\lambda = 500$ nm) transmitted by them is maximum. Now if one of the polaroid is rotated through an angle of 60° , then to what percentage of its maximum value is the intensity of transmitted light will be reduced ?
- (1) It will remain the same
 - (2) It will be reduced to 75%
 - (3) It will be reduced to 60%
 - (4) It will be reduced to 25%
70. For a certain photosensitive material in a photoelectric apparatus, which one of the following statements is **NOT** true ?
- (1) The photoelectric current is directly proportional to the intensity of incident radiation of a given frequency.
 - (2) The saturation current is proportional to the intensity of incident radiation of a given frequency.
 - (3) The stopping potential is independent of the intensity of incident radiation of a given frequency.
 - (4) Both the saturation current and stopping potential vary linearly with the intensity of incident radiation of a given frequency.

71. What is the de Broglie wavelength associated with an electron moving with a speed of 4.12×10^5 m/s. (mass of electron = 9.11×10^{-31} kg; Planck's constant = 6.63×10^{-34} J.s)
- (1) 0.176 nm
 - (2) 0.88 nm
 - (3) 176
 - (4) 1.76 nm
72. An electron is accelerated through a potential difference of 50 V. Which one of the following statements could be true for this electron ? (Planck's constant = 6.63×10^{-34} J.s, mass of electron = 9.11×10^{-31} kg, charge of electron = 1.6×10^{-19} C).
- (1) The associated de Broglie wavelength is about 0.175 nm that is of the order of X - ray wavelengths.
 - (2) The associated de Broglie wavelength is about 170 nm that is of the order of Infrared wavelengths.
 - (3) The associated de Broglie wavelength is about 125 nm that is of the order of X - ray wavelengths.
 - (4) The associated de Broglie wavelength is about 300 nm that corresponds to visible region.
73. Which one of the following statements is **NOT** correct ?
- (1) The nuclear forces are short - range.
 - (2) The nuclear force between neutron - neutron, proton - proton, proton - neutron is approximately same.
 - (3) The nuclear forces are stronger than both Coulombian forces and gravitational forces.
 - (4) The nuclear forces between neutron - neutron and proton - proton are defined differently.
74. Work function of a metal is :
- (1) the minimum energy needed by an electron to come out from the metal surface.
 - (2) the minimum energy needed by an electron to come out from the nucleus of the metallic atom.
 - (3) the minimum energy needed by an nucleon to come out from the nucleus of the metal.
 - (4) the total work done by an electron to come out from the metal surface.

75. The graph below shows the binding energy per nucleon (E_b) as a function of atomic mass number (A).



Symbols A, B, C, D, E and F represents different nuclei. Consider the following three reactions :



Here the symbol ε represents the energy released. Which of these reactions have ε positive ?

- (1) (a) and (c) only
 - (2) (a) and (b) only
 - (3) (c) only
 - (4) (a) only
76. The mass of a ${}^8\text{O}^{16}$ nuclide is 15.99053 u. What is the mass defect of this nuclide in units of MeV/c^2 ? ($c = 3 \times 10^8 \text{ m/s}$, mass of electron = 0.00055 u; mass of proton = 1.00727 u; mass of neutron = 1.00866 u; electron charge = $1.6 \times 10^{-19} \text{ C}$; and $1 \text{ u} = 1.6605 \times 10^{-27} \text{ kg}$)
- (1) about 100
 - (2) about 930
 - (3) about 500
 - (4) about 127
77. In an alpha - particle scattering experiment, an alpha - particle of 4 MeV energy approaches a target nuclei that has atomic number 79. What is the approximate distance of closest approach of the alpha - particle before it comes momentarily to rest and reverses its direction ? (charge on an electron = $1.6 \times 10^{-19} \text{ C}$; $4\pi\epsilon_0 = (9 \times 10^9)^{-1}$ in SI units.)
- (1) 5.6 fm
 - (2) $5.6 \times 10^{-16} \text{ cm}$
 - (3) $5.6 \times 10^{-14} \text{ cm}$
 - (4) $5.6 \times 10^{-12} \text{ cm}$
78. A common base transistor amplifier has an input resistance of 40Ω and output resistance of $200 \text{ k}\Omega$. The collector load is $1 \text{ k}\Omega$. The input signal voltage applied between emitter and base is 400 mV. If the current amplification gain is 1, the voltage amplification is :
- (1) 200
 - (2) 40
 - (3) 25
 - (4) 20

79. In a n-type semiconductor the charge carriers are :
- (1) only hole
 - (2) only electron
 - (3) both, electrons are more and holes are less
 - (4) both, electrons are less and holes are more
80. Which one of the following statements is true for a Light Emitting Diode ?
- (1) It emits light when both electrons and holes are sent from the n - region to p - region.
 - (2) It emits light when electrons are sent from the n - region to p - region and holes are sent from p - region to n - region.
 - (3) It emits light when electrons collide with atoms.
 - (4) It emits light when electrons are accelerated by the electric field in the depletion region.