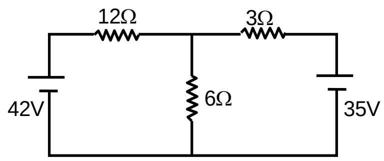
WB-JEE-2016 (Physics)

1. The current flowing through the 3Ω resistor in the circuit is,



a. 4.2A
b. 3.0A
c. 3.5 A
d. 1.6A

2. A body attached to the lower end of a vertical spring oscillates with time period of 1 sec. The time period when two such springs are connected one below another is approximately

a. 0.7 sec
b. 1 sec
c. 1.4 sec
d. 2 sec

3. The minimum and maximum capacitances, which may be obtained by the combination of three capacitors each of capacitance 6μF are

a. 6 μF and 18μF
b. 2 μF and 18μF
c. 2 μF and 12μF
d. 6 μF and 12μF

4. A zener diode has break down voltage of 5.0 V. The resistance required to allow a current of 100 mA through the zener in reverse bias when connected to a battery of emf 12 V is

a. 50Ω
b. 70 Ω
c. 100 Ω
d. 150Ω

5. A series LCR circuit resonates at 10 kHZ. If the capacitor is 0.01 μF, the inductance used is approximately

a. 10 mH
b. 25 mH
c. 50 mH
d. 100 mH

6. Two charges of equal amount +Q are placed on a line. Another charge q is placed at the mid-point of the line. The system will be in equilibrium if the value of q is

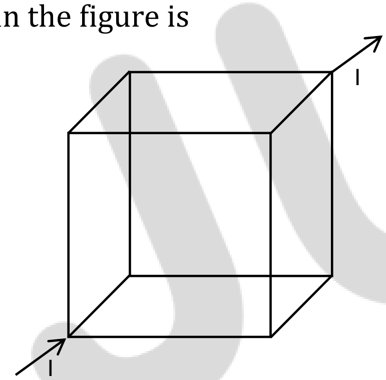
a. $-\frac{Q}{4}$
b. $-\frac{Q}{2}$
c. $+\frac{Q}{2}$
d. $+\frac{Q}{4}$

7. The increase in electrostatic potential energy of a dipole of moment p when it is taken from parallel to anti-parallel orientation in an electric field E is
   a. 2pE b. 3pE
   c. 5pE d. 6pE

8. An n-p-n transistor of current gain 80 in common emitter mode gives emitter current equal to 8.1 mA. The base current is
   a. $0.1\mu A$ b. 0.01mA
   c. 0.1mA d. $0.01\mu A$

9. If a bar magnet of magnetic moment M is kept in a uniform magnetic field B, its time period of oscillation is T. In the same magnetic field, the time period of another magnet of same dimension and same mass but of moment M/4 is,
   a. T b. 2T
   c. T/2 d. T/4

10. The magnetic field intensity at the centre of cubical cage of identical wires of length 'a' due to a current I flowing as shown in the figure is



   a. $\frac{2I}{a}$ b. $\frac{\sqrt{2}I}{a}$
   c. 0 d. I/2a

11. A micro-ammeter gives full scale deflection at 100 μA. Its resistance is $2k\Omega$. The resistance required to convert it to a voltmeter reading 1V is
   a. $1k\Omega$ in series b. $8k\Omega$ in series
   c. 1 $k\Omega$ in parallel d. $8k\Omega$ in parallel

12. An electron of mass 'm' is accelerated by a potential difference V and the corresponding de-Broglie wavelength is λ. The de Broglie wavelength of a proton of mass M if it is accelerated by the same potential difference is ,
   a. $0\lambda\left(\frac{m}{M}\right)$ b. $\lambda\left(\frac{M}{m}\right)$
   c. $\lambda\left(\frac{m}{M}\right)$ d. $\lambda\sqrt{\frac{M}{m}}$

13. If I_1 and I_2 be the sizes of real images for two positions of a convex lens between object and screen, then the size of the object is
    a. I_1/I_2
    b. $I_1 I_2$
    c. $\sqrt{I_1 I_2}$
    d. $\sqrt{I_1 / I_2}$

14. Impedance of a coil having inductance 0.4 H at frequency of 50 Hz will be
    a. $20\pi\Omega$
    β. $40\pi\Omega$
    c. $2\,\pi\Omega$
    d. $4\pi\Omega$

15. 1000 drops of water of radius 1 cm each carry a charge of 10 esu combine to form a single drop. The capacitance increases thereby
    a. 1 time
    b. 10 times
    c. 100 times
    d. 1000 times

16. Light is an electromagnetic wave whose
    a. $\vec{E}$ and $\vec{B}$ are parallel and both are perpendicular to the direction of propagation
    b. $\vec{E}$ and $\vec{B}$ are mutually perpendicular and the direction of propagation is parallel to $\vec{E}$
    c. $\vec{E}$ and $\vec{B}$ and the direction of propagation are mutually perpendicular
    d. $\vec{E}$ and $\vec{B}$ are mutually perpendicular and the direction of propagation is parallel to $\vec{B}$

17. In Bohr model of an atom, two electrons move round the nucleus in circular orbits of radii in the ratio 1: 4. The ratio of their kinetic energies are
    a. 1 : 4
    b. 4 : 1
    c. 8 : 1
    d. 1 : 8

18. If a Young's double slit experiment were conducted inside water instead of air, the fringe width would
    a. increase
    b. decrease
    c. remain same
    d. become zero

19. A photon of energy 8eV is incident on a metal plate with threshold frequency 1.6×10^{15} Hz. The maximum kinetic energy of the emitted photo electrons is (given $h = 6 \times 10^{-34}$ Js)

a. 6 eV
b. 1.6eV
c. 1.2eV
d. 2 eV

20. The ratio of the masses of two planets is 2:3 and the ratio of their radii is 3:2. The ratio of acceleration due to gravity on these two planets is

a. 9 : 4
b. 4 :9
c. 2 : 3
d. 3 : 2

21. A mass m rests on another mass M. The co-efficient of static friction between the surfaces of m and M is μ. M rests on a smooth frictionless horizontal plane. The maximum force applied horizontally on M for which m will move along with M without slipping is,

a. mg + μmg
b. (M + m) μg
c. $\frac{mM}{M+m}\mu g$
d. μmg

22. The dimension of co-efficient of viscosity η is

a. $[MLT_{-2}]$
b. $[M_{-1}LT_{-1}]$
c. $[M_{-1}LT_{-2}]$
d. $[ML_{-1}T_{-1}]$

23. An explosive of mass 9 kg is divided in two parts. One part of mass 3 kg moves with velocity of 16 m/s. The kinetic energy of other part will be

a. 192 J
b. 162 J
c. 150 J
d. 200 J

24. The length of a wire is l_1 when tension is T_1 and is l_2 when tension is T_2. The length of the wire without any tension is

a. $\frac{I_2T_1 - I_1T_2}{T_I - T_2}$
b. $\frac{I_1T_1 - I_2T_2}{T_1 - T_2}$
c. $\frac{I_1T_1}{T_2 - T_1}$
d. $\frac{I_2T_2}{T_1 - T_2}$

25. A particle of mass m is moving in a circular orbit of radius r in a force field given by $\vec{F} = -\frac{k}{r^2}\hat{r}$. The angular momentum L of the particle about the centre varies as

a. $L \propto \sqrt{r}$
b. $L \propto r^{3/2}$
c. $L \propto \frac{1}{\sqrt{r}}$
d. $L \propto r^{1/3}$

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26. A sphere, a cube and a thin circular plate, all made of the same material and having the same mass, are initially heated to a temperature of 200°C. When left in air at room temperature, the following cools fastest.
    a. Sphere
    b. Cube
    c. Plate
    d. All of these

27. Two sound waves of wavelengths 50 cm and 51 cm produce 12 beats per second. The velocity of sound is
    a. $306 ms^{-1}$
    b. $331 ms^{-1}$
    c. $340 ms^{-1}$
    d. $360 ms^{-1}$

28. Air is expanded from 50 litre to 150 litre at 2 atmospheric pressure (1 atm pressure = 10^5 kgm^{-2}). The external work done is
    a. 200 J
    b. 2000 J
    c. 2×10^4 J
    d. 2×10^4 J

29. The Young's modulus of a metal is 2×10^{12} dyne/cm2 and its breaking stress is 11000 kg/cm^2. In case of longitudinal strain the maximum energy that can be stored per cubic metre of this metal is approximately (Assume g = 10 m/s^2)
    a. 58.28×10^5 J
    b. 30.25×10^5 J
    c. 37.15×10^5 J
    d. 15.15×10^5 J

30. When a body moves in a circular orbit its total energy is
    a. positive
    b. negative
    c. Zero
    d. infinite

31. Equivalent resistance of the given infinite circuit is
    a. 4Ω
    b. 2Ω
    c. Infinity
    d. Greater than 4Ω but less than 6Ω

32. The ionization potential of hydrogen is –13.6 eV. The energy required to excite the electron from the first to the third orbit is approximately
    a. 10.2 J
    b. 12.09×10^{-6} J
    c. 19.94 J
    d. 19.34×10^{-19} J

33. Assume that the Earth rotates in a circular orbit round the Sun in 365 days. If the mass of the sun gets doubled but the radius of the orbit remains unchanged, the length of the year would be approximately
    a. 183 days
    b. 258 days
    c. 516 days
    d. 730 days

34. For the following set(s) of forces (in the same unit) the resultant can never be zero
    a. 10,10,10
    b. 10,10,20
    c. 10,20,30
    d. 10,20,40

35. A particle of mass 'm' and carrying a charge 'q' enters with a velocity 'v' perpendicular to a uniform magnetic field. The time period of rotation of the particle
    a. Decreases with increase of velocity v
    b. Increases with increase of radius of the orbit
    c. Depends only on magnetic field
    d. Depends on magnetic field and (q/m) of the particle

36. At any instant t current i through a coil of self-inductance 2 mH is given by $i = t^2e^{-t}$. The induced e.m.f. will be zero at time
    a. 1 sec
    b. 2 sec
    c. 3 sec
    d. 4 sec

37. A and B are two parallel sided transparent slabs of refractive indices n_1 and n_2 respectively. A ray is incident at an angle θ on the surface of separation of A and B, and after refraction from B into air grazes the surface of B. Then
    a. $\sin\theta = \frac{1}{n_2}$
    b. $\sin\theta = \frac{1}{n_1}$
    c. $\sin\theta = \frac{n_2}{n_1}$
    d. $\sin\theta = \frac{n_1}{n_2}$

38. The pair of parameters temperature T, pressure P, volume V and work W characterises the thermodynamic state of matter
    a. T, P
    b. T, V
    c. T, W
    d. P, W

39. Equation of a wave is given by $y = 10^{-4}\sin(60t + 2x)$, x and y in metre and t is in second. Then
    a. Wave is propagating along the negative x direction with velocity 30 m/s
    b. Wavelength is π metre
    c. Frequency is 30/π Hz
    d. Wave is propagating along positive x direction with velocity 60 m/s

40. An electric dipole is placed in a non-uniform electric field $\vec{E}$. The electric field is along x direction. The dipole will experience
    a. A torque when the dipole is parallel to $\vec{E}$
    b. A torque when the dipole makes an angle with $\vec{E}$
    c. A force perpendicular to $\vec{E}$
    d. A force when the dipole is parallel to $\vec{E}$

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ANSWER KEY

1. (b)	2. (c)	3. (b)	4. (b)	5. (b)	6. (a)	7. (a)	8. (c)	9. (b)	10. (c)
11. (b)	12. (c)	13. (c)	14. (b)	15. (b)	16. (c)	17. (b)	18. (b)	19. (d)	20. (G)
21. (b)	22. (d)	23. (a)	24. (a)	25. (a)	26. (c)	27. (a)	28. (c)	29. (b)	30. (b)
31. (d)	32. (d)	33. (b)	34. (d)	35. (d)	36. (b)	37. (b)	38. (a, b)	9. (a, b, c)	40. (b, d)

SOLUTIONS

1. (b)

Applying Kvl in loop (1)

$-12i - 6(i - i_1) + 42 = 0$

In loop (2)

$-3i_1 + 6i_1 - 6i - 35 = 0$

From loop (1) equation and (2) equation.

$\Rightarrow \quad -18i + 6i + 42 = 0$

$-18i - 27i - 105 = 0$

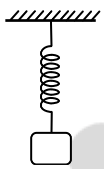
$-21i \quad = \quad 63$

$i = -3A$

2. (c)

Time period of oscillation is given by

$T = 2\pi\frac{\sqrt{m}}{K}$



Where

m = mass

K = spring constant

First case:-

So according to question $T = 2\pi\sqrt{\frac{m}{K}}$

Second case:-

When two springs are connected one below another then they will be in series therefore

$\frac{1}{K_{eq}} = \frac{1}{K} + \frac{1}{K}$

$\frac{1}{K_{eq}} = \frac{K}{2}$

$T' = \sqrt{\frac{m}{K_{eq}}}$

$K_{eq} = \frac{K}{2}$

$T' = \sqrt{2}\ T = 1.414T$

3. (b)

The minimum capacitance can be obtained by connecting all capacitor in series it can be calculated as follows:

$$\frac{1}{C}=\frac{1}{6}+\frac{1}{6}+\frac{1}{6}=\frac{1}{2}$$

$$\frac{1}{C}=\frac{3}{6}$$

C_{min} = 2μF

The maximum capacitance can be obtained by connecting all capacitors in parallel it can be calculated as follows:

C_{max} = 6 + 6 + 6 = 18μF

Therefore, the correct answer is (b)

4. (b)

Hence here the voltage remaining across the zener

= 12V – 5V = 7V

Therefore the resistance required to allow correct =

V = IR

$$R=\frac{V}{I} \quad \Rightarrow \quad \frac{7}{100\times10^{-3}}$$

$$R = 7 \times 10 \quad \Rightarrow \quad R = 70\Omega$$

5. (b)

Since Resonant frequency = $F=\frac{1}{2\pi}\frac{1}{\sqrt{LC}}$ ...... (1)

Given

E = 10 K Hz = 10^4Hz

C = 0.01 μF = 0.01 × 10^{-6} F

C = 1 × 10^{-8} F

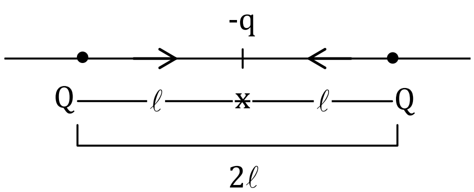
Substituting there values in equation (1)

$$10^4=\frac{1}{2\pi}\times\frac{1}{\sqrt{\cdot L\times10^{-8}}}$$

$$L \approx \frac{1}{40}H$$

$$L \approx 25mH$$

6. (a)



$$F_{QQ} = \frac{1}{4\pi\varepsilon_0}.\frac{Q^2}{(2\ell)^2} \qquad \text{...... (1)}$$

$$F_q Q = \frac{1}{4\pi\varepsilon_0}.\frac{qQ}{\ell^2} \qquad \text{...... (2)}$$

From eq. (1) and eq. (2)
Equilibrium condition eq.1 = 2

$$\frac{1}{4\pi\varepsilon_0} \times \frac{Q^2}{4\ell^2} = \frac{1}{4\pi\varepsilon_0}\frac{qQ}{\ell^2}$$

$q = \frac{-Q}{4}$ $\Rightarrow$ Therefore the correct answer is (a)

7. (a)
$U = -pE\cos\theta$

Dipole moment = p

Electric field = E

Now find the value of U_1 and U_2

$U_1 = -pE\cos 0$ [$\cos 0^o = 1$]

$U_1 = -pE \times 1$

$U_1 = -pE$

And

$U_2 = -pE \times \cos 180^o$

$U_2 = -pE \times (-1)$

$U_2 = +pE$

$\Delta U = (U_2 - U_1)$

$\Delta U \Rightarrow pE + pE = 2pE$

Increase in potential energy $\Delta U = 2pE$

8. (c)

$$B = \frac{I_C}{I_B} = 80 \quad \ldots\ldots (1)$$

$$I_e = 8.1\,mA$$

For CE configuration

$$I_E = I_C$$

$$I_C = 8.1\,mA$$

$$I_B = \frac{I_C}{B} = \frac{8.1 \times 10^{-3} A}{80}$$

$$I_B = 0.1\,mA$$

Therefore, the correct answer is (c)

9. (b)

Given value

$$T = 2\pi\sqrt{\frac{I}{MB}} \quad \ldots\ldots (1) \qquad [I = \text{moment of inertia}]$$

$$T' = 2\pi\sqrt{\frac{I}{\frac{M}{4}B}} = 2 \times 2\pi\sqrt{\frac{I}{MB}}$$

From eq. (1) $2\pi\sqrt{\frac{I}{MB}} = T$

Now

$$T' = 2T$$

Therefore, the correct answer is (b)

10. (c)

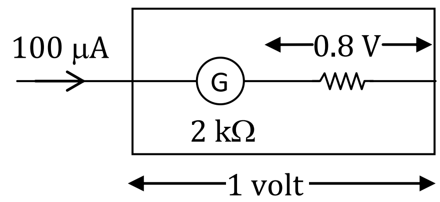
For symmetrical current distribution, magnetic field at the centre due to all current carrying conductors will get cancelled.

Hence $B_{net} = 0$

11. (b)

Since we know that to convert a Galvanometer in to voltmeter a resistance is connected in series with it. (Galvanometer)

$\because$ V = IR



I = 100μA (Given)

R = 2kΩ(Given)

$\therefore V = 100\times10^{-6} \times2 \times10^{3}$

V = 0.2 volt

Resultant voltage across the resistance which is connected in series with galvanometer (or micro ammeter) will be = 1 – 0.2 = 0.8 volt.

$\therefore$ Now resistance required to convert in voltmeter.

$I\times R=(0.8V)$

$10^{-4}\times R=0.8$

$R=(8\times10^{3})\Omega$ in series.

12. (c)

$\text{K.E.}=\frac{1}{2}mv^{2}$

$\Rightarrow \quad m\times\frac{1}{2}mv^{2}=v\times m$

$p^{2}=2vm$

$p=\sqrt{2vm}$

De-Broglie wave length formula

$\lambda=\frac{h}{p}$

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

Same potential difference

$\lambda\propto\frac{1}{\sqrt{m}}$

Now

$\frac{\lambda}{\lambda_{p}}=\frac{\sqrt{M}}{\sqrt{m}} \quad \Rightarrow \quad \lambda_{p}=\frac{\lambda\sqrt{m}}{\sqrt{M}}$

$\lambda_{p}=\sqrt{\frac{m}{M}}$

Therefore, the correct answer is (c)

13. (c)

$\frac{I_1}{O} = \frac{v}{u}$ ...... (1)

$\frac{I_2}{O} = \frac{u}{v}$ ...... (2)

From eq. (1) and (2)

$\Rightarrow \quad \frac{I_1}{O} = \frac{O}{I_2}$

$\Rightarrow \quad O^2 = I_1 I_2$

$\Rightarrow \quad O = \sqrt{I_1 I_2}$

Therefore, the correct answer is (c)

14. (b)

$Z = \sqrt{(X_L - X_C)^2 + R^2}$ $\begin{bmatrix} X_C = 0 \\ R = 0 \end{bmatrix}$

Now

$Z = X_L = (\omega_L)$

$\omega = 2\pi F$

$Z = 2 \times \pi \times F \times L$

$Z = 2 \times \pi \times 50 \times 0.4$

$Z = 40\pi\Omega$

Therefore, the correct answer is (b)

15. (b)

$1 \text{esu} = 3.33 \times 10^{-10} C$

Volume of single big drop = vol. of 1000 small drops

$\frac{4}{3}\pi R^3 = \frac{4}{3}\pi r^3 \times 1000$

$R^3 = \sqrt{1000\, r^3}$

$R = 10r$

Electric potential on surface of drop

$V_S = K\frac{q}{r}$ [K = Coulomb's constant]

Comparing with $Q = C \cdot V$

$C = \frac{q}{V_s} = \frac{q}{\frac{Kq}{r}}$

$C = \frac{r}{K}$ ...... (1)

Similarly capacitance of big drop

$C_b = \frac{R}{K}$ ...... (2)

From eq. (1) and (2)

$\frac{C_b}{C} = \frac{R}{r}$

$\frac{C_b}{C} = \frac{10r}{r}$

$C_b = 10_C$ ∴ Capacitance is 10 times

Therefore, the correct answer is (b)

16. (c)
As we know that the electromagnetic waves are the waves in which electric field $\vec{E}$, magnetic field $\vec{B}$ and the direction of propagation of electromagnetic wave are mutually perpendicular light is electromagnetic waves so it will also contains these properties.

17. (b)
Since Kinetic energy

$E \propto \frac{1}{r}$ where = r = radius

$E_2 r_2 = E_1 r_1$

$\frac{E_1}{E_2} = \frac{r_2}{r_1} \Rightarrow \frac{4}{1}$

Therefore, the correct answer is (b)

18. (b)
In water, speed of light decreases
Since frequency remains same, therefore the wavelength decrease
The formula for fringe width is $\frac{\lambda D}{d}$
Thus, fringe width decreases in water because wavelength of light decreases.
Therefore, the correct answer is (b)

19. (d)
v_0 = threshold frequency

$\phi = uv_0 = \frac{6 \times 10^{-34} \times 1.6 \times 10^{15}}{1.6 \times 10^{-19}} ev$

$= 6 \times 10^{-34} \times 10^{34}$

= 6ev

$K_{max} = E - \phi$

$= 8ev - 6ev = 2ev$

Therefore, the correct answer is (d)

20. (G)

Bonus
Acceleration due to gravity on the first planet

$$g_1 = \frac{GM_1}{R_1^2}$$

Acceleration due to gravity on the second planet

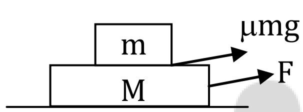
$$g_2 = \frac{GM_2}{R_2^2}$$

$$\frac{g_1}{g_2} = \frac{M_1}{M_2} \times \frac{R_2^2}{R_1^2}$$

$$\Rightarrow \quad \frac{2}{3} \times \left(\frac{2}{3}\right)^2 \quad \Rightarrow \quad \frac{8}{27}$$

Therefore, none of the options are correct

21. (b)



$$F - \mu N^1 = (m + M)a$$

$$a = \frac{F - \mu(m + M)g}{(m + M)}$$

$$a = \frac{f}{(m + M)} - \mu g \qquad \text{...... (1)}$$

Maximum value of acceleration

$$ma = \mu_1 mg$$

$$a = \mu_1 g$$

Value of 'a' put in eq. (1)

$$\frac{F}{m + M} - \mu_2 g = \mu_1 g$$

$$f_{max} = (\mu_1 g + \mu_2 g) \cdot (m + M) \qquad [\mu_1 + \mu_2 = a]$$

$$f_{max} = \mu g(m + M)$$

Therefore, the correct answer is (b)

22. (d)

Coefficient of viscosity $(\eta) = \frac{f_r}{A_v}$ ...... (1)

Where;

F = tangential force

r = distance between the layers,

v = velocity

Dimensional formula of ⇒

Force	$= M^1L^1T^{-2}$
Area	$= M^0L^2T^0$
Distance	$= M^0L^1T^0$
Velocity	$= M^0L^1T^{-1}$

Put all these values in eq. (1)

We get,

$$(\eta)=\frac{[M^1L^1T^{-2}][M^0L^1T^0]}{[M^0L^2T^0][M^0L^1T^{-1}]}$$

$$(\eta) \Rightarrow [M^1L^{-1}T^{-1}]$$

SI unit = Pascal second

Therefore the correct answer is (d)

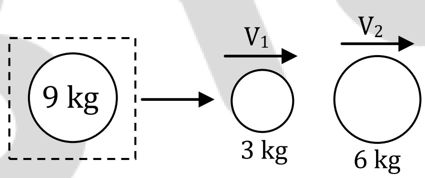
23. (a)

Given mass of explosive = M = 9kg

Initial value of explosive = 0 m/s

Mass of smaller fragment = 3kg $\rightarrow m_1$

Mass of bigger fragment = 6kg $\rightarrow m_2$



$$3v_1 = 6v_2$$

$$v_2 = \frac{3v_1}{6}$$

$$= \frac{3\times16}{6} = 8\,m/s$$

$$(KE)6\,kg = \frac{1}{2}\times6\times(8)^2$$

=192 J

Therefore, the correct answer is (a)

24. (a)
Change in length in the first case = (l_1 -l)
Change in length in second case = (l_2 - l)

Now, young modulus $=\frac{\text{Normal stress}}{\text{Longitudinal strain}}$

$$\gamma=\frac{T/A}{\Delta l/l}$$

Where
γ = Young's Modulus
T = Tension
A = Area
ΔL = Change in length
l = Original length

$\therefore \quad \gamma=\frac{T_1}{A}\times\frac{l}{(l_1-l)}$ for first case

$\gamma=\frac{T_2}{A}\times\frac{l}{(l_1-l)}$ for second case

Since young's modulus remains the same,
So,

$$\frac{T_1}{A}\times\frac{l}{(l_1-l)} = \frac{T_2}{A}\times\frac{l}{(l_1-l)}$$

$$T_1(l_2-l)=T_2(l_2-l)$$

$$l(T_2-T_1)=T_2l_1-T_1l_2$$

$$l=\frac{T_1l_2-T_2I_1}{T_1-T_2}$$

25. (a)

$$mv^2r^2=kr$$

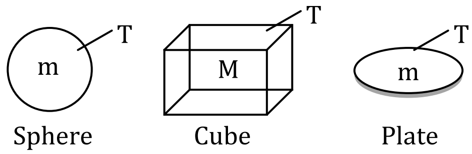
$$\Rightarrow \quad \frac{mv^2}{r}=\frac{k}{r^2}$$

$$\Rightarrow \quad v=\sqrt{\frac{k}{mr}}$$

$$L=mvr=\sqrt{mrk}$$

Thus we get = $L\propto\sqrt{r}$

26. (c)



$$\rho = \frac{\text{mass}}{\text{volume}}$$

$\Rightarrow$ ρ = Same for all objects

As volume and mass same for 3 objects. Thickness of plate $\rightarrow$ Least $\rightarrow$surface area = Max.

According to Stefan's loss heat law $H \propto AT^4$

$H_{sphere} = H_{cube} = H_{plate} = A_{sphere} : A_{cube} : A_{plate}$

$\therefore$ Plate will cool fast

Sphere cools slowest

Therefore, the correct answer is (c)

27. (a)

Wavelength of first wave $\lambda_1 = 0.5\text{m}$

Wavelength of second wave $\lambda_2 = 0.51\text{m}$

Frequency of beat = 12

We know that

$$f = \frac{v}{\lambda_1} = \frac{u}{\lambda_2}$$

$$12 = v\left(\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right)$$

$$12 = v\left(\frac{1}{0.5} - \frac{1}{0.51}\right)$$

$$v = \frac{12 \times 0.50 \times 0.51}{0.51 - 0.50}$$

$= v = 306\text{m/s}$

Therefore, the correct answer is (a)

28. (c)

v_1 = 50 litre = 50 × 10^{-3}

v_2 = 150 litre = 150 ×10^{-3}

W = PΔV $\Rightarrow$ P ($V_2 - V_1$)

P = 2 atm = 2×10^5 N^{-2}

W = 2×10^5 (150-50) ×10^{-3}

W = 2×10^5 × 100 ×10^{-3}

W = 2 × 10^4 J

Therefore, the correct answer is (c)

29. (b)

Energy density, $\frac{du}{dv} = \frac{(\text{Stress})^2}{2y}$

Stress $= \frac{11000\text{ g}}{10^{-4}} \text{N/m}^2$

Now $\Rightarrow \frac{\left(\frac{11000\text{g}}{10^{-4}}\right)^2}{2 \times 2 \times 10^{12} \times \frac{10^{-5}}{10^{-4}}}$

Stress = $\frac{121 \times 10^6 \times 10^2}{4 \times 10^{12} \times 10^{-1} \times 10^{-8}}$

$\Rightarrow \frac{30.25 \times 10^8}{10^{-8} \times 10^{12} \times 10^1}$

$\Rightarrow \frac{30.25 \times 10^{17}}{10^{12}}$

Stress $\Rightarrow 30.25 \times 10^5$J

Therefore, the correct answer is (b)

30. (b)

Suppose an object with mass m doing a circular orbit around a much heavier object with mass M.

Now we know its potential energy, it's

$U = -\frac{GMm}{R}$ ......(1)

As we know that the relation between linear velocity and angular velocity is given by

$\nu = \omega R$

$\nu^2 = \omega^2 R^2 = G\frac{M}{R}$ ......(2)

$K = \frac{1}{2}mv^2 = \frac{1}{2}\frac{GMm}{R}$ ......(3)

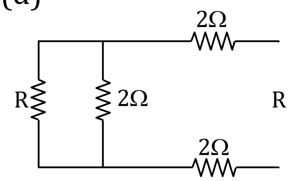
$\left[K = \frac{U}{2}\right]$

$E = K + U = \frac{U}{2} = -\frac{GMm}{2R}$ ......(4)

So the total energy is always negative

Therefore, the correct answer is (b)

31. (d)



$$R = 2 + 2 + \frac{R \times 2}{R + 2}$$

$\Rightarrow \quad R = 4 + \frac{2R}{2 + R}$

$\Rightarrow \quad 2R + R^2 = 8 + 4R + 2R$

$\Rightarrow \quad R^2 - 4R - 8 = 0$

$\Rightarrow \quad R = 5.46\ \Omega$

Therefore, the correct answer is (d)

32. (d)

$E = \frac{-13.6}{n^2} = \frac{-13.6}{9} = -1.5ev$

We know that energy required

$\Delta E = E_2 - E_1$

$\Delta E = 1.51 + 13.6 \ = 12.08ev$

So, $\Delta E = 12.08ev$

$= 12.08 \times 1.6 \times 10^{-19} J$

$\Delta E = 19.34 \times 10^{-19} J$

Therefore, the correct answer is (d)

33. (b)

Since time period of revolution

$\because \quad T = 2\pi\sqrt{\frac{R}{g}}$

We know

$g = \frac{GM}{R^2}$

So, $T = 2\pi\sqrt{\frac{R^3}{GM}}$

$T \propto \frac{1}{\sqrt{M}}$

$\frac{T_1}{T_2} = \frac{\sqrt{2M}}{\sqrt{M}}$

$T_2 = \frac{T_1}{\sqrt{2}}$

$T_2 = \frac{360}{\sqrt{2}} = 258.13$

$T_2 \simeq 258.13$

34. (d)

Option (a)

a = 10, b = 10, c = 10

The resultant force is (a + b) < c

20 < 10

The resultant force is zero

Option (b)

a = 10, b = 10, c = 20

The resultant force is (a + b) < c

20 < 20

The resultant force is zero

Option (c)

a = 10, b = 20, c = 23

The resultant force is (a + b) < c

30 < 23

The resultant force is zero

Option (d)

a = 10, b = 20, c = 40

The resultant force is (a + b) < c

30 < 40

The resultant force is not zero

Therefore, the correct answer is (d)

35. (d)

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

Depends on B and $\left(\frac{a}{m}\right)$ of particle

Therefore, the correct answer is (d)

36. (b)

$L = 2\times10^{-3}$ H,

$I = t^2 e^{-t}$

t = –?

At induced emf zero

$$\varepsilon = \frac{-LdI}{dt} = \frac{Ld(t^2e^{-t})}{dt} \quad [\varepsilon = 0]$$

$\varepsilon = -L[2t\, e^{-t} - t^2 e^{-t}]$

$\Rightarrow \quad 2te^{-t} = t^2e^{-t}$

$\Rightarrow \quad \tau = 2$sec.

Therefore, the correct answer is (b)

37. (b)

$n_1 \sin\theta = n_2 \sin\theta$

Also

$n_2 \sin\theta = 1 \times \sin 90$

$\Rightarrow \quad \sin\theta = \frac{1}{n_2}$

$n_1 \sin\theta = \frac{n_2}{n_2} = 1$

$\sin\theta = \frac{1}{n_1}$

38. (a,b)

We know that

The relation between the thermodynamics variable (P,V,T) of the system is called equation of state where in –

PV = nRT

(P,V,T) represent thermodynamic state of matter work does not represent thermodynamic state of matter.

Therefore, the correct answer is (a,b)

39. (a,b,c)

$V = \frac{dy}{dt} = 10 \times 60 \times \cos(60t + 2x)$

$\text{Velocity} = \frac{w}{K} = \frac{60}{2} = 30\,\text{m/s}$

y is the form $A\sin(\omega t + kx)$, velocity is negative

K = 2, $\lambda = \frac{2\pi}{K}$

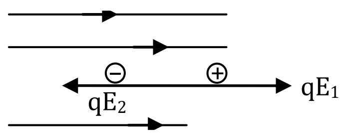
$\Rightarrow \quad \lambda = \pi m$

$f = \frac{\omega}{2\pi} = \frac{60}{2\pi} = \frac{30}{\pi}\text{Hz}$

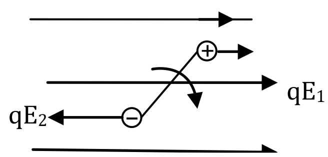
Therefore, the correct answer is (a,b,c)

40. (b,d)

Case – 1



Case – 2



In the question the electric field is in x-direction and a dipole is placed in this electric field.
Here we can consider 2 cases.

Case – 1 and Case – 2

In Case – 1

Dipole is placed parallel to the electric field so dipole will experience a net force and in this case the line of force is same. So there will be no torque for the dipole but as electric field is non uniform so there will be a net force on the dipole i.e.,

$F = q(E_1 - E_2) \neq 0$

In Case – 2

We placed the dipole in electric field (non-uniform) making an angle with electric field. So there will be definitely a torque working and that will not be equal to zero.

$E_1 = E_2$ or $E_1 \neq E_2$

$\tau \neq 0$