JEE Main - 2015

Set – A, Physics

Note: Answers have been highlighted in "Yellow" colorand Explanations to answers are given at the end

1. Immediately fill in the particulars on this page of the Test Booklet with Blue/ Black Ball Point Pen, Use of pencil is strictly prohibited,

2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet take out the Answer Sheet and fill in the particulars carefully.

3. The test is of **3 hours** duration.

4. The Test Booklet consists of 90 questions. The maximum marks are **360**

5. There are three parts in the question paper A, B, C consisting of Physics, Chemistry and Mathematics having 30 questions in each part of equal weightage Each question is allotted **4(four)** marks for correct response.

6. Candidates will be awarded marks as stated above in instruction NO. 5 for correct response of each question. ¼ (one fourth) marks will be deducted for indicating incorrect response of each question, No deduction from the total score will be made if no response is indicated for an item in the answer sheet.

7. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.

8. Use blue/ Black Ball Point Pen only for writing particulars / marking response on side – 1 and side – 2 of the Answer Sheet. Use of Pencil is strictly prohibited.

9. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device , etc, except the admit card inside the examination room/hall.

10. Rough work is to be done on the space provided for this purpose in the Test Booklet only. This space is given at the bottom of each page and in one page (i.e. Page 39) at the end of the booklet.

11. On completion of the test , the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. However , the candidates are allowed to take away this Test Booklet with them.

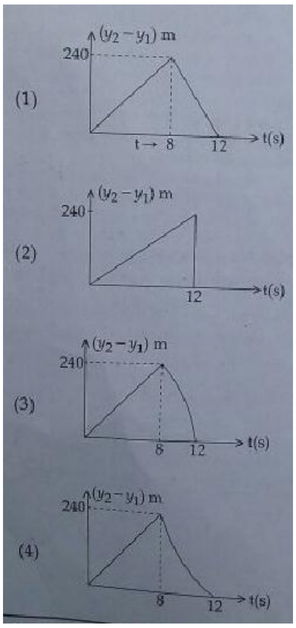
12. The CODE for this Booklet is **A**. Make sure that CODE printed on Side-2 of the Answer Sheet and also tally the serial number of the Test Booklet and Answer Sheet are the candidate should immediately report the matter to the invigilator for replacement of both the Test Booklet and the Answer Sheet.

13. Do not fold or make any stray mark on the Answer Sheet.

Note: Answers have been highlighted in "Yellow" colorand Explanations to answers are given at the end

Q1. Twostone are thrown up simultaneously from the edge of a cliff 240 m high with initial speed of 10 m/s and 40 m/s respectively. Which of the following graph best represents the time variation of relative position of the second stone with respect to the first?

(*The figures are schematic and not drawn to scale*)



Answer: (3)

Q2. The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{\frac{L}{g}}$, Measured value of L is 20.0 cm known to 1 mm accuracy and time for 100 oscillations of the pendulum is found to be 90 s using a wrist watch of 1s resolution. The accuracy in the determination of g is:

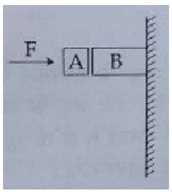
(1) 2%

(2) 3%

(3) 1%

(4) 5%

Q3.



Given in the figure are two blocks A and B of weight 20 N and 100 N, respectively. These are being pressed against a wall by a force F as shown. If the coefficient of friction between the blocks is 0.1 and between block B and the wall is 0.15, the frictional force applied by the wall on block B is:

(1) 100 N

(2) 80 N

(3) 120 N

(4) 150 N

Q4. A particle of mass m moving in the x direction with speed $2v$ is hit by another particle of mass 2m moving in the y direction with speed v. If the collision is perfectly inelastic, the percentage loss in the energy during the collision is close to:

(1) 44%

(2) 50%

(3) 56%

(4) 62%

Q5. Distance of the centre of mass of a solid uniform cone from its vertex is z_0. If the radius of its base is R and its height is h then z_0 is equal to:

(1) $\frac{h^2}{4R}$

(2) $\frac{3h}{4}$

(3) $\frac{5h}{8}$

(4) $\frac{3h^2}{8R}$

Q6. From a solid sphere of mass M and radius R, a cube of maximum possible volume is cut. Moment of inertia of the cube about an axis passing through its center and perpendicular to one of its faces is:

(1) $\frac{MR^2}{32\sqrt{2}\pi}$

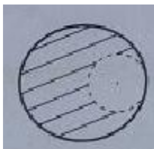
(2) $\frac{MR^2}{16\sqrt{2}\pi}$

(3) $\frac{4MR^2}{9\sqrt{3}\pi}$

(4) $\frac{4MR^2}{3\sqrt{3}\pi}$

Q7. From a solid sphere of mass M and radius R, a spherical portion of radius $\frac{R}{2}$ is removed, as shown in the figure. Taking gravitational potential v= 0 at r = ∞ , the potential at the center of the cavity thus formed is:

($G = gravitational\ constant$)



(1) $\frac{-GM}{2R}$

(2) $\frac{-GM}{R}$

(3) $\frac{-2GM}{3R}$

(4) $\frac{-2GM}{R}$

Answer: (2)

Q8. A pendulum made of a uniform wire of cross sectional area A has time period T. When an additional mass M is added to its bob, the time period changes to T_M. If the Young's modulus of the material of the wire is Y then $\frac{1}{y}$

($g = gravitational\ acceleration$)

(1) $\left[\left(\frac{T_M}{T}\right)^2 - 1\right]\frac{A}{Mg}$

(2) $\left[\left(\frac{T_M}{T}\right)^2 - 1\right]\frac{Mg}{A}$

(3) $\left[1 - \left(\frac{T_M}{T}\right)^2\right]\frac{A}{Mg}$

(4) $\left[1 - \left(\frac{T}{T_M}\right)^2\right]\frac{A}{Mg}$

Q9. Consider a spherical shell of radius R at temperature T. The black body radiation inside it can be considered as an ideal gas of photons with internal energy per unit volume $u = \frac{U}{V} \propto T^4$ and pressure $P = \frac{1}{3}\left(\frac{U}{V}\right)$. If the shell now undergoes an adiabatic expansion the relation between T and R is:

(1) $T \propto e^{-R}$

(2) $T \propto e^{-3R}$

(3) $T \propto \frac{1}{R}$

(4) T $\propto \frac{1}{R^3}$

Q10. A solid body of constant heat capacity 1 J/°C is being heated by keeping it in contact with reservoirs in two ways:

(i) Sequentially keeping in contact with 2 reservoirs such that each reservoir supplies same amount of heat.

(ii) Sequentially keeping in contact with 8 reservoirs such that each reservoir supplies same amount of heat.

In both the cases body is brought from initial temperature 100° to final temperature 200°C. Entropy change of the body in the two cases respectively is:

(1) In2, 4In2

(2) In2, In2

(3) In2, 2In2

(4) 2In2, 8In2

Q11. Consider 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:

$\left(y = \frac{C_p}{C_v}\right)$

(1) $\frac{3y+5}{6}$

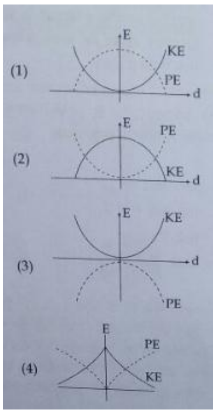
(2) $\frac{3y-5}{6}$

(3) $\frac{y+1}{2}$

(4) $\frac{y-1}{2}$

Q12. For a simple pendulum, a graph is plotted between its kinetic energy (KE) and potential energy (PE) against its displacement d. Which one of the following represents these correctly?

(*graphs are schematic and not drawn to scale*)



Answer: (2)

Q13. A train is moving on a straight track with speed 20 ms^{-1}. It is blowing its whistle at the frequency of 1000 Hz. The percentage change in the frequency heard by a person standing near the track as the train passes him is (speed of sound = 320 ms^{-1}) close to:

(1) 6%

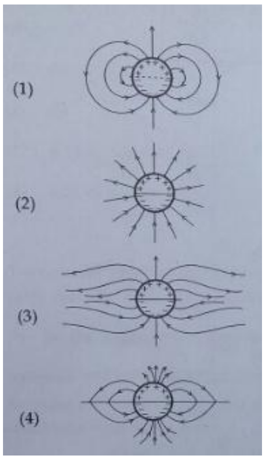
(2) 12%

(3) 18%

(4) 24%

Q14. A long cylindrical shell carries positive surface charge σ in the upper half and negative surface charge –σ in the lower half. The electric field lines around the cylinder will look like figure given in:

(figures are schematic and not drawn to scale)



Answer: (1)

Q15. A uniformly charged solid sphere of radius R has potential V_0 (measured with respect to ∞) on its surface. For this sphere the equipotential surfaces with potentials $\frac{3V_0}{2}, \frac{5V_0}{4}, \frac{3V_0}{4}$ *and* $\frac{V_0}{4}$ have radius R_1, R_2, R_3 and R_4 respectively. Then

(1) $R_1 = 0$ and $R_2 > (R_4 - R_3)$

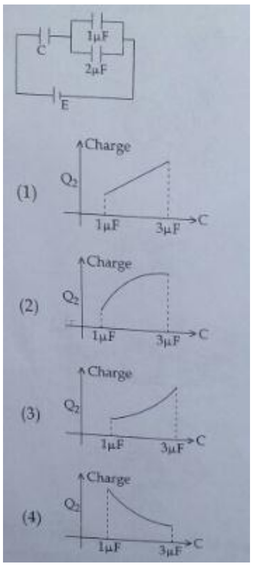
(2) $R_1 \neq 0$ and $(R_2 - R_1) > (R_4 - R_3)$

(3) $R_1 = 0$ and $R_2 < (R_4 - R_3)$

(4) $2R < R_4$.

Q16. In the given circuit, charge Q_2 on the 2μF capacitor changes as C is varied from 1μF to 3μF. Q_2 as a function of 'C' is given properly by:

(*Figures are drawn schematically and are not to scale*)



Answer: (3)

Q17. When 5V potential difference is applied across a wire of length 0.1 m, the drift speed of electrons is 25×10^{-4} ms^{-1}. If the electron density in the wire is 8×10^{-3}, the resistivity of the material is close to:

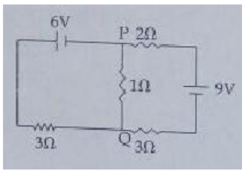
(1) 1.6×10^{-8} Ωm

(2) 1.6×10^{-7} Ωm

(3) 1.6×10^{-6} Ωm

(4) 1.6×10^{-5} Ωm

Q18.



In the circuit shown, the current in the 1Ω resistor is:

(1) 1.3 A, from P to Q

(2) 0A

(3) 0.13 A, from Q to P

(4) 0.13 A, from P to Q

Q19. Two coaxial solenoids of different radii carry current I in the same direction. Let $\overrightarrow{F_1}$ be the magnetic force on the inner solenoid due to the outer one and $\overrightarrow{F_2}$ be the magnetic force on the outer solenoid due to the inner one. Then:

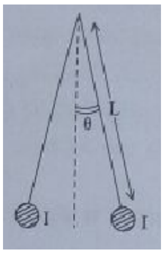
(1) $\overrightarrow{F_1} = \overrightarrow{F_2} = 0$

(2) $\overrightarrow{F_1}$ is radially inwards and $\overrightarrow{F_2}$ is radially outwards

(3) $\overrightarrow{F_1}$ is radially inwards and $\overrightarrow{F_2} = 0$

(4) $\overrightarrow{F_1}$ is radially outwards and $\overrightarrow{F_2} = 0$

Q20.



Two long current carrying thin wires, both with current I, are held by insulating threads of length L and are in equilibrium as shown in the figure, with threads making an angle 'θ' with the vertical. If wires have mass 4 λ per unit length then the value of I is:

($g = gravitational\ acceleration$)

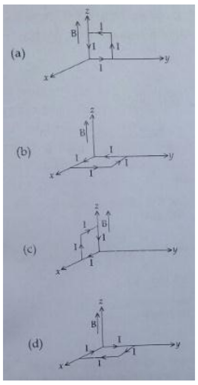
(1) $\sin\sqrt{\frac{\pi\lambda gL}{\mu_0\ cos\theta}}$

(2) $2\sin\theta\ \sqrt{\frac{\pi\lambda gL}{\mu_0\ cos\theta}}$

(3) $2\ \sqrt{\frac{\pi gL}{\mu_0}\ tan\theta}$

(4) $\sqrt{\frac{\pi\lambda gL}{\mu_0}\ tan\theta}$

Q21. A rectangular loop of sides 10 cm and 5 cm carrying a current I of 12 A is placed in different orientations as shown in the figures below:



If there is a uniform magnetic field of 0.3 T in the positive z direction in which orientations the loop would be in (i) stable equilibrium and (ii) unstable equilibrium?

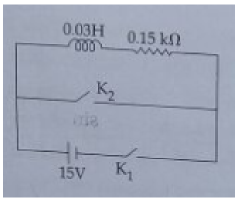
(1) (a) and (b), respectively

(2) (a) and (c), respectively

(3) (b) and (d), respectively

(4) (b) and (c), respectively

Q22. An inductor (L = 0.03H) and a resistor (R = 0.15 kΩ) are connected in series to a battery of 15V EMF in a circuit shown below. The key K_1 has been kept closed for a long time. Then at t = 0, K_1 is opened and key K_2 is closed simultaneously. At t = 1ms, the current in the circuit will be: ($e^5 \cong$ 150)



(1) 100 mA

(2) 67 mA

(3) 6.7 mA

(4) 0.67 mA

Q23. A red LED emits light at 0.1 watt uniformly around it. The amplitude of the electric field of the light at a distance of 1 m from the diode is:

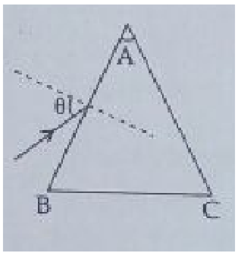
(1) 1.73 V/m

(2) 2.45 V/m

(3) 5.48 V/m

(4) 7.75 V/m

Q24. Monochromatic light is incident on a glass prism of angle A. If the refractive index of the material of the prism is μ, a ray, incident at an angle θ, on the face AB would get transmitted through the face AC of the prism provided:



(1) $\theta > \sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

(2) $\theta < \sin\text{-}1 \left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

(3) $\theta > \cos^{-1}\left[\mu \sin\left(A + \sin^{1}\left(\frac{1}{\mu}\right)\right)\right]$

(4) $\theta < \cos^{-1}\left[\mu \sin\left(A + \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

Q25. On a hot summer night, the refractive index of air is smallest near the ground and increases with height from the ground. When a light beam is directed horizontally, the Huygens' principle leads us to conclude that as it travels, the light beam:

(1) becomes narrower

(2) goes horizontally without any deflection

(3) bends downwards

(4) bends upwards

Q26. Assuming human pupil to have a radius of 0.25 cm and a comfortable viewing distance of 25 cm, the minimum separation between two objects that human eye can resolve at 500 nm wavelength is:

(1) 1 μm

(2) 30 μm

(3) 100 μm

(4) 300 μm

Q27. As an electron makes a transition from an excited state to the ground state of a hydrogen – like atom /ion:

(1) its kinetic energy increases but potential energy and total energy decreases

(2) kinetic energy , potential energy and total energy decreases

(3) kinetic energy decreases, potential energy increases but total energy remains same

(4) kinetic energy and total energy decrease but potential energy increases

Q28. Match List – I (Fundamental Experiment) with List – II (its conclusion) and select the correct option from the choices given below the list:

	List – I		List – II
(A)	Franck-Hertz Experiment	(i)	Particle nature
(B)	Photo- electric Experiment.	(ii)	Discrete energy levels of atom
(C)	Davison – Germer Experiment.	(iii)	Wave nature of electron
		(iv)	Structure of atom

(1) (A)-(i) (B)-(iv) (C) –(iii)

(2) (A) –(ii) (B)-(iv) (C)-(iii)

(3) (A)- (iii) (B)-(i) (C)-(iii)

(4) (A)-(iv) (B)-(iii) (C)-(ii)

Q29. A signal of 5 kHz frequency is amplitude modulated on a carrier wave of frequency 2 MHz. The frequencies of the resultant signal is/are:

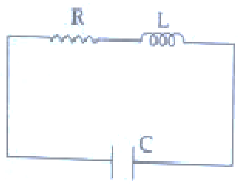
(1) 2 MHz only

(2) 2005 kHz, and 1995 kHz

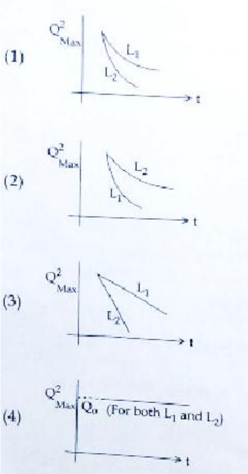
(3) 2005 kHz, 2000 kHz and 1995 kHz

(4) 2000 kHz and 1995 kHz

Q30. An LCR circuit is equivalent to a damped pendulum. In an LCR circuit the capacitor is charged to Q_0 then connected to the L and R as shown below:



If a student plots graphs of the square of maximum charge (Q^2_{Max})on the capacitor with time (t) for two different values L_1 and L_2 ($L_1 > L_2$) of L then which of the following represents this graph correctly? (Plots are schematic and not drawn to scale)



Answer: (1)

Answer Key and Explanations

Sol. 1 (3)

For t = 0 to t = 8s,

V_{rul} = constant = (40 - 10) m/s = 30 m/s.

So, $(Y_2 - Y_1) = 30 \times t$; for t = 0 to t = 8s

Then particle 1 comes to rest as it reaches the ground and then the distance changes by simple kinematics equation for a particle,

$(Y_2 - Y_1) = S = ut - \frac{1}{2}gt^2$, which is a parabola with speed increasing. In the remaining two figures, speed is increasing in 3rd graph (As evident from increasing slope).

Sol. 2 (4)

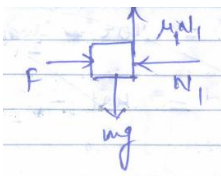
$\left(\frac{\Delta g}{g}\right) = \left(2\frac{\Delta T}{T} + \frac{\Delta l}{l}\right)$

$\left(\frac{\Delta g}{g} \times 100\right) = \left(2 \times \frac{1}{90} + \frac{0.1}{20}\right) \times 100$

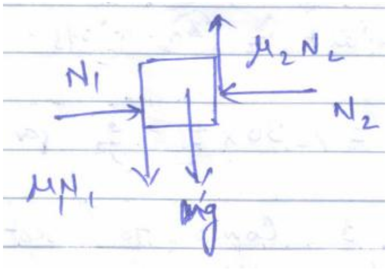
= 2.72 %

= 3 %

Sol. 3 (3)



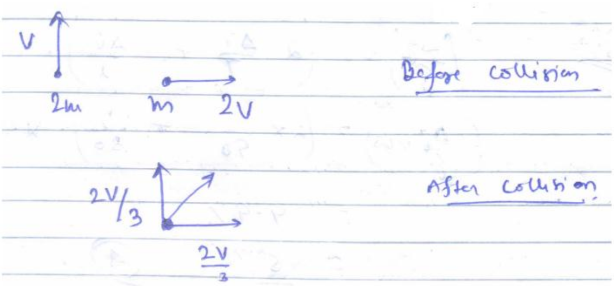
Here $M_1N_1 = mg = 20$ N



$M_1N_1 + mg = M_2N_2$

$\Rightarrow M_2N_2 = 20 + 100 = 120$ N

Sol. 4 (3)



Applying momentum conservation

Along x = axis

$2\ mV = (3m)\ v_x^1$

$\Rightarrow v_x^1 = \frac{2v}{3}$

Along y – axis

$2\ mv = (\ 3m)V_j^1$

$\Rightarrow V_j^1 = \frac{2v}{3}$

So, $V_{net} = \sqrt{\left(\frac{2v}{3}\right)^2 + \left(\frac{2v}{3}\right)^2} = \frac{2\sqrt{2}v}{3}$

$K.E = \frac{1}{2} \times 3m \times \frac{8}{9} V^2$

Initial K.E. $= \frac{1}{2} \times 2m \times v^2 + \frac{1}{2} \times m \times (2v)^2$

$= 3\ mV^2$

So, $\Delta K.E. = \frac{3mV^2 - (4mv^2/3)}{3mV^2}$

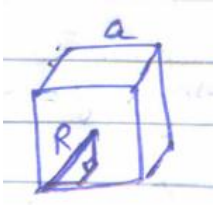
$= \frac{5}{9} \times 100 = 56\%$

Sol. 5 (2)

Centre of mean of solid cone $= \frac{h}{4}$ from the base

So, $Z_0 = h - \frac{h}{4} = \frac{3h}{4}$

Sol. 6 (3)



$R^2 = \left(\frac{a}{2}\right)^2 + \left(\frac{a}{\sqrt{2}}\right)^2$

'a' is the side of cube

So, $R^2 = \frac{3a}{4} \Rightarrow a = \frac{2R}{\sqrt{3}}$

Now, Mean of cube $= \frac{\mu}{\frac{4}{3}\pi R^3} \times a^3$

$= \frac{\mu}{\frac{4}{3}\pi R^3} \times R^3 \times \frac{8}{3\sqrt{3}}$

$= \frac{3M}{4\pi} \times 2\sqrt{2} = \frac{2M}{\pi\sqrt{3}}$

$= \frac{3\sqrt{2}M}{2\pi}$

Moments of inertia of cube $= \frac{ma^2}{6}$

$= \frac{3\sqrt{2}M}{2\pi \times 6} \times R^2 \times 2 = \frac{2m}{\pi\sqrt{3}} \times \frac{4R^2}{3} \times \frac{1}{6}$

$\Rightarrow = \frac{4mR^2}{a\sqrt{3}\pi}$

Sol. 7 (2)

Potential at the centre of cavity $= V_0 =$

Potential at the centre due to whole sphere - Potential due to the removed portion

$V = \frac{-Gm}{2R^3}(3R^2 - r^2)$

Due to the removed sphere,

$V_1 = \frac{-3Gm}{2R} = -\frac{3G\left(\frac{m}{8}\right)}{2\times\left(\frac{R}{2}\right)}$

Mean $= \frac{M}{\frac{4}{3}\pi k^3} \times \frac{4}{3}\left(\frac{R}{2}\right)^3$

$= \frac{M}{8}$

So,

$V_o = V - V_1$

$= \frac{-GM}{R}$

Sol. 8 (1)

$T = 2\pi\sqrt{\frac{l}{g}}$

When 'M' is attached,

$T_m = 2\pi\sqrt{\frac{l_1}{g}}$

Now,

$\frac{\left(\frac{F}{A}\right)}{\left(\frac{\Delta l}{l}\right)} = Y$ so, $\frac{\frac{mg}{A}}{\left(\frac{\Delta l}{l}\right)} = Y$

$\Rightarrow \frac{\Delta l}{l} = \frac{mg}{AY}$

So, $\frac{\Delta l + l}{l} = \left(\frac{Mg}{AY} + 1\right)$

$\Rightarrow \frac{l_1}{l} = \left(1 + \frac{mg}{AY}\right)$

So,

$\frac{Tm^2}{T^2} = \frac{l_1}{l} = 1 + \frac{mg}{AY}$

$\Rightarrow \frac{1}{Y} = \left(\frac{Tm^2}{T^2} - 1\right)\frac{A}{Mg}$

Sol. 9 (3)

$P = \frac{1}{3}\left(\frac{U}{v}\right)$

$\frac{nRT}{V} \alpha\ T^4 \Rightarrow VT^3 = K;\ K = \text{constant}$

$\Rightarrow \frac{4}{3}\pi\ R^3 \times T^3 = K$

$\Rightarrow$ TR = A different constant L

$\Rightarrow T\ \alpha \frac{1}{R}$

Sol. 10 (2)

$ds = \int \frac{c \cdot dT}{T} = C \cdot ln\ \left(\frac{T_f}{T_2}\right)$

$= \ln 2$

This is for one or many reservoir in contact as entropy is a state function.

Sol. 11 (3)

As $\tau \frac{l}{V_{rms}} = \frac{1}{\sqrt{2n\pi} v_{rms} d^2}$

As $n = \frac{N}{V}$

So, $\tau \times \frac{V}{\sqrt{T}}$

Since, $V_{rms} = \sqrt{\frac{3RT}{m}} \times \sqrt{T}$

So, $\tau \, \alpha \, V^{\frac{y+1}{2}}$

Sol. 12 (2)

P.E. is min at the mean position and K.E. is maximumhere. Reverse happens at extreme position.

Sol. 13 (2)

$f_1 = \left(\frac{V}{V-V_5}\right) f_0 = 1000 \times \frac{320}{300}$

$f_2 = \left(\frac{V}{V+V_5}\right) = 1000 \times \frac{320}{340}$

So, $\Delta f \simeq 12\%$

Sol. 14 (1)

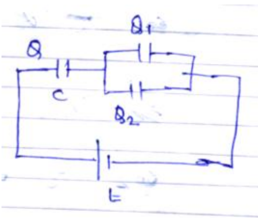
Field lines originate from positive charge & end on negative charge and are perpendicular at the surfer of a conductor.

Sol. 15 (3)

$V_{r<R} = \frac{KQ}{2R^3}(3R^2 - r^2)$

$V_r > R = \frac{KQ}{r}$

Sol. 16 (3)



$Q_2 = \frac{2}{2+1} \cdot Q = \frac{2Q}{3}$

$Q = F \times \frac{3\mu}{\mu+3}$

$\Rightarrow Q_2 = \frac{2\mu F}{\mu+3}$

Sol. 17 (4)

$V_d = jne = \frac{I}{A} ne$

$\Rightarrow I = neAV_d$

Now,

$S = \frac{V}{neV_d l} = 1.6 \times 10^{-5}$ -2m

Sol. 18(3)

Applying KVL,

If we take potential at P to be 0 and at Q to be V

$\frac{V-6}{3} + \frac{V-0}{1} + \frac{V+9}{5} = 0$

$\Rightarrow V = \frac{2}{23}$

So,

$I = \frac{V-0}{1} = \frac{3}{23} = 0.13$ A

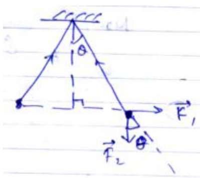
The direction is from Q to P, as 'I' is positive.

Sol. 19 (1)

As magnetic field due to the inner solenoid is zero outside of it, so $\overrightarrow{F_2} = 0$. But, magnetic field due to outer solenoid is actually perpendicular to all current elements of the inner Solenoid. So, force acts radially outward. Net force over each loop is zero as they act radially outward along all direction. So,

$\overrightarrow{F_1} = 0$ (net force).

Sol. 20 (2)



$\overrightarrow{F_1} = \left[\frac{\mu_0 I^2}{2\pi(2LSin\theta)}\right] \times l$

$\overrightarrow{F_2} = \lambda$ eg

From the equilibrium condition,

$\lambda egsin\theta = \frac{\mu_0 I^2}{2\pi(2Lsin\theta)} \times l\ cos\theta$

$\Rightarrow I = \sqrt{\frac{jgzl}{\mu_0 cos\theta}} \times 2$ sin

Sol. 21 (3)

At $\theta = 0$, equilibrium is stable

$\theta = 180$, equilibrium is unstable

Sol. 22(4)

For decay of current in LR circuit

$I = I_o \cdot e^{-tR/L}$

So, $I = \frac{E_O}{R} \cdot e^{-tR/L}$

Sol. 23(2)

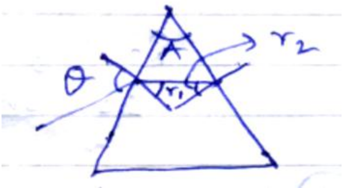
Intensity $= \frac{1}{2}\epsilon_0 E^2 \cdot c = \frac{Power\ emitted}{Surface\ area}$

$\Rightarrow \frac{P}{4\pi R^2} = \frac{1}{2}\epsilon_0 E_0^2 C$

$\Rightarrow E_0 = 2 \cdot 45$ V/w.

Sol. 24(1)

For emergence to other side



$r_2 < i_c$

$\Rightarrow (A - r_1) < i_c$

$\Rightarrow \sin(A - r_1) < \sin i_c$

$\Rightarrow (A - r_1) < \sin^{-1}\left[\frac{1}{\mu}\right] \left[\because \sin ic = \frac{1}{\mu}\right]$

$\Rightarrow r_1 > A - \sin^{-1}\left(\frac{1}{\mu}\right)$

So,

$\sin r_1 > \left[A - \sin^{-1}\left(\frac{1}{4}\right)\right]$

Also,

$\frac{\sin r_1}{\sin\theta} = \frac{1}{\mu}$

which implies,

$\Rightarrow \frac{\sin\theta}{\mu} > \sin\left[A - \sin^{-1}\left(\frac{1}{\mu}\right)\right]$

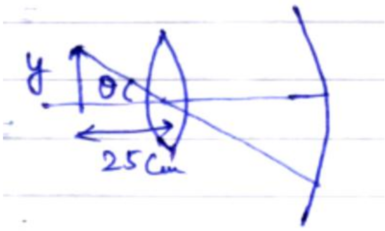
$\Rightarrow \theta > \sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

Sol. 25(4)

Ray 'B' travels faster, have wave front bends as shown

Sol. 26(2)

Resolving power $= \frac{1.22\lambda}{D}$



So, $\theta = \frac{y}{d} = \frac{1.22\lambda}{D}$

$\Rightarrow y = 30\ \mu m$.

Sol. 27(1)

Kinetic energy

= – Total energy

And Total energy $\propto \frac{z^2}{r^2}$

So, as 'n' decreases, K.E increases and potential and total energy decreases

Sol. 28(3)

Franck-Hertz experiment is associated with discrete energy levels of atom.

Photo electric effect → Particle nature of light

Davison Germer → Wave nature of electron

Sol. 29(3)

Resultant frequencies are,

$f_0 + f_m, f_0, f_0 - f_m$

Sol. 30(1)

Applying KVL,

$$\frac{d^2q}{dt^2} + \frac{R}{L}\frac{dq}{dt} + \frac{q}{LC} = 0.$$

Damping constant = R/L.

Now,

$$\theta_{\max} = Q_o \cdot e^{-\frac{Rt}{LL}}.$$

So, lesser the self-inductance, faster is the damping.