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SUBJECT : PHYSICS

KARNATAKA COMMON ENTRANCE TEST (KCET) 2019

Date: 30 April, 2019 | Total Duration: 80 Minutes

Maximum Time for Answering: 70 Min. | Max. Marks: 60

Dos :

1. Once again confirm whether the CET No. and name printed on the OMR Answer Sheet and the Admission Ticket are same.
2. This question booklet is issued to you by the invigilator after the 2' bell i.e., after 10.30 AM.
3. Confirm whether the OMR Answer Sheet and the Question Paper issued to you are with same version code.
4. The Version Code and Serial Number of this question booklet should be entered on the Nominal Roll without any mistakes.
5. Compulsorily affix the complete signature at the bottom portion of the OMR answer sheet in the space provided.

DONTs :

1. The timing and marks printed on the OMR answer sheet should not be damaged / mutilated / spoiled.
2. The 3rd Bell rings at 10.40 AM, till then;

- Do not remove the seal present on the right hand side of this question booklet.
- Do not look inside this question booklet.
- Do not start answering on the OMR answer sheet.

IMPORTANT INSTRUCTIONS TO CANDIDATES

1. This question booklet contains **60** questions and each question will have one statement and four distracters. (Four different options choices.)
2. After the 3rd Bell is rung at 10.40 AM, remove the seal on the right hand side of this question booklet and check that this booklet does not have any unprinted or torn or missing pages or items etc., if so, get it replaced immediately by complete test booklet by showing it to Room Invigilator. Read each item and start answering on the OMR answer sheet.
3. During the subsequent 70 minutes:

- Read each question carefully.
- Choose the correct answer from out of the four available distracters (options / choices) given under each question / statement.
- Completely darken / shade the relevant circle with a blue or black ink ballpoint pen against the question number on the OMR answer sheet.

CORRECT METHOD **WRONG METHOD**

4. Please note that even a minute unintended ink dot on the OMR answer sheet will also be recognized and recorded by the scanner. Therefore, avoid multiple markings of any kind on the OMR answer sheet.
5. Use the space provided on each page of the question booklet for Rough Work. Do not use the OMR answer sheet for the same.
6. After the last bell is rung at 11.50 AM, stop writing on the OMR answer sheet and affix your left hand thumb impression on the OMR answer sheet as per the instructions.
7. Hand over the OMR answer sheet to the room invigilator as it is.
8. After separating the top sheet (KEA copy), the invigilator will return the bottom sheet replica (Candidate's copy) to you to carry home for self-evaluation.
9. Preserve the replica of the OMR answer sheet for a minimum period of ONE year.
10. In case of any discrepancy in the English and Kannada Versions, the English version will be taken as final.

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PHYSICS

1. In a cyclotron a charged particle

(A) speeds up in dee

(B) undergoes acceleration all the time

(C) slows down within a dee and speeds up between dees

(D) speeds up between the dees because of the magnetic field.

Ans. (B)

Sol. Between the dee's the charged particle accelerates due to electric field. Within the dee the particle undergoes circular motion. Hence it undergoes centripetal acceleration.

2. The number of turns in a coil of Galvanometer is tripled, then

(A) Both voltage and current sensitivity remains constant

(B) Voltage sensitivity increases 3 times and current sensitivity remains constant

(C) Both voltage and current sensitivity decreases by 33%

(D) Voltage sensitivity remains constant and current sensitivity increases 3 times

Ans. (D)

Sol. $\frac{\theta}{I} = \frac{NAB}{C}$

$\frac{\theta}{V} = \frac{NAB}{CR}$

3. A circular current loop of magnetic moment M is in an arbitrary orientation in an external uniform magnetic field $\vec{B}$. The work done to rotate the loop by 30° about an axis perpendicular to its plane is

(A) $\frac{MB}{2}$ (B) MB (C) Zero (D) $\sqrt{3}\frac{MB}{2}$

Ans. (C)

Sol. Even though the coil is rotated, about an axis perpendicular to its plane, the potential energy does not change. Hence, work done is zero.

4. In a permanent magnet at room temperature

(A) domains are partially aligned.

(B) magnetic moment of each molecule is zero.

(C) domains are all perfectly aligned.

(D) the individual molecules have non-zero magnetic moment which are all perfectly aligned.

Ans. (A)

Sol. Even in the case of a permanent magnet all the domains are not perfectly aligned due to thermal agitations.

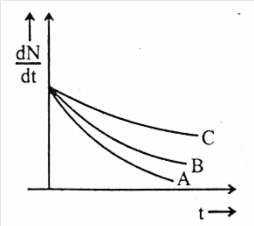
5. Coersivity of a magnet where the ferromagnet gets completely demagnetized is 3×10^3 Am^{-1}. The minimum current required to be passed in a solenoid having 1000 turns per metre, so that the magnet gets completely demagnetized when placed inside the solenoid is

(A) 3 A (B) 30 mA (C) 6 A (D) 60 mA

Ans. (A)

Sol. H = nI $\quad \therefore \; I = \frac{H}{n} = \frac{3 \times 10^3}{1000} = 3A$

6. Which one of the following nuclei has shorter mean life?



(A) C (B) A (C) Same for all (D) B

Ans. (B)

Sol. Slope of the graph gives activity.

Higher activity shorter mean life and vice versa.

7. The conductivity of semiconductor increases with increase in temperature because

(A) both number density of charge carriers and relaxation time increase

(B) number density of charge carriers increases

(C) number density of current carriers increases, relaxation time decreases but effect of decrease in relaxation time is much less than increase in number density

(D) relaxation time increases

Ans (C)

Sol. As temperature increases the number density of charge carries increases according to the equation $n = CT^{\frac{3}{2}} \cdot \exp\left(-\frac{E}{2}kT\right)$. Thus as temperature increases, the number density of charge carries increase resulting in conductivity of semiconductors.

8. For a transistor amplifier, the voltage gain

(A) is low at high and low frequencies and constant at mid frequencies

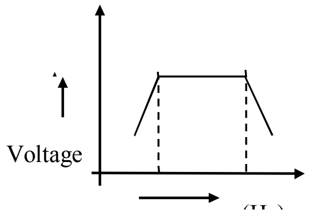
(B) remains constant for all frequencies

(C) constant at high frequencies and low at low frequencies

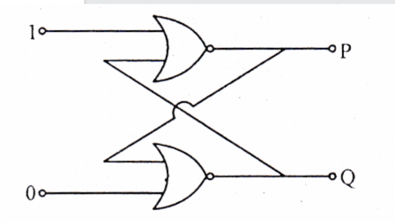
(D) is high at high and low frequencies and constant in the middle frequency range

Ans. (A)

Sol.



9. In the following circuit, what are P and Q?



(A) P = 0, Q = I (B) P = 0, Q = 0 (C) P = I, Q = 1 (D) P = 1, Q = 0

Ans. (A)

Sol. For both NOR gates $Y = \overline{A+B}$

For gate 1, A = 1 $\therefore$ P = 0

For gate 2, B = 0 $\therefore$ Q = 1

10. An antenna uses electromagnetic waves of frequency 5 MHz. For proper working, the size of the antenna should be :

(A) 15 km (B) 15 m (C) 3 km (D) 300 m

Ans. (B)

Sol. C = fλ

$$\lambda = \frac{C}{f} = \frac{3\times10^8}{5\times10^6} = \frac{3}{5}\times10^2 = 60\text{m}$$

The antenna length should be $\frac{\lambda}{4} = \frac{60}{4} = 15\,\text{m}$

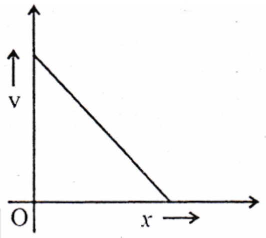
11. If P, Q and R are physical quantities having different dimensions, which of the following combinations can never be a meaningful quantity?

(A) $\frac{PQ}{R}$ (B) $\frac{P-Q}{R}$ (C) $\frac{PR-Q^2}{R}$ (D) PQ – R

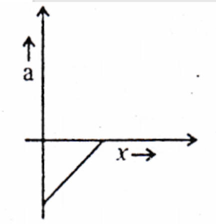
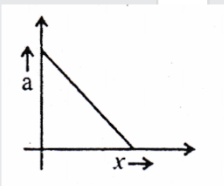
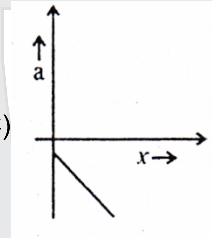
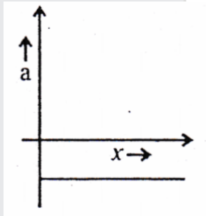
Ans. (B)

Sol. Principle of homogeneity

12. The given graph shows the variation of velocity (v) with position (x) for a particle moving along a straight line



Which of the following graph shows the variation of acceleration (a) with position (x)?

(A)  (B)  (C)  (D) 

Ans (A)

Sol. Given line have positive intercept but negative slope.

So its equation can be written as,

$v = -mx + v_0$ ...(1)

where $m = \tan\theta = \frac{v_0}{x_0}$

By differentiating with respect to time we get, $\frac{dv}{dt} = -m\frac{dx}{dt} = -mv$

Now substituting the value of 'v' from equation (1) we get

$\frac{dv}{dx} = -m[-mx + v_0] = m^2x - mv_0$

$a = m^2x - mv_0$

i.e., the graph between a and x should have positive slope but negative intercept on acceleration axis.

Hence option (A) is correct.

13. The trajectory of a projectile projected from origin is given by the equation $y = x - \frac{2x^2}{5}$. The initial velocity of the projectile is

(A) 25 ms^{-1} (B) $\frac{2}{5}ms^{-1}$ (C) $\frac{5}{2}ms^{-1}$ (D) 5 ms^{-1}

Ans. (D)

Sol. $y = x - \dfrac{2x^2}{5}$

$\tan\theta = 1$

$\theta = 45°$

$\dfrac{g}{2u^2\cos^2\theta} = \dfrac{2}{5}$

$\dfrac{10}{\cancel{2}u^2 \dfrac{1}{\cancel{2}}} = \dfrac{2}{5}$

$u^2 = \dfrac{50}{2} = 25$

$u = 5\ ms^{-1}$

14. An object with mass 5 kg is acted upon by a force, $\vec{F} = \left(-3\hat{i} + 4\hat{j}\right)N$. If its initial velocity at t = 0 is $\vec{v} = \left(6\hat{i} - 12\hat{j}\right)$ m s^{-1}, the time at which it will just have a velocity along y-axis is

(A) 2 s (B) 5 s (C) 15 s (D) 10 s

Ans. (D)

Sol. $\vec{F} = \left(-3\hat{i} + 4\hat{j}\right)$

$M\vec{a} = \left(-3\hat{i} + 4\hat{j}\right)$

M = 5 kg

$\vec{a} = \left(\dfrac{-3}{5}\hat{i} + \dfrac{4}{5}\hat{j}\right) \Rightarrow \vec{a} = a_x\hat{i} + a_y\hat{j}$

$a_x = \dfrac{-3}{5}$

at t = 0

$\vec{V}_0 = \left(6\hat{i} - 12\hat{j}\right) \Rightarrow V_{0x}\hat{i} + V_{oy}\hat{j}$

$V_{ox} = 6$

For the body to have velocity along y-axis only, x-component of velocity should be zero

i.e., $V_x = 0$

$V_x = V_{ox} + a_x t$

$0 = 6 + \left(\dfrac{-3}{5}\right)t$

$6 = \dfrac{3}{5}t$

$t = \dfrac{6 \times 5}{3} = 10\ s$

OR

$$A = \frac{F}{m} = \frac{-3}{5}\hat{i} + \frac{4}{5}\hat{j}$$

$$u = 6\hat{i} - 12\hat{j}\ ms^{-1}$$

v = u + at.

$$1\hat{j} = 6\hat{i} - 12\hat{j} + \left(\frac{-3}{5}\hat{i} + \frac{4}{5}\hat{j}\right)t$$

$$= \left(6 - \frac{3}{5}t\right)\hat{i}\left(-12 + \frac{4}{5}t\right)\hat{j}$$

$$-12 + \frac{4}{5}t\ \hat{j} = 1\hat{j}$$

$$-\frac{56}{5}t\ \hat{j} = 1\ \hat{j}$$

t = 10 s

15. During inelastic collision between two objects, which of the following quantity always remains conserved?

(A) Total linear momentum (B) Total kinetic energy

(C) Speed of each body (D) Total mechanical energy

Ans. (A)

Sol. Concept based.

16. In Rutherford experiment, for head-on collision of α-particles with a gold nucleus, the impact parameter is

(A) of the order of 10^{-10} m (B) zero

(C) of the order of 10^{-6} m (D) of the order of 10^{-14} m

Ans. **(B)**

Sol. For head on collision the impact parameter is zero as it retraces the path.

17. Frequency of revolution of an electron revolving in n^{th} orbit of H-atom is proportional to

(A) n independent of n (B) $\frac{1}{n^2}$ (C) $\frac{1}{n^3}$ (D) n

Ans. (C)

Sol. Time period of revolution, $T = \frac{2\pi r}{v}$

Frequency of revolution , $f = \frac{v}{2\pi r}$

$v \propto \frac{1}{n}$

$r \propto n^2$ and hence $f \propto \frac{1}{n^3}$

18. A hydrogen atom in ground state absorbs 10.2 eV of energy. The orbital angular momentum of the electron is increased by

(A) 3.16×10^{-34} Js (B) 1.05×10^{-34} Js (C) 4.22×10^{-34} Js (D) 2.11×10^{-34} Js

Ans. (B)

Sol. By absorbing 10.2ev, electron goes to 2nd orbit as $E^n = \frac{-13 \cdot 6}{n^2} ev,$

$E_1 = -13.6$ eV

$E_2 = -3.4$ eV

$E_2 - E_1 = 10.2$ eV

$$L_2 - L_1 = \frac{n_2 h}{2\pi} - \frac{n_1 h}{2\pi} = \frac{2h}{2\pi} - \frac{h}{2\pi} = \frac{6.62 \times 10^{-34}}{2 \times 3.14} = 1 \cdot 05 \times 10^{-34} J\,S$$

19. The end product of decay of $_{90}Th^{232}$ is $_{82}Pb^{208}$. The number of α and β particles emitted are respectively

(A) 6, 0 (B) 3, 3 (C) 4, 6 (D) 6, 4

Ans. (D)

Sol. $_{90}Th^{232} \rightarrow {}_{82}Pb^{208}$

Mass number changes by 24 and hence 6 α particles are emitted (as 1 α particle emitted decreased mass number by 4) then proton number should decrease by 12, but change in proton number is by 8 and hence 4 β particle should be emitted so that proton number increased by 4

20. Two protons are kept at a separation of 10 nm. Let F_n and F_e be the nuclear force and the electromagnetic force between them

(A) $F_e << F_n$ (B) $F_e = F_n$

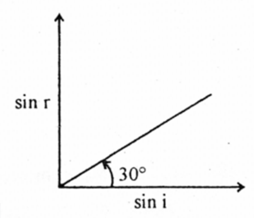
(C) F_e and F_n differ only slightly (D) $F_e >> F_n$

Ans. (D)

Sol. As separation is less than fm, electromagnetic force is greater than nuclear force. $F_e >> F_n$.

[Nuclear force is short range force acts. Within few fms]

21. A transparent medium shows relation between i and r as shown. If the speed of light in vacuum is c the Brewster angle for the medium is



(A) 60° (B) 30° (C) 90° (D) 45°

Ans. (A)

Sol. By Brewster's law, n = tan θ_p

Also $n = \frac{\sin i}{\sin r}$

But $\frac{\sin i}{\sin r} = \frac{1}{\text{slope}}$ of given graph

$$\frac{\sin i}{\sin r} = \frac{1}{\tan 30°} = \frac{1}{\frac{1}{\sqrt{3}}} = \sqrt{3}$$

$$\therefore \tan\theta_p = n = \sqrt{3}$$

$$\theta_p = \tan^{-1}\left(\sqrt{3}\right) = 60°$$

22. In Young's double slit experiment using monochromatic light of wavelength λ, the intensity of light at a point on the screen where path different is λ is K units. The intensity of light at a point where path difference is $\frac{\lambda}{3}$ is

(A) 4 K (B) K (C) 2 K (D) $\frac{K}{4}$

Ans. (D)

Sol. $\Delta x = \frac{\lambda}{2\pi}\Delta\phi$ $\therefore \frac{\lambda}{3} = \frac{\lambda}{2\pi}.\Delta\phi$

$\therefore$ Phase difference, $\phi = \frac{2\pi}{3}$

Intensity, I = $I_0\cos^2\phi$

$$= K.\cos^2\left(\frac{2\pi}{3}\right) = K\left(\frac{-1}{2}\right)^2$$

$$I = \frac{K}{4}$$

23. Due to Doppler's effect the shift in wavelength observed is 0.1 Å for a star producing wavelength 6000 Å. Velocity of recession of the star will be

(A) 5 km/s (B) 25 km/s (C) 20 km/s (D) 10 km/s

Ans. (A)

Sol. The formula for Doppler shift $\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$

$v = \frac{\Delta\lambda}{\lambda}.c = \frac{0.1}{6000}\times 3\times 10^8$ = 0.5 × 10^4 = 5 km s^{-1}

24. An electron is moving with an initial velocity $\vec{V} = V_0\hat{i}$ and is in a uniform magnetic field $\vec{B} = B_0\hat{j}$. Then its de Broglie wavelength

(A) decreases with time (B) remains constant

(C) increase and decreases periodically (D) increases with time

Ans. (B)

Sol. de-Broglie wavelength $\lambda = \frac{h}{mv}$

Electron is entering perpendicular to magnetic field. It moves in a circular path. But its speed remains same. Therefore de Broglie wavelength also remains constant.

25. Light of certain frequency and intensity incident on a photosensitive material causes photoelectric effect. If both the frequency and intensity are doubled, the photoelectric saturation current becomes

(A) halved (B) quadrupled (C) unchanged (D) doubled

Ans. (D)

Sol. We know photoelectric current is directly proportional to the intensity of incident light provided incident frequency is greater than threshold frequency.

∴ When intensity is doubled, photoelectric saturation current doubles.

26. A magnetic needle has a magnetic moment of 5 × 10^{-2} Am^2 and moment of inertia 8 × 10^{-6} kgm^2. It has a period of oscillation of 2 s in a magnetic field $\vec{B}$. The magnitude of magnetic field is approximately

(A) 3.2 × 10^{-4} T (B) 1.6 × 10^{-4} T (C) 0.8 × 10^{-4} T (D) 0.4 × 10^{-4} T

Ans. (B)

Sol. $T = 2\pi\sqrt{\frac{I}{MB}}$

$2 = 2\pi\sqrt{\frac{8\times 10^{-6}}{5\times 10^{-2}\times B}}$

Squaring $1 = \frac{\pi^2\times 8\times 10^{-6}}{5\times 10^{-2}\times B}$

$\therefore B = \frac{3.14^2\times 8\times 10^{-4}}{5} = 1.6\times 10^{-4}$ T

27. A toroid has 500 turns per metre length. If it carries a current of 2A, the magnetic energy density inside the toroid is

(A) 6.28 J/m^3 (B) 0.628 J/m^3 (C) 3.14 J/m^3 (D) 0.314 J/m^3

Ans. (B)

Sol. Magnetic field inside a toroid

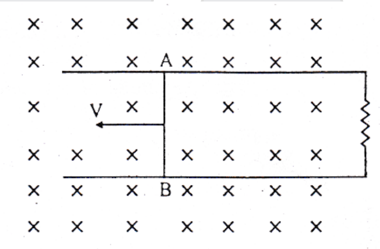
B = μ_onI

Magnetic energy density inside the toroid is

$$u_o = \frac{B^2}{2\mu_o} = \frac{\mu_o{}^2 n^2 I^2}{2\mu_o} = \frac{\mu_o n^2 I^2}{2}$$

$$= \frac{4\pi \times 10^{-7} \times (500)^2 \times 2^2}{2} = 0.628 \text{ J m}^{-3}$$

28. Consider the situation given in figure. The wire AB is slid on the fixed rails with a constant velocity. Ifthe wire AB is replaced by a semicircular wire, the magnitude of the induced current will



(A) decrease

(B) increase

(C) increase or decrease depending on whether the semicircle bulges towards the resistance or away from it

(D) remain same

Ans. (D)

Sol. The induced emf $e = l.(\vec{v} \times \vec{B})$ = l (vB sin θ) = Bvl

Induced current, $i = \frac{e}{R}$

If the straight wire is replaced by a semicircular wire, resistance R remains unchanged.

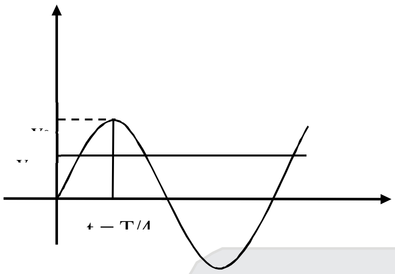
Hence, current remains same.

29. The frequency of an alternating current is 50 Hz. What is the minimum time taken by current to reach its peak value from rms value?

(A) 0.02 s (B) 5 × 10^{-3} s (C) 10 × 10^{-3} s (D) 2.5 × 10^{-3} s

Ans **(D)**

Sol.



We know that $v_{rms} = v_0 \sin \omega t$

$$\frac{v_0}{\sqrt{2}} = v_0 \sin \omega t$$

$$\therefore \ \sin \omega t = \left(\frac{1}{\sqrt{2}}\right)$$

i.e., $\omega t = \frac{\pi}{4} \Rightarrow \frac{2\pi}{T}.t = \frac{\pi}{4}$

$$\therefore \ t = \frac{T}{8}$$

Time for current to reach from rms value to peak value is i.e., $I_{rms} \rightarrow I_0$

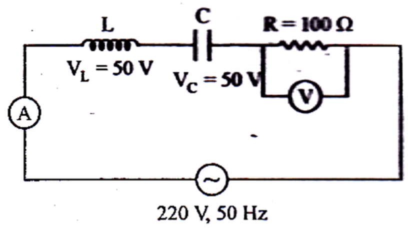
$$\frac{T}{4} - \frac{T}{8} = \frac{T}{8} \qquad \left(\frac{I_0}{\sqrt{2}} \rightarrow I_0\right)$$

$$f = 50 \quad \therefore \ t = \frac{I}{8}$$

$$= \frac{1}{50 \times 8} = \frac{1}{400} = 0.25 \times 10^{-2}$$

$= 2.5 \times 10^{-3}$ sec $\quad \therefore$ [D] is correct.

30. The readings of ammeter and voltmeter in the following circuit are respectively



(A) 2.7 A, 220 V (B) 1.2 A, 120 V (C) 2.2 A, 220 V (D) 1.5 A, 100 V

Ans. (C)

Sol. $\because V_L = V_C$ it is a resistive circuit

$\therefore$ V = 220 V and $I = \frac{V}{R} = \frac{220}{100} = 2.2A$

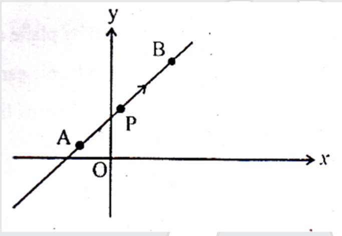
31. Two particles which are initially at rest move towards each other under the action of their mutual attraction. If their speeds are v and 2 v at any instant, then the speed of center of mass of the system is,

(A) 1.5 v (B) 2v (C) v (D) zero

Ans. (D)

Sol. At initial position both A and B are at rest, hence, momentum is zero. It is given that no external force is acting on them. So, momentum remains zero. Since mass cannot be zero, therefore velocity is zero.

32. A particle is moving uniformly along a straight line as shown in the figure. During the motion of the particle from A to B, the angular momentum of the particle about 'O'



(A) remains constant (B) increases

(C) first increases then decreases (D) decreases

Ans (A)

Sol. Concept based.

33. A satellite is orbiting close to the earth and has a kinetic energy K. The minimum extra kinetic energy required by it to just overcome the gravitation pull of the earth is

(A) $\sqrt{3}K$ (B) K (C) $2\sqrt{2}K$ (D) 2 K

Ans. (B)

Sol. We know $v_e = \sqrt{2}\ v_0$

When satellite is in orbit $K = \frac{1}{2}mv_0^2$

For satellite to escape its velocity should be v_e

$\therefore$ K.E. To escape, $K_e = \frac{1}{2}mv_e^2 = \frac{1}{2}m\left(\sqrt{2}\ v_0\right)^2 = 2K$

$\therefore$ Extra K.E. required = 2K – K = K

34. A wire is stretched such that its volume remains constant. The Poission's ratio of the material of the wire is

(A) 0.25 (B) 0.50 (C) – 0.25 (D) – 0.50

Ans (B)

Sol. Poisson's ratio of a stable, isotropic, linear elastic material lies in the range – 1 < σ < 0.5, theoretically.

For most of the materials σ < 0.5. This is because, moduli of elasticity should have positive values.

Negative Poisson's ratio in DESIGNED materials and in some anisotropic materials has been observed.

$\therefore$ For most of the materials σ < 0.5. $\therefore$ option (B) is correct.

35. A cylindrical container containing water has a small hole at height of H = 8 cm from the bottom and at a depth of 2 cm from the top surface of the liquid. The maximum horizontal distance travelled by the water before it hits the ground (x) is

(A) 4 cm (B) 8 cm (C) 6 cm (D) $4\sqrt{2}$ cm

Ans. (B)

Sol. $v = \sqrt{2gh} = \sqrt{2 \times 10 \times 2} = \sqrt{40}$

$t = \sqrt{\frac{2h}{g}}$

$R = v.t = \sqrt{\cancel{40}^{4}} \sqrt{\frac{2 \times 8}{\cancel{10}}}$ = 8cm.

36. An inductor of inductance L and resistor R are joined together in series and connected by a source of frequency ω. The power dissipated in the circuit is

(A) $\frac{V}{R^2 + \omega^2 L^2}$ (B) $\frac{R^2 + \omega^2 L^2}{V}$ (C) $\frac{V^2 R}{\sqrt{R^2 + \omega^2 L^2}}$ (D) $\frac{V^2 R}{R^2 + \omega^2 L^2}$

Ans. (D)

Sol. $I = \frac{v}{\sqrt{R^2 + \omega^2 L^2}}$

$P = I^2 R = \frac{v^2 R}{R^2 + \omega^2 L^2}$

37. An electromagnetic wave is travelling in x-direction with electric field vector given by,

$\vec{E}_y = E_0 \sin(kx - \omega t)\hat{j}$. The correct expression for magnetic field vector is

(A) $\vec{B}_y = \frac{E_0}{C} \sin(kx - \omega t)\hat{j}$ (B) $\vec{B}_y = E_0 C \sin(kx - \omega t)\hat{j}$

(C) $\vec{B}_z = \frac{E_0}{C} \sin(kx - \omega t)\hat{k}$ (D) $\vec{B}_z = E_0 C \sin(kx - \omega t)\hat{k}$

Ans. (C)

Sol. $\vec{E}_y = E_0 \sin(kx - \omega t)\hat{j}$

$$C = \frac{E_0}{B_0} \Rightarrow B_0 = \frac{E_0}{C}$$

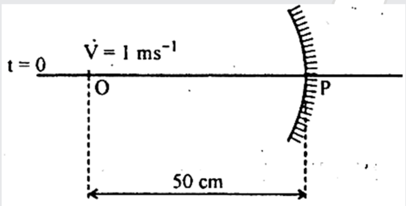
$$\therefore\ B_2 = \frac{E_0}{C}\sin(kx - \omega t)\hat{k}$$

38. The phenomenon involved in the reflection of radio-waves by ionosphere is similar to
(A) dispersion of light by water molecules during the formation of a rainbow
(B) reflection of light by plane mirror
(C) scattering of light by air particles
(D) total internal reflection of light in air during a mirage

Ans. (D)

Sol. Concept based.

39. A Point object is moving uniformly towards the pole of a concave mirror of focal length 25 cm along its axis as shown below. The speed of the object is 1 ms^{-1}. At t = 0, the distance of the object from the mirror is 50 cm. The average velocity of the image formed by the mirror between time t = 0 and t = 0.25 s is



(A) zero (B) 40 cm s^{-1} (C) infinity (D) 20 cm s^{-1}

Ans. (C)

Sol. Focal length = 25 cm
U_f = 25 cm
$V_f = \infty$

$$< V > = \frac{V_f - V_i}{\Delta t} = \infty.$$

40. A certain prism is found to produce a minimum deviation of 38°. It produces a deviation of 44° when the angle of incidence is either 42° or 62°. What is the angle of incidence when it is undergoing minimum deviation?

(A) 49° (B) 30° (C) 60° (D) 40°

Ans. (A)

Sol. D = 38°

$$i = \frac{A + D}{2}$$

d = (i_1 + i_2) – A

44 – (104) = – A $\quad \therefore$ A = 60° $\quad \therefore\ i = \frac{60+38}{2} = \frac{98}{2}$

$$\boxed{i = 49°}$$

41. An aluminium sphere is dipped into water. Which of the following is true?

(A) Buoyancy in water at 0 °C will be same as that in water at 4 °C

(B) Buoyancy will be less in water at 0 °C than that in water at 4 °C

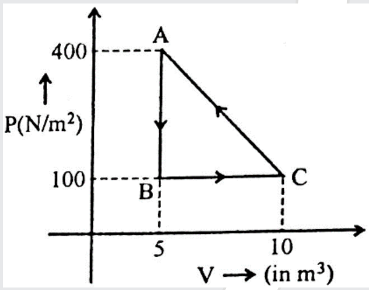
(C) Buoyancy may be more or less in water at 4 °C depending on the radius of the sphere

(D) Buoyancy will be more in water at 0 °C than that in water at 4 °C

Ans. (B)

Sol. Concept based.

42. A thermodynamic system undergoes a cyclic process ABC as shown in the diagram. The work done by the system per cycle is



(A) –750 J (B) 750 J (C) 1250 J (D) – 1250 J

Ans (A)

Work done = p × Δv

Work done = Area of triangle ABC

$\therefore\ W = \frac{1}{2}(10-5)\times(100-400)\ = \frac{5}{2}\times(-300)$ = – 750 J

The negative sign means the work is done by the system.

43. One mole of O_2 gas is heated at constant pressure starting at 27 °C. How much energy must be added to the gas as heat to double its volume?

(A) 750 R (B) Zero (C) 1050 R (D) 450 R

Ans (C)

Sol. At constant pressure it volume is doubled, temperate gets doubled,

T_1 = 300 k, T_2 = 600 k

hence ΔT = 600 – 300 = 300 k

Q = $nc_p\Delta T = 1\times\frac{7}{2}R\times 300$ = 1050 R

44. A piston is performing S.H.M. in the vertical direction with a frequency of 0.5 Hz. A block of 10 kg is placed on the piston. The maximum amplitude of the system such that the block remains in contact with the piston is

(A) 1.5 m (B) 1 m (C) 0.1 m (D) 0.5 m

Ans. (B)

Sol. f = 0.5 Hz

$\omega = 2\pi f = \pi$

for block to remain in contact with the piston at amplitude position

weight A the block = Force due to oscillation.

mg = ma

mg = m(ω^2 A)

$A = \frac{g}{\omega^2} = \frac{10}{\pi^2} = 1m$

45. The equation of a stationary wave is $y = 2\sin\left(\frac{\pi x}{15}\right)\cos(48\pi t)$. The distance between a node and its next antinode is

(A) 22.5 units (B) 7.5 units (C) 30 units (D) 1.5 units

Ans. (B)

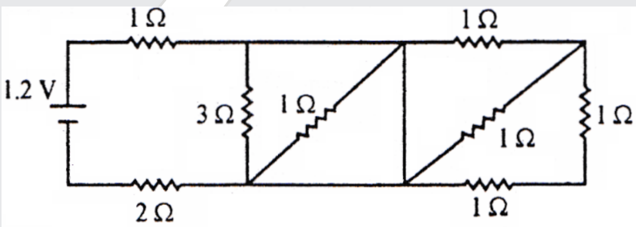
Sol. $y = 2\sin\left(\frac{\pi x}{15}\right)\cos(48\pi t)$

$\frac{2\cancel{\pi}}{\lambda} = \frac{\cancel{\pi}}{15}$

$\lambda = 30$

$\frac{\lambda}{4} = \frac{30}{4} = 7.5$

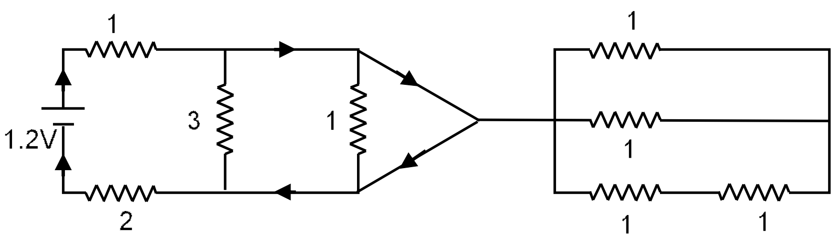
46. In the given circuit, the current through 2 Ω resistor is



(A) 0.4 A (B) 0.2 A (C) 0.1 A (D) 0.3 A

Ans (A)

Sol.



$R_{eq} = (1 + 2)\ \Omega = 3\Omega$

$I = \frac{V}{R_{eq}} = \frac{1.2}{3} = 0.4$ A

47. Kichhoff's junction rule is a reflection of

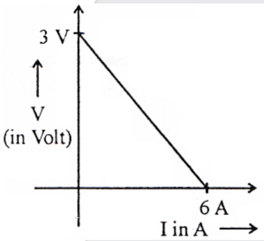
(A) conservation of momentum (B) conservation of current density vector

(C) conservation of charges (D) conservation of energy

Ans. (C)

Sol. Kirchhoff's junction rule is based on the conservation of charges.

48. The variation of terminal potential difference (V) with current flowing through as cell is as shown



The emf and internal resistance of the cell are

(A) 6 V, 2 Ω (B) 3 V, 2 Ω (C) 6 V, 0.5 Ω (D) 3 V, 0.5 Ω

Ans. (D)

Sol. V = E – Ir

This is the form of : y = mx + c

When I = 0, V = E = 3v When V = 0, $r = \frac{E}{I} = \frac{3}{6} = 0.5\Omega$

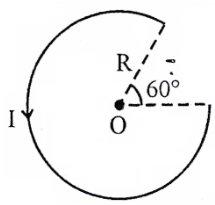
49. In a potentiometer experiment, the balancing point with a cell is at a length 240 cm. On shunting the cell with a resistance of 2 Ω, the balancing length becomes 120 cm. The internal resistance of the cell is

(A) 1 Ω (B) 4 Ω (C) 0.5 Ω (D) 2 Ω

Ans. (D)

Sol. Internal resistance of a cell is $R\left(\frac{\ell_1 - \ell_2}{\ell_2}\right) = 2\left(\frac{240 - 120}{120}\right) = 2\Omega$

50. The magnetic field at the centre 'O' in the given figure is



(A) $\frac{3}{10}\frac{\mu_0 I}{R}$ (B) $\frac{7}{14}\frac{\mu_0 I}{R}$ (C) $\frac{\mu_0 I}{12R}$ (D) $\frac{5}{12}\frac{\mu_0 I}{R}$

Ans. (D)

Sol. Here $\theta = 300°$

$\therefore$ Number of turns $n = \frac{300}{360} = \frac{5}{6}$

$B = \mu_0 \frac{nI}{2R}$ i.e., $\mu_0 \frac{5}{6} \times \frac{I}{2R}$

$\therefore B = \frac{5\mu_0 I}{12\ R}$

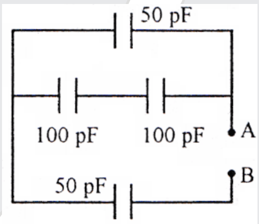
51. Two metal plates are separated by 2 cm. The potentials of the plates are – 10 V and + 30 V. The electric field between the two plates is :

(A) 200 V/m (B) 500 V/m (C) 3000 V/m (D) 1000 V/m

Ans. (A)

Sol. $E = \frac{V}{\alpha} = \frac{30-(-10)}{2\times10^{-2}} = 2000\ Vm^{-1}$ (α = distance between two plates)

52. The equivalent capacitance between A and B is,



(A) 150 pF (B) 50 pF (C) 300 pF (D) $\frac{100}{3}$pF

Ans. (D)

Sol. $C_{AB} = (50||50)\text{series } 50 \quad = \frac{100\times50}{100+50} = \frac{100}{3}\text{pF}$

53. A capacitor of capacitance C charged by an amount Q is connected in parallel with an uncharged capacitor of capacitance 2C. The final charges on the capacitors are

(A) $\frac{Q}{3}, \frac{2Q}{3}$ (B) $\frac{Q}{2}, \frac{Q}{2}$ (C) $\frac{Q}{5}, \frac{4Q}{5}$ (D) $\frac{Q}{4}, \frac{3Q}{4}$

Ans. (A)

Sol. The two capacitors attain common potential (V_C) given by the relation.

$V_C = \frac{\text{Total charge}}{\text{Total Capacitance}} = \frac{Q+0}{C+2C} = \frac{Q}{3C}$

The final charges on two capacitors are

$Q_1 = CV_C = \frac{CQ}{3C} = \frac{Q}{3}$ and $Q_2 = 2CV_C = \frac{2Q}{3}$

54. Though the electron drift velocity is small and electron charge is very small, a conductor can carry an appreciably large current because

(A) electron number density depends on temperature

(B) electron number density is very large

(C) relaxation time is small

(D) drift velocity of electron is very large

Ans. (B)

Sol. Current $I = neAV_d$

The large value of I is because of number density of free electrons in a conductor (n) which is of the order n = 10^{28} per m^3

55. Masses of three wires of copper are in the ration 1 : 3 : 5 and their lengths are in the ratio 5 : 3 : 1. The ratio of their electrical resistance are

(A) 1 : 15 : 125 (B) 1 : 3 : 5 (C) 125 : 15 : 1 (D) 5 : 3 : 1

Ans. (C)

Sol. Resistance $R = \frac{sl}{A}$

$$A = \frac{\text{volume}}{l} = \frac{\text{mass}}{l \times \text{Density}} = \frac{m}{ld}$$

$$R = \frac{sl}{\frac{m}{ld}} = \frac{sdl^2}{m}$$

$$R \alpha \frac{l^2}{m}$$

$$R_1 : R_2 : R_3 = \frac{l_1^2}{m_1} : \frac{l_2^2}{m_2} : \frac{l_3^2}{m_3}$$

$$= \frac{(5l)^2}{m} : \frac{(3l)^2}{3m} : \frac{l^2}{5m}$$

$= 25 : 3 : \frac{1}{5} \ldots \left(\frac{l}{m} \text{ is a constant}\right)$ = 125 : 15 : 1

56. A certain charge 2Q is divided at first into two parts q_1 and q_2. Later the charges are placed at a certain distance. If the force of interaction between two charges is maximum then $\frac{Q}{q_1} =$

(A) 1 (B) 4 (C) 0.5 (D) 2

Ans. (A)

Sol. For force F to be maximum between charges q_1 and q_2, $q_1 = q_2 = \frac{2Q}{2} = Q$

Now $\frac{Q}{q_1} = \frac{Q}{Q} = 1$

57. A particle of mass m and charge q is placed at rest in uniform electric field E and then released. The kinetic energy attained by the particle after moving a distance y is

(A) qEy (B) qEy^2 (C) q^2Ey (D) qE^2y

Ans. (A)

Sol. Velocity gained after moving a distance y is $v^2 = u^2 + 2ay$

Here u = 0 and $a = \frac{qE}{m}$

$$v^2 = 2\left(\frac{qE}{m}\right)y$$

Kinetic energy, $E = \frac{1}{2}mv^2$

$$= \frac{1}{2} \times m \times \left(2 \times \frac{qE}{m} \times y\right)$$

E = qEy

58. An electric dipole is kept in non-uniform electric field. It generally experiences

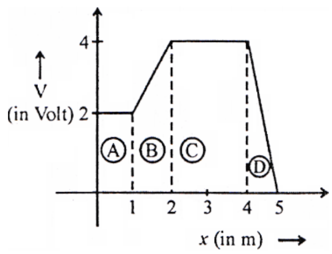
(A) a torque but not a force (B) a force and torque

(C) neither a force nor a torque (D) a force but not a torque

Ans. (B)

Sol. An electric dipole generally experience a force and a torque

59. The figure gives the electric potential V as a function of distance through four regions on x-axis. Which of the following is true for the magnitude of the electric field E in these regions?



(A) $E_B = E_D$ and $E_A < E_C$ (B) $E_A > E_B > E_C > E_D$

(C) $E_A < E_B < E_C < E_D$ (D) $E_A = E_C$ and $E_B < E_D$

Ans. (D)

Sol. In region A, V = constant $\Rightarrow E_A = 0$

In region B, $E_B = \frac{4-2}{2} = 1\text{vm}^{-1}$

In region C, V = constant $E_C = 0$

In Region D, $E_D = \frac{4-2}{1} = 2\text{vm}^{-1}$

Here $E_A = E_C$ and $E_B < E_D$

60. A system of two charges separated by a certain distance apart stores electrical potential energy. If the distance between them is increased, the potential energy of the system,

(A) may increase or decrease
(B) increases in any case
(C) remains the same
(D) decreases in any case

Ans. (A)

Sol. Potential energy of a system of charges is $U = \left(\frac{1}{4\pi\varepsilon_0}\right)\frac{q_1q_2}{r}$

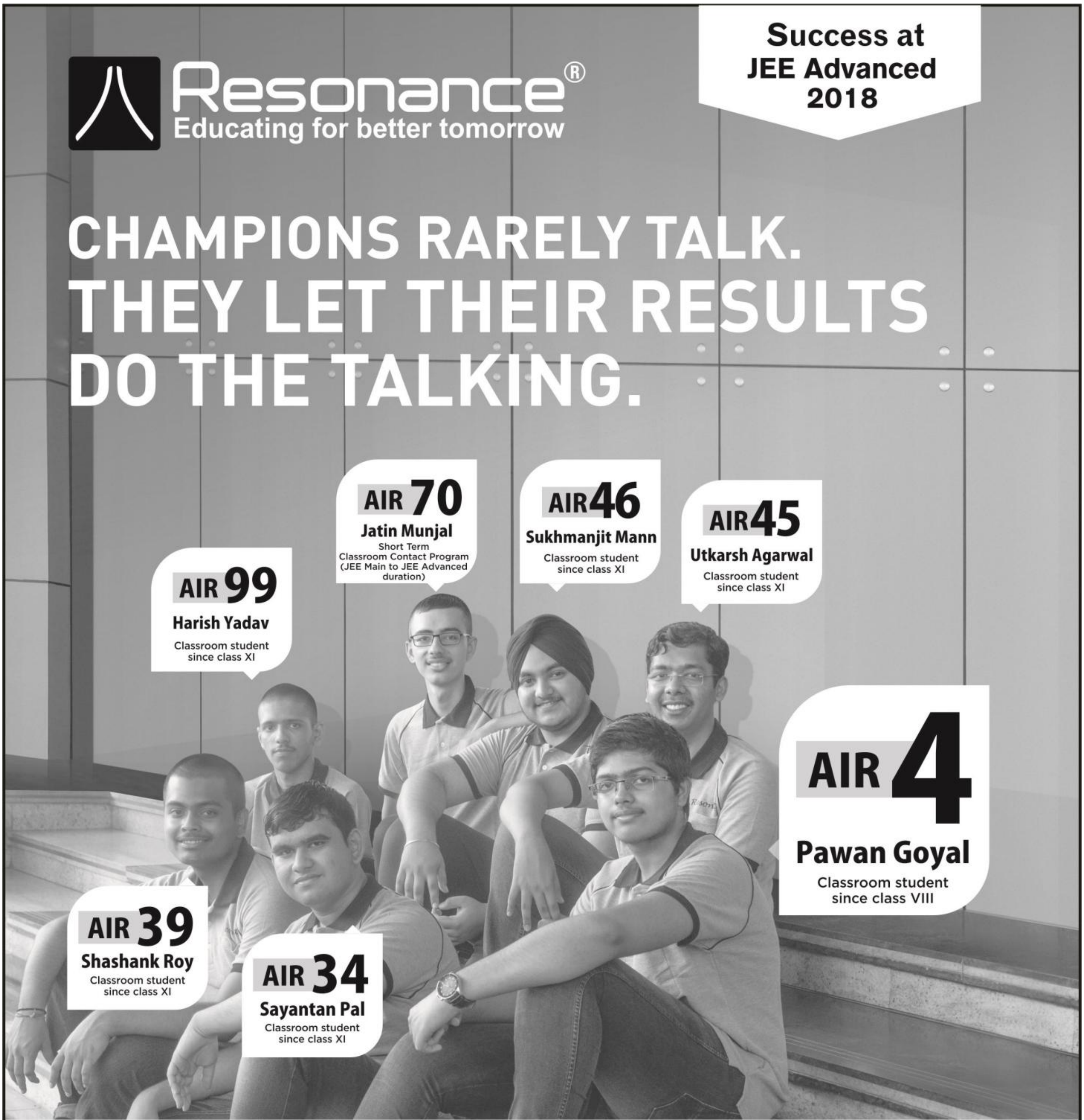
In case of like charges, (q_1 q_2) is positive

when r increases, U decreases

In case of unlike charges, (q_1 q_2) is negative

when r increases, | U | decreases

but because of negative sign, U increases.



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