JEE–MAIN EXAMINATION – JANUARY 2026

(HELD ON FRIDAY 23rd JANUARY 2026) **TIME : 3:00 PM TO 6:00 PM**

PHYSICS — TEST PAPER WITH SOLUTION

SECTION-A

26. The internal energy of a monoatomic gas is 3nRT. One mole of helium is kept in a cylinder having internal cross section area of 17 cm^2 and fitted with a light movable frictionless piston. The gas is heated slowly by suppling 126 J heat. If the temperature rises by 4 °C, then the piston will move______cm.

(atmospheric pressure = 10^5 Pa)

(1) 14.5 (2) 1.55

(3) 15.5 (4) 1.45

Ans. (3)

Sol. $\Delta U = 3nR\Delta T$

$\Delta U = 3 \times 1 \times \frac{25}{3} \times 4 = 100$ Joule

$\Delta Q = 126$

$W = 26 = P\Delta V$

$26 = 10^5 \times 17 \times 10^{-4}\ \Delta x$

$\Delta x = \frac{26}{170} = 15.3$

27. A body of mass 14 kg initially at rest explodes and breaks into three fragments of masses in the ratio 2 : 2 : 3. The two pieces of equal masses fly off perpendicular to each other with a speed of 18 m/s each. The velocity of the heavier fragment is ____m/s.

(1) $10\sqrt{2}$

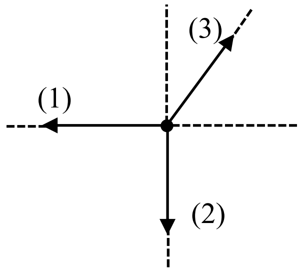
(2) $12\sqrt{2}$

(3) 12

(4) $24\sqrt{2}$

Ans. (2)

Sol.



Apply C.O.M

$M_1V_1 + M_2V_2 + M_3V_3 = 0$

$2(-18i) + 2(-18j) + 3V_3 = 0$

$V_3 = 12i + 12j$

$|V_3| = 12\sqrt{2}$ m/s

28. A block is sliding down on an inclined plane of slope θ and at an instant *t* = 0 this block is given an upward momentum so that it starts moving up on the inclined surface with velocity *u*. The distance (*S*) travelled by the block before its velocity become zero, is______.

(g = gravitational acceleration)

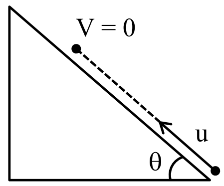
(1) $\frac{u^2}{4g\sin\theta}$ (2) $\frac{2u^2}{g\cos\theta}$

(3) $\frac{u^2}{\sqrt{2}g\cos\theta}$ (4) $\frac{u^2}{2g\cos\theta}$

NTA Ans. (4)

Allen Ans. (Bonus)

Sol.



$a = -g\sin\theta$

$V^2 = U^2 + 2as$

$0 = u^2 - 2g\sin\theta \cdot s$

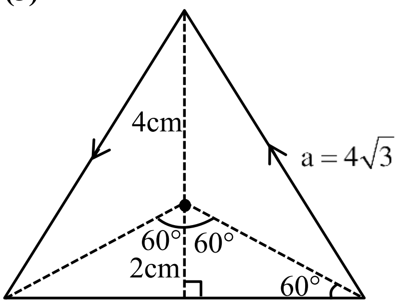
$s = \frac{u^2}{2g\sin\theta}$

29. The current passing through a conducting loop in the form of equilateral triangle of side $4\sqrt{3}$ cm is 2A. The magnetic field at its centroid is $\alpha \times 10^{-5}$ T. The value of α is ______.
(Given : $\mu_o = 4\pi \times 10^{-7}$ SI units)

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

Ans. (3)

Sol.



$$B = \frac{\mu_0}{4\pi} \times \frac{I}{d}\ [\sin 60° + \sin 60°] \times 3$$

$$B = 10^{-7} \times \frac{2}{2\times10^{-2}}\left(\frac{\sqrt{3}}{2}+\frac{\sqrt{3}}{2}\right)\times 3$$

$$= \sqrt{3} \times 10^{-5} \times 3 = 3\sqrt{3}\times10^{-5}$$

30. A paratrooper jumps from an aeroplane and opens a parachute after 2 s of free fall and starts deaccelerating with 3 m/s^2. At 10 m height from ground, while descending with the help of parachute, the speed of paratrooper is 5 m/s. The initial height of the aeroplane is _____m.
($g = 10$ m/s^2)

(1) 62.5 (2) 92.5
(3) 20 (4) 82.5

Ans. (2)

Sol. A to B

$x_1 = \frac{1}{2} \times 10 \times 2^2 = 20$ m

$V = 0 + 10 \times 2$

B to C

$5^2 = 20^2 - 2(3)x_2$

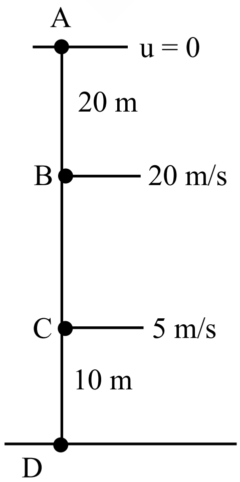
$x_2 = \frac{375}{6}$

$x_2 = 62.5$

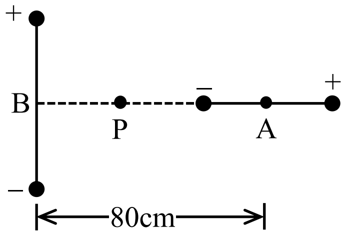
C to D

$x_3 = 10$m

$H = x_1 + x_2 + x_3 = 92.5$



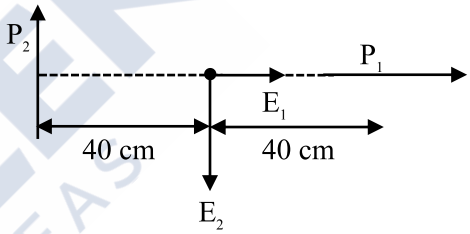
31. Two shorts dipoles (A, B), A having charges $\pm$ 2μC and length 1 cm and B having charges $\pm$ 4μC and length 1 cm are placed with their centres 80 cm apart as shown in the figure. The electric field at a point P, equi-distant from the centres of both dipoles is_____N/C.



(1) $\frac{9}{16}\sqrt{2}\times10^5$ (2) $4.5\sqrt{2}\times10^4$
(3) $9\sqrt{2}\times10^4$ (4) $\frac{9}{16}\sqrt{2}\times10^4$

Ans. (4)

Sol.



$$\vec{E}_2 = -\frac{KP_2}{r^3}\ ;\ \vec{E}_1 = -\frac{2KP_1}{r^3}$$

$P_1 = 2 \times 10^{-6} \times 10^{-2} = 2 \times 10^{-8}$

$P_2 = 4 \times 10^{-6} \times 10^{-2} = 4 \times 10^{-8}$

$$\vec{E}_{net}\ \frac{2\times9\times10^9\times2\times10^{-8}}{(0.4)^3}\ \hat{i} - \frac{9\times10^9\times4\times10^{-8}}{(0.4)^3}\ \hat{j}$$

$$\vec{E}_{net} = \frac{9\times10^9\times4\times10^{-8}}{(0.4)^3}[\hat{i}-\hat{j}]$$

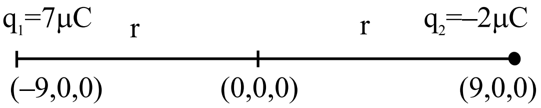
$$\left|\vec{E}_{net}\right| = \frac{9\times10^4}{16}(\sqrt{2})$$

32. Two charges 7μC and –2 μC are placed at (–9, 0, 0) cm and (9, 0, 0) cm respectively in an external field $E = \frac{A}{r^2}\hat{r}$, where $A = 9 \times 10^5$ N/C.m^2.
Considering the potential at infinity is 0, the electrostatic energy of the configuration is_____J.

(1) 1.4 (2) –90.7
(3) 49.3 (4) 24.3

Ans. (3)

Sol.



$$dV = -\vec{E}.\vec{dr}$$

$$\int_0^v dV = -\int_\infty^r \frac{A}{r^2}dr$$

$$V = -\left[\frac{-A}{r^2}\right]_\infty^r \Rightarrow \boxed{V = \frac{A}{r}}$$

$$U = U_{self} + U_{interaction}$$

$$= q_1v_1 = q_2v_2 + \frac{kq_1q_2}{2r}$$

$$= 7\times10^{-6}\frac{A}{9\times10^{-2}} - 2\times10^{-6}\frac{A}{9\times10^{-2}}$$

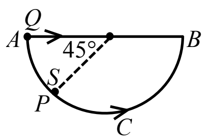
$$-\frac{9\times10^9\times14\times10^{-12}}{2\times9\times10^{-2}}$$

$$= \frac{5\times10^{-6}\times9\times10^5}{9\times10^{-2}} - 7\times10^{-1}$$

$$= 50 - 0.7$$

$$= 49.3\ J$$

33. A bead *P* sliding on a frictionless semi-circular string (*ACB*) and it is at point *S* at t = 0 and at this instant the horizontal component of its velocity is v. Another bead *Q* of the same mass as *P* is ejected from point *A* at t = 0 along the horizontal string *AB*, with the speed *v*, friction between the beads and the respective strings may be neglected in both cases. Let t_p and t_Q be the respective times taken by beads *P* and *Q* to reach the point *B*, then the relation between t_p and t_Q is



(1) $t_P > t_Q$

(2) $t_p < t_Q$

(3) $t_p > 1.25t_Q$

(4) $t_p = t_Q$

Ans. (2)

Sol. Horizontal displacement of Q is more then P.

$$X_Q > X_P$$

Horizontal component of velocity is same

So $t_p = \frac{x_p}{v}$

$$t_Q = \frac{x_Q}{v}$$

$t_Q > t_p$

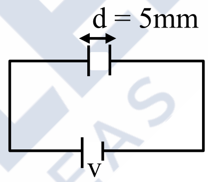
34. A parallel plate capacitor with plate separation 5 mm is charged by a battery. On introducing a mica sheet of 2 mm and maintaining the connections of the plates with the terminals of the battery, it is found that it draws 25% more charge from the battery. The dielectric constant of mica is____.

(1) 2.5 (2) 2.0

(3) 1.5 (4) 1.0

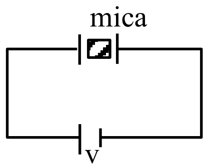
Ans. (2)

Sol.



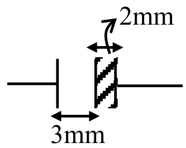
$$C = \frac{\epsilon_0 A}{d}$$

$$Q_1 = CV$$



$Q_2 = (c_{eq})\ v$

$Q_2 = 1.25\ cv$



$$c_{eq} = \frac{C_1C_2}{C_1 + C_2} = \frac{\frac{\epsilon_0 A}{3}\times\frac{K\epsilon_0 A}{2}}{\frac{\epsilon_0 A}{3}+\frac{K\epsilon_0 A}{2}}$$

$$c_{eq} = \frac{(\epsilon_0 A)^2\left(\frac{K}{6}\right)}{\epsilon_0 A\left(\frac{2+3K}{6}\right)} \Rightarrow C_{eq} = \frac{K\epsilon_0 A}{2+3K}$$

$$1.25 \times \frac{\epsilon_0 A}{5} = \frac{K\epsilon_0 A}{2+3K} \Rightarrow 0.25\,(2+3K) = K$$

$$2 + 3K = 4K \Rightarrow K = 2$$

35. To compare EMF of two cells using potentiometer the balancing lengths obtained are 200 cm and 150 cm. The least count of scale is 1 cm. The percentage error in the ratio of EMFs is____

(1) 1.45 (2) 1.65

(3) 1.75 (4) 1.55

NTA Ans. (2)

Allen Ans. (Bonus)

Sol. $\epsilon = \lambda \ell$

Potential gradient

$\epsilon_1 = \lambda \ell_1$

$\epsilon_2 = \lambda \ell_2$

$$y = \frac{\epsilon_1}{\epsilon_2} = \frac{\ell_1}{\ell_2}$$

$$\frac{\Delta y}{y} = \frac{\Delta \ell_1}{\ell_1} + \frac{\Delta \ell_2}{\ell_2}$$

$$\frac{\Delta y}{y} = \frac{1}{200} + \frac{1}{150}$$

$$\frac{\Delta y}{y} \times 100\left(\frac{1}{200} + \frac{1}{150}\right) \times 100$$

$$= \left(\frac{3+4}{600}\right) \times 100 \Rightarrow \frac{7}{6} = 1.16\%$$

No options matching

36. An air bubble of volume 2.9 cm^3 rises from the bottom of a swimming pool of 5 m deep. At the bottom of the pool water temperature is 17 °C. The volume of the bubble when it reaches the surface, where the water temperature is 27 °C, is____ cm^3.

($g = 10\ m/s^2$, density of water $= 10^3\ kg/m^3$, and 1 atm pressure is 10^5 Pa)

(1) 4.2 (2) 2.0

(3) 3.0 (4) 4.5

Ans. (4)

Sol. For an air bubble rising in water, the no. of moles remain constant

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{(P_{atm} + \rho gh)2.9cm^3}{290K} = \frac{(P_{atm})V_2}{300}$$

$V_2 = 4.5\ cm^3$

37. Which of the following pair of nuclei are isobars of the element ?

(1) ${}^2_1H$ and ${}^3_1H$

(2) ${}^{236}_{92}U$ and ${}^{238}_{92}U$

(3) ${}^{198}_{80}Hg$ and ${}^{197}_{79}Au$

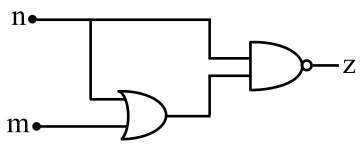
(4) ${}^3_1H$ and ${}^3_2H$

Ans. (4)

Sol. Isobars are nuclei that have the same mass number

${}^3_1H$ & ${}^3_2He$ have same mass number.

38. For the given logic gate circuit, which of the following is the correct truth table?



(1)

n	m	z
0	0	1
0	1	0
1	1	0
1	0	0

(2)

n	m	z
0	0	0
0	1	1
1	1	0
1	0	1

(3)

n	m	z
0	0	1
0	1	0
1	1	1
1	0	0

(4)

n	m	z
0	0	1
0	1	1
1	1	0
1	0	0

Ans. (4)

Sol. **Gate 1 :** At bottom there is an OR gate with inputs n & m

out put = n + m

Gate 2 : A NAND gate, its Input are direct n & the output of OR gate (n + m)

out put $z = \overline{n.(n+m)}$

since n.(n + m) = (n.n) + (n.m)

= n + n.m = n(1 + m) = n

$\therefore$ output $z = \overline{n.(n+m)} = \bar{n}$

n	m	$z = \bar{n}$
0	0	1
0	1	1
1	1	0
1	0	0

39. One mole of an ideal diatomic gas expands from volume V to 2V isothermally at a temperature 27°C and does W joule of work. If the gas undergoes same magnitude of expansion adiabatically from 27°C doing the same amount of work W, then its final temperature will be (close to) __________ °C.

(1) –189 (2) –56

(3) –30 (4) –117

Ans. **(2)**

Sol. For Isothermal process

$W_{isothermal} = nRT\ell n\left(\frac{V_2}{V_1}\right)$

$= 1.R\ 300.\ \ell n(2)$

$= 300\ R\ (0.693)$…………..(1)

Now for adiabatic process,

It is given work done in Isothermal = work done in adiabatic

$W_{adiabatic} = \frac{nR(T_1 - T_2)}{\gamma - 1}$ …………..(2)

(1) = (2)

$\frac{nR(300 - T_{final})}{1.4 - 1} = 300R(0.693)$

$T_{Final} = 216.84$ K

= –56.3°C

40. A prism of angle 75° and refractive index $\sqrt{3}$ is coated with thin film of refractive index 1.5 only at the back exit surface. To have total internal reflection at the back exit surface the incident angle must be _______.

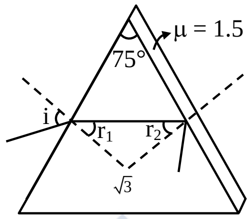
(sin 15° = 0.25 and sin 25° = 0.43)

(1) between 15° and 20° (2) 15°

(3) > 25° (4) < 15°

Ans. **(1, 2, 4)**

Sol.



$r_1 + r_2 = 75°$

For T I R at back surface

$\sqrt{3}\sin r_2 = \frac{3}{2}\sin 90°$

$r_2 \geq 60°$

$r_1 \leq 15°$

$1 \sin i = \sqrt{3}\sin 15°$

sin i = 1.73 × .25

sin i = .433

$i = 25° \Rightarrow i < 25°$

41. A circular loop of radius 7 cm is placed in uniform magnetic field of 0.2 T directed perpendicular to plane of loop. The loop is converted into a square loop in 0.5 s. The EMF induced in the loop is ___________ mV.

(1) 6.6 (2) 13.2

(3) 8.25 (4) 1.32

Ans. **(4)**

Sol. induced EMF = $\frac{d\phi}{dt}$

circumference $\simeq 14\pi$

side length of square loop = $\frac{14\pi}{4} = \frac{7\pi}{2}$

$\Delta\phi = B\ (A_1 - A_2)$

$= (.2)\left(\left(\frac{7\pi}{2}\right) \times \frac{7\pi}{2} - 49\pi\right) \times 10^{-4}$

$= .2\left(\frac{49\pi^2}{4} - 49\pi\right)\times 10^{-4}$

$\Delta\phi = .2 \times 33.07 \times 10^{-4}$

$\Delta\phi = 6.614 \times 10^{-4}$

$\text{EMF} = \frac{6.614\times10^{-4}}{\frac{1}{2}}\text{V} = 13.23 \times 10^{-4}\text{ V}$

EMF = 1.32 mV

42. Suppose a long solenoid of 100 cm length, radius 2 cm having 500 turns per unit length, carries a current $I = 10 \sin(\omega t)$ A, where $\omega = 1000$ rad./s. A circular conducting loop (B) of radius 1 cm coaxially slided through the solenoid at a speed v = 1 cm/s. The r.m.s. current through the loop when the coil B is inserted 10 cm inside the solenoid is $\alpha/\sqrt{2}$ μA. The value of α is _________.

[Resistance of the loop = 10 Ω]

(1) 197 (2) 80

(3) 280 (4) 100

Ans. (1)

Sol. EMF induced $\varepsilon = A\frac{dB}{dt} = A\mu_0 n\frac{di}{dt}$

$\varepsilon = A\mu_0 n\, i_0\omega \cos\omega t$

current induced $i = \frac{\varepsilon}{R} = \frac{\pi r^2\mu_0 n i_0\omega}{R}\cos\omega t$

So $i = \frac{\pi r^2\mu_0 n i_0\omega}{\sqrt{2}R}$

$= \frac{\pi\times10^{-4}\times4\pi\times10^{-7}\times500\times10\times10^3}{\sqrt{2}\times10}$

$= \frac{20\pi^2}{\sqrt{2}}\times10^{-6}$

$\simeq \frac{197}{\sqrt{2}}\mu\text{A}$

43. The ratio of speeds of electromagnetic waves in vacuum and a medium, having dielectric constant k = 3 and permeability of $\mu = 2\mu_0$, is

(μ_0 = permeability of vacuum)

(1) 36 : 1

(2) 3 : 2

(3) 6 : 1

(4) $\sqrt{6}$: 1

Ans. (4)

Sol. $\frac{C}{V} = \mu = \sqrt{\varepsilon_r\mu_r}$

$\frac{C}{V} = \sqrt{\frac{3\times2}{1}} = \frac{\sqrt{6}}{1}$

44. When an unpolarized light falls at a particular angle on a glass plate (placed in air), it is observed that the reflected beam is linearly polarized. The angle of refracted beam with respect to the normal is _________.

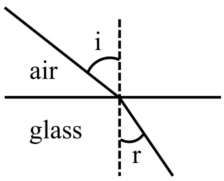
($\tan^{-1}(1.52) = 57.7°$, refractive indices of air and glass are 1.00 and 1.52, respectively)

(1) 39.6° (2) 32.3°

(3) 42.6° (4) 36.3°

Ans. (2)

Sol.



$\tan i = \frac{\mu_2}{\mu_1} = \frac{\mu_g}{\mu_a}$

tan i = 1.52

i = 57.7°

r = 90° – i

r = 32.3°

45. A small metallic sphere of diameter 2 mm and density 10.5 g/cm^3 is dropped in glycerine having viscosity 10 Poise and density 1.5 g/cm^3 respectively. The terminal velocity attained by the sphere is ________ cm/s.

($\pi = \frac{22}{7}$ and g = 10 m/s^2)

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

Ans. (1)

Sol. $V_T = \frac{2r^2 g}{9\eta}(\rho_b - \rho_\ell)$

$V_T = \frac{2}{9}\frac{(.1)^2 \times 10}{(10)}(10.5-1.5)$

$V_T = 2$ cm/sec.

SECTION - B

46. The average energy released per fission for the nucleus of ${}^{235}_{92}U$ is 190 MeV. When all the atoms of 47 g pure ${}^{235}_{92}U$ undergo fission process, the energy released is α × 10^{23} MeV. The value of α is _______.

(Avogadro Number = 6 × 10^{23} per mole)

Ans. (228)

Sol. Total numbers of U-235 atom is

$47\text{ g} = \frac{47}{235}$ moles $= \frac{1}{5}$ moles

$\therefore$ Total energy released $= \frac{1}{5} \times 6 \times 10^{23} \times 190$ MeV

= 228 × 10^{23} MeV

47. The size of the images of an object, formed by a thin lens are equal when the object is placed at two different positions 8 cm and 24 cm from the lens. The focal length of the lens is ________ cm.

Ans. (16)

Sol. $m = \frac{f}{f+u}$

$m_1 = -m_2$

$\frac{f}{f-8} = -\frac{f}{f-24}$

f – 8 = 24 – f

2f = 32

f = 16 cm

48. A ball of radius r and density ρ dropped through a viscous liquid of density σ and viscosity η attains its terminal velocity at time t, given by t = A $\rho^a r^b \eta^c \sigma^d$, where A is a constant and a, b c and d are integers. The value of $\frac{b+c}{a+d}$ is ______.

Ans. (1)

Sol. $T = (ML^{-3})^a L^b (ML^{-1}T^{-1})^c (ML^{-3})^d$

$T = M^{a+c+d} L^{-3a-c-3d+b} T^{-c}$

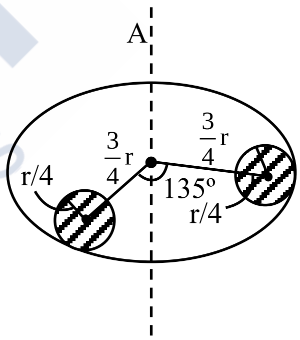
on comparing

c = –1; a + c + d = 0; –3a – c – 3d + b = 0

b = 2; a + d = 1

b + c = 1

49. Suppose there is a uniform circular disc of mass M kg and radius r m shown in figure. The shaded regions are cut out from the disc. The moment of inertia of the remainder about the axis A of the disc is given by $\frac{x}{256}$ Mr^2. The value of x is _________.



Ans. (109)

Sol. $M = \sigma\pi R^2$

$\sigma\pi R^2 = 16$ m

$m = \frac{\sigma\pi R^2}{16}$

$I_{system} = \frac{MR^2}{2} - 2\left(\frac{mR^2}{2\times16} + \frac{9mR^2}{16}\right)$

$= \frac{MR^2}{2} - 2\times\frac{19mR^2}{32}$

$= \frac{MR^2}{2} - \frac{19}{16}mR^2$

$= \frac{MR^2}{2} - \frac{19}{256}MR^2$ becoz $m = \frac{M}{16}$

$= \frac{(128-19)(MR^2)}{256}$

$= \frac{109MR^2}{256}$

50. The velocity of sound in air is doubled when the temperature is raised from 0°C to α°C. The value of α is _______.

Ans. (819)

Sol. $V = \sqrt{\frac{\gamma RT}{M}}$

$$\frac{V_1}{V_2} = \frac{\sqrt{T_1}}{\sqrt{T_2}}$$

$$\frac{V_0}{2V_0} = \sqrt{\frac{273}{T_2}}$$

$$\frac{1}{4} = \frac{273}{T_2}$$

$T_2 = 4 \times 273 = \alpha + 273$

$\alpha = 3 \times 273$

$\alpha = 819°C$