MEMORY BASED QUESTIONS JEE–MAIN EXAMINATION – JANUARY 2026

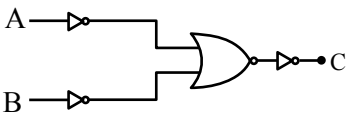
(HELD ON WEDNESDAY 21st JANUARY 2026) **TIME : 9:00 AM TO 12:00 NOON**

PHYSICS

TEST PAPER WITH SOLUTION

SECTION-A

1. Which logic gate is given in the figure?



(1) XOR (2) NOR

(3) NAND (4) OR

Ans. **(3)**

Sol.

A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

(NAND)

2. Given energy density equation for unsteady flow

$$\left(P+\frac{A}{Bt^2}\right)+\frac{1}{2}\rho v^2+\rho g(h+Bt)$$

Find dimension of A and B.

(1) $[A]=MT^{-1}$, $[B]=LT^{-1}$

(2) $[A]=MT^{-2}$, $[B]=LT^{-1}$

(3) $[A]=MT^{-1}$, $[B]=LT^{-2}$

(4) $[A]=M^2T^{-1}$, $[B]=LT^{-1}$

Ans. **(1)**

Sol. $[h]=[B][t]$

$[L]=[B][T]$

$[B]=[L][T]^{-1}$

$[B]=LT^{-1}$ unit : m/s

$$[P]=\left[\frac{A}{Bt^2}\right]$$

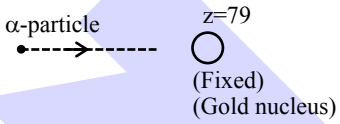
$$[ML^{-1}T^{-2}]=\frac{[A]}{[LT^{-1}][T^2]}$$

$[A]=[ML^{-1}T^{-2}][LT^{-1}][T^2]$

$=[MT^{-1}]$

$[A]=MT^{-1}$ unit Kg/s

3. An α-particle is projected from infinity towards a fixed gold nucleus with energy 7.7 MeV. Find minimum distance between α-particle and gold nucleus:



(1) 0.4×10^{-13} m (2) 0.3×10^{-13} m

(3) 0.5×10^{-13} m (4) 0.7×10^{-13} m

Ans. **(2)**

Sol. Energy conservation

$K_i+U_i=K_f+U_f$

$7.7\times10^6\times1.6\times10^{-19}+0$

$$=0+\frac{9\times10^9\times2\times(1.6\times10^{-19})\times79\times1.6\times10^{-19}}{r}$$

$7.7\times10^6\times1.6\times10^{-19}$

$$=\frac{9\times10^9\times2\times(1.6\times10^{-19})\times79\times(1.6\times10^{-19})}{r}$$

$$r=\frac{9\times10^9\times2\times1.6\times10^{-19}\times79}{7.7\times10^6}$$

$=295.5\times10^{-16}$

$=0.2955\times10^{-13}$

$=0.3\times10^{-13}$ m

4. From a ring of area 1 m^2 and resistance 100 Ω, a magnetic field B = sin (100t) T is passing perpendicular to the ring. Find heat produce in one time period in joule :

(1) 4π (2) 3π (3) 2π (4) π

Ans. **(4)**

Sol. $\phi = NAB = (1)\,(1)\,[\sin(100t)]$

$\phi = \sin(100t)$

$e = -\frac{d\phi}{dt} = -\frac{d}{dt}[\sin(100t)] = -100\cos(100t)$

$e = -100\cos(100t)$ volt

$\text{current}: i = \frac{E}{R} = \frac{-100\cos(100t)}{100} = -\cos(100t)$

$\text{Heat}: \int i^2 R dt = \int[\cos^2(100t)]100dt$

$= 100\int_0^T \cos^2(100t)dt$

For 1 time period : $<\cos^2(100t)> = \frac{1}{2}$

$= 100\times\frac{T}{2} = 50T = 50\left(\frac{2\pi}{\omega}\right) = \pi$

5. A charge $q_1 = 10^{-6}$C is at (0, 0, 0). Another charge $q_2 = 2\mu$C is taken from A (4, 4, 2) to B(2, 2, 1).

Find work done by external :

(1) 3×10^{-7} J (2) 2×10^{-7} J

(3) 3×10^{-5} J (4) 4×10^{-7} J

Ans. (1)

Sol. $V_A = \frac{Kq_1}{r_A} = \frac{K\times10^{-10}}{\sqrt{16+16+4}}$

$= \frac{9\times10^9\times10^{-10}}{6} = \frac{3}{2}\times10^{-1}$ Volt

$V_B = \frac{Kq_1}{r_B} = \frac{9\times10^9\times10^{-10}}{3} = 3\times10^{-1}$ Volt

$W = q_2(V_B - V_A) = 2\times10^{-6}(3-1.5)\times10^{-1}$

$W = 3\times10^{-7}$ Joule

6. An electromagnetic wave has electric filed component

$E_z = (63\text{ V/m})\sin(\omega t - kx)$

The corresponding magnetic field component should be :

(1) $B_y = -2.1\times10^{-7}\sin(\omega t - kx)$

(2) $B_y = 2.1\times10^{-7}\sin(\omega t + kx)$

(3) $B_z = 63\sin(\omega t - kx)$

(4) $B_z = 2.1\times10^{-7}\sin(\omega t + kx)$

Ans. (1)

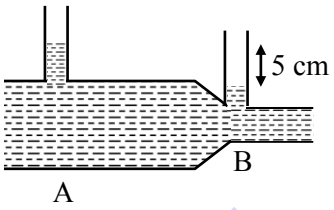
Sol. $E \to \hat{k}, C \to \hat{i}$

$\hat{C}\times\hat{E} = \hat{B} = -\hat{j}$

$B_0 = \frac{E_0}{C} = \frac{63}{3\times10^8} = 2.1\times10^{-7}$

$B_y = -(2.1\times10^{-7})\sin(\omega t - kx)$

7.



As shown in the figure find volume flow rate at cross section-B. Given area at A is 6 cm^2 and at B is 3 cm^2 :

(1) $2\sqrt{2}$ m^3/s (2) $2\sqrt{3}$ m^3/s

(3) $3\sqrt{2}$ m^3/s (4) $3\sqrt{3}$ m^3/s

Ans. (2)

Sol. $\rho gh = \frac{1}{2}\rho\left(v_B^2 - v_A^2\right)$

$v_B = 2v_A$

$\rho gh = \frac{1}{2}\rho\left(3v_A^2\right)$

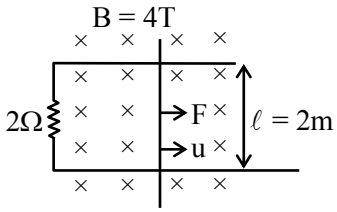
$v_A = \sqrt{\frac{2gh}{3}}$

vol-flow rate : $(6)\sqrt{\frac{2gh}{3}}$

$\Rightarrow \sqrt{\frac{2gh\times36}{3}} = \sqrt{\frac{2\times10\times5\times36}{100\times3}}$

Vol. flow rate = $2\sqrt{3}$ m^3/s

8. As shown in the figure find force required to move rod with constant velocity 15 m/s in uniform magnetic field :



(1) 480 N (2) 500 N

(3) 380 N (4) 280 N

Ans. (1)

Sol. Induced emf $e = Bv\ell = 4 \times 15 \times 2 = 120$ v

$$I = \frac{e}{R} = 60A$$

$$F = i\ell B = 60 \times 2 \times 4 = 480 \text{ N}$$

9. A gas based geyser heat water at rate of 5 litres per minute from 27° to 87°C. If the rate of consumption of energy by gas geyser is $x \times 10^4$ W. Find value of 'x' :

(1) 2.1 (2) 0.2

(3) 4.2 (4) 0.42

Ans. **(1)**

Sol. Rate of water flow $= \frac{(5)(1)}{60}\text{Kg/s} = \frac{1}{12}\text{Kg/s}$

Power $= mS_w(\Delta T)$

$$= \frac{1}{12} \times (4200)(87-27)$$

$= 21$ KW

10. Given acceleration as a function of time $\vec{a} = t^3\hat{i} - \frac{3t}{4}\hat{j}$. Initially (t = 0) position is $0\hat{i} + 0\hat{j} + 0\hat{k}$ and particle is at rest find position and velocity at any instant:

(1) $\vec{v} = \frac{t^4}{4}\hat{i} - \frac{3t^2}{8}\hat{j}$, $\vec{r} = +\frac{t^5}{20}\hat{i} - \frac{t^3}{8}\hat{j}$

(2) $\vec{v} = \frac{t^3}{4}\hat{i} - \frac{3t^3}{8}\hat{j}$, $\vec{r} = +\frac{t^5}{20}\hat{i} - \frac{t^3}{8}\hat{j}$

(3) $\vec{v} = \frac{t^4}{4}\hat{i} - \frac{3t^2}{8}\hat{j}$, $\vec{r} = +\frac{t^6}{20}\hat{i} - \frac{t^2}{8}\hat{j}$

(4) $\vec{v} = \frac{t^4}{2}\hat{i} - \frac{t^2}{3}\hat{j}$, $\vec{r} = +\frac{t^5}{20}\hat{i} - \frac{t^3}{8}\hat{j}$

Ans. **(1)**

Sol. $\vec{a} = t^3\hat{i} - \frac{3t}{4}\hat{j}$

$$\frac{d\vec{v}}{dt} = t^3\hat{i} - \frac{3t}{4}\hat{j}$$

$$\vec{v} = \int_0^t \left(t^3\hat{i} - \frac{3t}{4}\hat{j}\right)dt$$

$$\vec{v} = \frac{t^4}{4}\hat{i} - \frac{3t^2}{8}\hat{j}$$

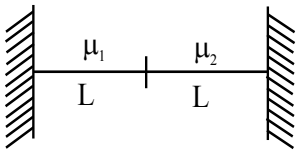
$$\frac{d\vec{r}}{dt} = \frac{t^4}{4}\hat{i} - \frac{3t^2}{8}\hat{j}$$

$$\vec{r} = \int d\vec{r} = \int \left(\frac{t^4}{4}\hat{i} - \frac{3t^2}{8}\hat{j}\right)dt$$

$$\vec{r} = +\frac{t^5}{20}\hat{i} - \frac{3t^3}{24}\hat{j}$$

$$\vec{r} = +\frac{t^5}{20}\hat{i} - \frac{t^3}{8}\hat{j}$$

11. In the diagram shown time taken by a pulse to travel on string 1 is t_1 while on string 2 is t_2. Find . $\frac{t_1}{t_2}$



Given $\mu_1 = 2 \times 10^{-4}$ kg/m , $\mu_2 = 4 \times 10^{-4}$ kg/m

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

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

Ans. **(1)**

Sol. $t_1 = \frac{L}{v_1}, t_2 = \frac{L}{v_2}$

$$v_1 = \sqrt{\frac{T}{\mu_1}} = \sqrt{\frac{500}{2\times10^{-4}}}$$

$$v_1 = 10^2 \times 10\sqrt{\frac{5}{2}}$$

$$v_2 = \sqrt{\frac{T}{\mu_2}} = \sqrt{\frac{500}{4\times10^{-4}}}$$

$$v_2 = 10^2 \times 10\sqrt{\frac{5/4}{4}}$$

$$\frac{t_1}{t_2} = \frac{v_2}{v_1} = \frac{\sqrt{5/4}}{\sqrt{5/2}} = \sqrt{\frac{2}{4}} = \frac{1}{\sqrt{2}}$$ Ans.

12. A light wave described by E = 60 (sin $(3 \times 10^{15})t$ + sin $(12 \times 10^{15})t$) (in SI unit) fall on a metal surface of work function 2.8 eV. The maximum kinetic energy of ejected photon is approximate (in eV)

(Given : h = 6.6×10^{-34} J-S)

(1) 5.1 eV (2) 6.1 eV

(3) 4.1 eV (4) 3.1 eV

Ans. **(1)**

Sol. $\omega_1 = 3 \times 10^{15}$ rad/s

$\omega_2 = 12 \times 10^{15}$ rad/s

$\phi = 2.8$ eV

$$v = \frac{\omega}{2\pi}$$

$$v_{max} = \frac{12\times10^{15}}{2\pi} \simeq 1.91 \times 10^{15} \text{ Hz}$$

$E_{photon} = h\nu = 6.6 \times 10^{-34} \times 1.91 \times 10^{15}$

$= 1.26 \times 10^{-18}$ J

$$E_{max} = \frac{1.26\times10^{-18}}{1.6\times10^{-19}} \simeq 7.9\text{eV}$$

$k_{max} = E_{max} - \phi = 7.9 - 2.8$

$k_{max} = 5.1$ eV

13. Two equal rods are joined to form a single rod of 120 cm. Find final rod length when temperature is raised from 30°C to 100°C. Given :

$\alpha_A = 1.2 \times 10^{-5}$/°C

$\alpha_B = 24 \times 10^{-6}$/°C

(1) 121.15 cm

(2) 122.15 cm

(3) 120.15 cm

(4) 119.15 cm

Ans. **(3)**

Sol. $\ell_{final} = \ell_0 (1 + \alpha_A \Delta T) + \ell_0 (1 + \alpha_B \Delta T)$

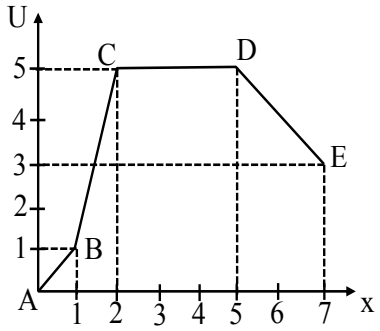
$= 60 (2 + (\alpha_A + \alpha_B)\Delta T)$

$= 60 (2 + (12 \times 10^{-6} + 24 \times 10^{-6})70)$

$= 60 (2 + 0.0025)$

final = 120.15 cm

14. A graph of potential energy as position is given below. Give the order of magnitude of forces.



(1) $|F_{CD}| < |F_{AB}| = |F_{DE}| < |F_{BC}|$

(2) $|F_{CD}| < |F_{AB}| > |F_{DE}| < |F_{BC}|$

(3) $|F_{CD}| < |F_{AB}| < |F_{DE}| < |F_{BC}|$

(4) $|F_{CD}| = |F_{AB}| = |F_{DE}| < |F_{BC}|$

Ans. (1)

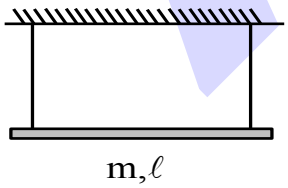
Sol. $|F_{AB}| = \left|\frac{-dU}{dx}\right| = \frac{1-0}{1-0} = 1$

$|F_{BC}| = \left|\frac{-dU}{dx}\right| = \frac{5-1}{2-1} = 4$

$|F_{CD}| = \left|\frac{-dU}{dx}\right| = 0$

$|F_{DE}| = \left|\frac{-dU}{dx}\right| = \left|\frac{3-5}{7-5}\right| = 1$

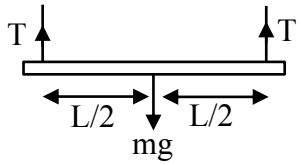
15. A rod of mass m and length ℓ is attached to two ideal strings. Find tension in left string just after right of string is cut.



(1) $\frac{mg}{2}$ (2) $\frac{mg}{4}$ (3) $\frac{2}{3}mg$ (4) $\frac{mg}{5}$

Ans. (2)

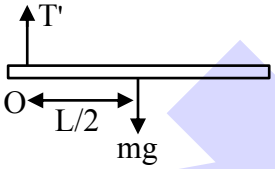
Sol. Before



$2T = mg$

$T = \frac{mg}{2}$

After :



$mg\frac{L}{2} = I_0\alpha$

$mg\frac{L}{2} = \frac{mL^2}{3}\alpha$

$\frac{3}{2}\frac{g}{L} = \alpha$

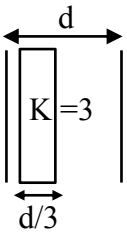
$mg - T' = ma_t$

$T' = mg - m\left(\alpha\frac{L}{2}\right)$

$T' = mg - m\left(\frac{3g}{4}\right)$

$T' = \frac{mg}{4}$

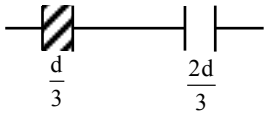
16. A capacitor of capacitance 'C' is given. Find the capacitance after dielectric is inserted as shown.



(1) $\frac{9}{7}C$ (2) $\frac{3}{7}C$ (3) $\frac{6}{7}C$ (4) $\frac{5}{7}C$

Ans. (2)

Sol.



$$C_1 = \frac{3A\epsilon_0 k}{d}, C_2 = \frac{3A\epsilon_0}{2d}$$

$$\frac{1}{C'} = \frac{d}{3A\epsilon_0 k} + \frac{2d}{3A\epsilon_0}$$

$$= \frac{d}{3A\epsilon_0}\left(\frac{1}{k} + 2\right)$$

$$C' = \frac{3A\epsilon_0 k}{(1+2k)d} = \frac{3k}{1+2k}.C$$

$k = 3$

$$C' = \frac{9}{7}C$$

17. A magnet is dropped inside a coil as shown in figure. Its acceleration as it falls through the coil is 'a'. Choose the correct option.

(1) $a = g$ (2) $a > g$

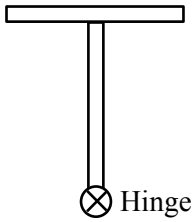
(3) $a < g$ (4) $a = 0$

Ans. (3)

Sol. The coil will oppose the motion of magnet due to induced current as result of change in magnetic flux.

$\therefore a < g$

18. Two rods are joined together as shown. If moment of inertia about Hinge is $\frac{x}{12}m\ell^2$. Find x. (Both rods have mass m and length ℓ)



(1) 10 (2) 12

(3) 13 (4) 17

Ans. (4)

Sol. $I_{hinge} = I_1 + I_2$

$$= \frac{m\ell^2}{3} + \left(\frac{m\ell^2}{12} + m(\ell)^2\right)$$

$$= \frac{m\ell^2}{3} + \frac{13m\ell^2}{12}$$

$$= \frac{4m\ell^2 + 13m\ell^2}{12}$$

$$I = \frac{17}{12}m\ell^2$$

$$\frac{x}{12}m\ell^2 = \frac{17}{12}m\ell^2$$

$x = 17$

19. Find energy required for a satellite to go from $r = 1.5\ R_E$ to $r = 3R_E$. (Given : Mass of satellite is 100 kg. Radius of Earth $R_E = 6 \times 10^6$ m and acceleration due to gravity $g = 10\ m/s^2$).

(1) 10^9 J

(2) 10^{11} J

(3) 10^{10} J

(4) 10^8 J

Ans. (1)

Sol. $E = \frac{-GMm}{2r}$ $\qquad r_1 = 1.5R_E = \frac{3}{2}R_E$

$E_1 = \frac{-GMm}{2r_1}$ $\qquad r_2 = 3R_E$

$E_2 = -\frac{GMm}{2r_2}$

$E_1 = \frac{-GMm}{2\left(\frac{3}{2}R_E\right)} = \frac{-GMm}{3R_E}$

$E_2 = \frac{-GMm}{2(3R_E)} = \frac{-GMm}{6R_E}$

Energy Req : $E_2 - E_1 = \frac{-GMm}{6R_E} - \left(\frac{-GMm}{3R_E}\right)$

$= \frac{GMm}{R_E}\left[\frac{1}{3} - \frac{1}{6}\right] = \left[\frac{GMm}{6R_E}\right]$

$= \frac{mgR_E}{6} = 10^9\ J$ $\qquad \left[g = \frac{Gm}{(R_E)^2}\right]$

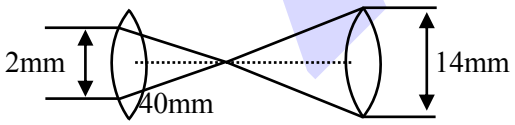
20. A collimated beam of light of diameter 2mm is propagating along x-axis. The beam is required to be expanded in a collimated beam of diameter 14mm using a system of two convex lenses. If first lens has focal length 40mm then focal length of 2nd lens is :

(1) 270 mm (2) 260 mm

(3) 290 mm (4) 280 mm

Ans. (4)

Sol.



Similar triangle

$\frac{2}{40} = \frac{14}{f}$

$f = 280$ mm

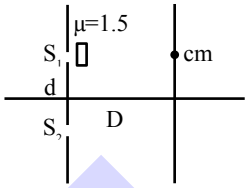
SECTION-B

21. In YDSE arrangement

$d = 0.1$ cm

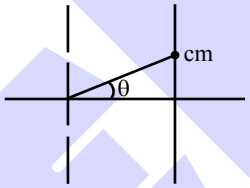
$D = 50$ cm

If a thin film placed as in the figure in front of S_1 central maxima forms 0.2 cm above centre. The thickness of film should be (in μm):



Ans. (8)

Sol.



$\sin\theta = \tan\theta = \frac{0.2}{50} = \frac{1}{250}$

$\Delta x_{cm} = 0$

$\Delta x_{cm} = (\mu - 1)t - d\sin\theta = 0$

$0.5t = 0.1 \times 10^{-2} \times \frac{1}{250}$

$= 10^{-3} \times 4 \times 10^{-3} = 4 \times 10^{-6}$

$t = 8 \times 10^{-6} = 8\ \mu m$

22. Initial temperature of 10 moles O_2 is 30°C. Find change in internal energy (in calorie) if final temperature becomes 40°C. Given $C_P = \frac{7cal}{mole°C}$, $R = \frac{2cal}{mole°C}$

Ans. (500)

Sol. $\Delta U = nC_v\Delta T = n(C_P - R)(T_f - T_i)$

$\Delta U = 10(7 - 2)(40 - 30)$

$= 10 \times 5 \times 10$

$\Delta U = 500$ Calorie

23. Compound microscope has $f_0 = 2$ cm, $f_e = 4$ cm and tube length $\ell = 32$ cm. For normal adjustment find magnification.

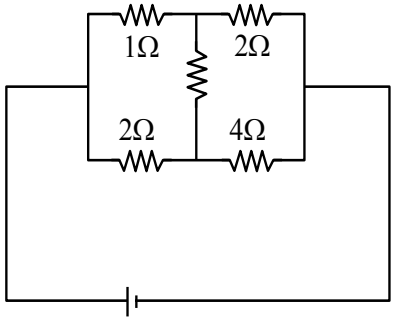
Ans. **(100)**

Sol. $m \simeq \frac{\ell}{f_0}\frac{D}{f_e}$

$m \simeq \frac{32}{2} \times \frac{25}{4}$

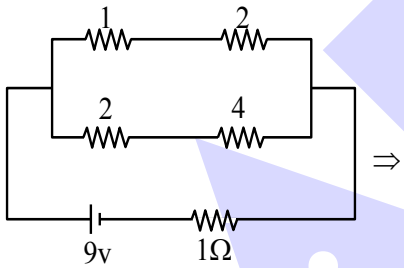
$m \simeq 100$

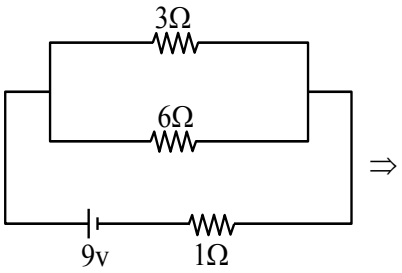
24. Find heat (in joule) dissipated in 1 minute in external circuit.

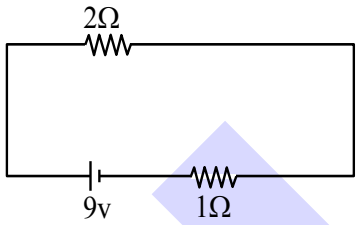


Ans. **(1620)**

Sol. It is wheatstone bridge







Req. $i = \frac{v}{Req} = \frac{9}{3} = 3amp$

Heat : $i^2Rt = (9)(3)(60) = 1620$ J

25. There are two springs of spring constant $k_1 = (20 \pm 0.3)$ N/m and $k_2 = (30 \pm 0.2)$ N/m. If they are connected in parallel then percentage error in equivalent spring constant of combination is _____%.

Ans. **(1)**

Sol. $\Delta k = \Delta k_1 + \Delta k_2 = 0.5$

Keq = 50 N/m

$\%\ \text{error} = \frac{0.5}{50} \times 100 = 1$

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