JEE MAIN 2023
Paper with Solution

PHYSICS | 24th Jan 2023 _ Shift-2

Umeed Rank Ki Ho Ya Selection Ki, JEET NISCHIT HAI!

Most Promising RANKS
Produced by MOTION Faculties

NEET / AIIMS

- AIR-1 to 10 — 25 Times
- AIR-11 to 50 — 83 Times
- AIR-51 to 100 — 81 Times

JEE MAIN+ADVANCED

- AIR-1 to 10 — 8 Times
- AIR-11 to 50 — 32 Times
- AIR-51 to 100 — 36 Times

Nation's Best SELECTION
Percentage (%) Ratio

Student Qualified in NEET

(2022)
4837/5356 = 90.31%
(2021)
3276/3411 = 93.12%

Student Qualified in JEE ADVANCED

(2022)
1756/4818 = 36.45%
(2021)
1256/2994 = 41.95%

Student Qualified in JEE MAIN

(2022)
4818/6653 = 72.41%
(2021)
2994/4087 = 73.25%

NITIN VIIJAY (NV Sir)
Founder & CEO

SECTION - A

1. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A: A pendulum clock when taken to Mount Everest becomes fast.
Reason: The value of g (acceleration due to gravity) is less at Mount Everest than its value on the surface of earth.
In the light of the above statements, choose the most appropriate answer from the options given below
(1) Both **A** and **R** are correct but **R** is NOT the correct explanation of **A**
(2) A is correct but **R** is not correct
(3) Both **A** and **R** are correct and **R** is the correct explanation of **A**
(4) **A** is not correct but **R** is correct

Sol. **4**

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

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

on Everest g decreases, so T increases, so moves slow.

2. The frequency (v) of an oscillating liquid drop may depend upon radius (r) of the drop, density (ρ) of liquid and the surface tension (s) of the liquid as : $v = r^a\rho^b s^c$. The values of a, b and c respectively are
(1) $\left(-\frac{3}{2},\frac{1}{2},\frac{1}{2}\right)$ (2) $\left(\frac{3}{2},-\frac{1}{2},\frac{1}{2}\right)$ (3) $\left(-\frac{3}{2},-\frac{1}{2},\frac{1}{2}\right)$ (4) $\left(\frac{3}{2},\frac{1}{2},-\frac{1}{2}\right)$

Sol. **3**

$f \alpha r^a \rho^b s^c$

$T^{-1} = [L]^a \left[M L^{-3}\right]^b \left[MT^{-2}\right]^c$

$T^{-1} = L^{a-3b}, M^{b+c}\ T^{-2c}$

$-2c = -1$ ..... (1)

$c = ½$

$b + c = 0$ .....(2)

$b = -½$

$a - 3b = 0$ .....(3)

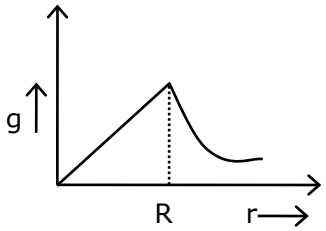
$a = 3b = \frac{-3}{2}$

3. Given below are two statements:
Statement I : Acceleration due to earth's gravity decreases as you go 'up' or 'down' from earth's surface.
Statement II : Acceleration due to earth's gravity is same at a height 'h' and depth 'd' from earth's surface, if h = d.
In the light of above statements, choose the most appropriate answer form the options given below
(1) Both Statement I and Statement II are incorrect
(2) Statement I is incorrect but statement II is correct
(3) Both Statement I and II are correct
(4) Statement I is correct but statement II is incorrect

Sol. **4**

$$g\left(1-\frac{2h}{R}\right) = g\left(1-\frac{d}{R}\right)$$

$$h = \frac{d}{2}$$



4. A long solenoid is formed by winding 70 turns cm^{-1}. If 2.0 A current flows, then the magnetic field produced inside the solenoid is _____ $\left(\mu_0 = 4\pi \times 10^{-7}\ TmA^{-1}\right)$

(1) 88×10^{-4} T (2) 352×10^{-4} T (3) 176×10^{-4} T (4) 1232×10^{-4} T

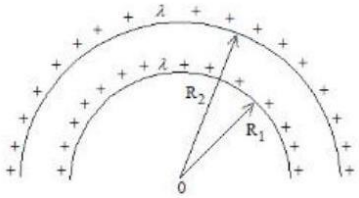
Sol. **3**

$B = \mu_0 ni$

$= 4 \times \frac{22}{7} \times 10^{-7} \times 70 \times 100 \times 2$

$= 176 \times 10^{-4}$

5. The electric potential at the centre of two concentric half rings of radii R_1 and R_2, having same linear charge density λ is :



(1) $\frac{\lambda}{2\varepsilon_0}$ (2) $\frac{\lambda}{4\varepsilon_0}$ (3) $\frac{2\lambda}{\varepsilon_0}$ (4) $\frac{\lambda}{\varepsilon_0}$

Sol. **1**

$V_C = \frac{K}{R_1} q_1 + \frac{kq_2}{R_2}$

$= \frac{1}{4\pi\varepsilon_0} \times \frac{\lambda \pi R_1}{R_1} + \frac{1}{4\pi\varepsilon_0} \times \frac{\lambda \pi R_2}{R_2}$

$= \frac{\lambda}{2\varepsilon_0}$

6. If the distance of the earth from Sun is 1.5×10^6 km. Then the distance of an imaginary planet from Sun, if its period of revolution is 2.83 years is :

(1) 6×10^6 km (2) 3×10^6 km (3) 3×10^7 km (4) 6×10^7 km

Sol. **2**

$T^2 \propto R^3$

$\left(\frac{T_E}{T_p}\right)^{\frac{2}{3}} = \left(\frac{R_E}{R_p}\right)$

$\left(\frac{1}{2.83}\right)^{\frac{2}{3}} = \frac{1.5 \times 10^6}{R}$

$R = 1.5 \times 10^6 \times (2.83)^{\frac{2}{3}}$

$1.5 \times 10^6 \times (1.41 \times 2)^{\frac{2}{3}}$

$1.5 \times 10^6 \times \left(2\sqrt{2}\right)^{\frac{2}{3}}$

$1.5 \times 10^6 \times \left(\sqrt{8}\right)^{\frac{2}{3}}$

3×10^6 KM

7. A photon is emitted in transition from n = 4 to n = 1 level in hydrogen atom. The corresponding wavelength for this transition is (given, $h = 4 \times 10^{-15}$eVs) :

(1) 99.3 nm (2) 941 nm (3) 974 nm (4) 94.1 nm

Sol. **4**

$\Delta E = E_4 - E_1$

$\frac{hc}{\lambda} = -0.85 - (-13.6)$

$\frac{4\times10^{-15}\times3\times10^{17}}{\lambda_{(nm)}}\frac{nm}{s} = 12.75$

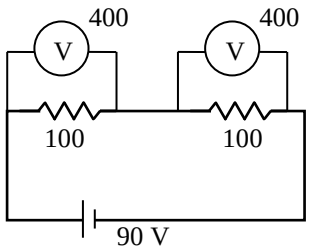
$\lambda = \frac{1200}{12.75}$ nm

= 94.1 nm

8. A cell of emf 90 V is connected across series combination of two resistors each of 100Ω resistance. A voltmeter of resistance 400Ω is used to measure the potential difference across each resistor. The reading of the voltmeter will be:

(1) 90 V (2) 45 V (3) 80 V (4) 40 V

Sol. **2**



as Resistance are same so equal division of potential.

$\therefore \frac{90}{2} = 45$ V

9. If two vectors $\vec{P} = \hat{\imath} + 2m\hat{\jmath} + m\hat{k}$ and $\vec{Q} = 4\hat{\imath} - 2\hat{\jmath} + m\hat{k}$ are perpendicular to each other. Then, the value of m will be:

(1) −1 (2) 3 (3) 2 (4) 1

Sol. **3**

$\vec{P}.\vec{Q} = 0$

$4 \times 1 + 2mx - 2 + m^2 = 0$

$m^2 - 4m + 4 = 0$

$(m-2)^2 = 0$

$m = 2$

10. The electric field and magnetic field components of an electromagnetic wave going through vacuum is described by

$E_x = E_0\sin(kz - \omega t)$

$B_y = B_0\sin(kz - \omega t)$

Then the correct relation between E_0 and B_0 is given by

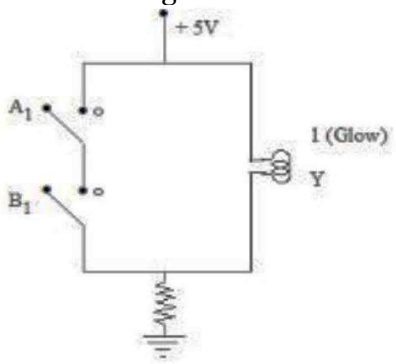
(1) $E_0 B_0 = \omega k$ (2) $E_0 = kB_0$ (3) $kE_0 = \omega B_0$ (4) $\omega E_0 = kB_0$

Sol. **3**

by theory of EM wave

$\frac{E_0}{B_0} = v = \frac{\omega}{K}$

11. The logic gate equivalent to the given circuit diagram is :



(1) NAND (2) OR (3) AND (4) NOR

Sol. **1**

by truth table

A_1	B_1	V_1
0	0	1
0	1	1
1	0	1
1	1	0

NAND gate

12. Let γ_1 be the ratio of molar specific heat at constant pressure and molar specific heat at constant volume of a monoatomic gas and γ_2 be the similar ratio of diatomic gas. Considering the diatomic gas molecule as a rigid rotator, the ratio, $\frac{\gamma_1}{\gamma_2}$ is :

(1) $\frac{25}{21}$ (2) $\frac{35}{27}$ (3) $\frac{21}{25}$ (4) $\frac{27}{35}$

Sol. **1**

$$\frac{r_1}{r_2} = \frac{\frac{5}{3}}{\frac{7}{5}} = \frac{25}{21}$$

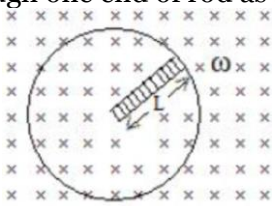
13. When a beam of white light is allowed to pass through convex lens parallel to principal axis, the different colours of light converge at different point on the principle axis after refraction. This is called:

(1) Spherical aberration (2) Polarisation

(3) Chromatic aberration (4) Scattering

Sol. Theory : Colors are due to chromatic aberration.

14. A metallic rod of length ' L ' is rotated with an angular speed of ' ω ' normal to a uniform magnetic field ' B ' about an axis passing through one end of rod as shown in figure. The induced emf will be:



(1) $\frac{1}{4}BL^2\omega$ (2) $\frac{1}{2}B^2L^2\omega$ (3) $\frac{1}{4}B^2L\omega$ (4) $\frac{1}{2}BL^2\omega$

Sol. **4**

$$\in = \int_0^L B\omega x\, dx$$

$$= \frac{1}{2}B\omega L^2$$

15. An a-particle, a proton and an electron have the same kinetic energy. Which one of the following is correct in case of their de-Broglie wavelength:

(1) $\lambda_\alpha < \lambda_p < \lambda_e$ (2) $\lambda_\alpha = \lambda_p = \lambda_e$ (3) $\lambda_\alpha > \lambda_p > \lambda_e$ (4) $\lambda_\alpha > \lambda_p < \lambda_e$

Sol. **1**

$$\lambda = \frac{h}{\sqrt{2mkE}} \propto \frac{1}{\sqrt{m}}$$

$m_a > m_p > m_e$

$\therefore \lambda_\alpha < \lambda_p < \lambda_e$

16. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason

Assertion A : Steel is used in the construction of buildings and bridges.

Reason R : Steel is more elastic and its elastic limit is high.

In the light of above statements, choose the most appropriate answer from the options given below

(1) Both **A** and **R** are correct and **R** is the correct explanation of **A**

(2) Both **A** and **R** are correct but **R** is NOT the correct explanation of **A**

(3) A is correct but **R** is not correct

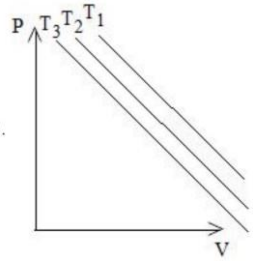
(4) A is not correct but **R** is correct

Sol. **1**

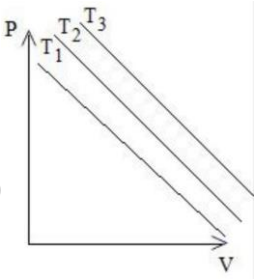
Steel is more elastic.

17. In an Isothermal change, the change in pressure and volume of a gas can be represented for three different temperature; $T_3 > T_2 > T_1$ as:

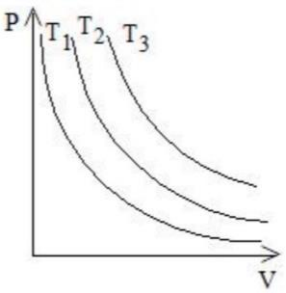
(1)



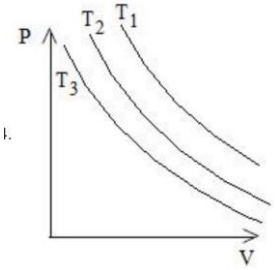
(2)



(3)

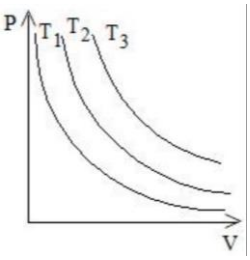


(4)



Sol. **3**

PV = nRT const.



$$P \propto \frac{1}{V}$$

18. Match List I with List II

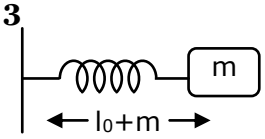
LIST I		LIST II	
A.	AM Broadcast	I.	88 – 108MHz
B.	FM Broadcast	II.	540 – 1600kHz
C.	Television	III	3.7 – 4.2GHz
D.	Satellite Communication	IV.	54MHz – 890MHz

Choose the correct answer from the options given below:
(1) A-II, B-I, C-IV, D-III (2) A-I, B-III, C-II, D-IV
(3) A-IV, B-III, C-I, D-II (4) A-II, B-III, C-I, D-IV

Sol. **1**
by concept of AM & FM freq. range

19. A body of mass 200 g is tied to a spring of spring constant 12.5 N/m, while the other end of spring is fixed at point 0. If the body moves about 0 in a circular path on a smooth horizontal surface with constant angular speed 5rad/s. Then the ratio of extension in the spring to its natural length will be :
(1) 2:5 (2) 1: 1 (3) 2: 3 (4) 1: 2

Sol. **3**



$kx = m\omega^2(\ell_0 + x)$

$$\frac{k}{m\omega^2} = \frac{\ell_0}{x} + 1$$

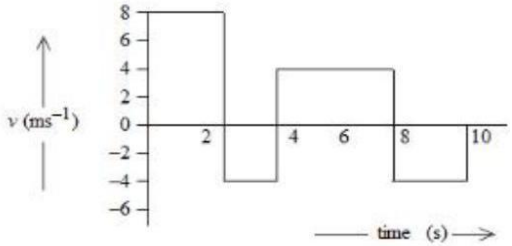
$$\frac{12.5}{0.2 \times 25} = \frac{\ell_0}{x} + 1$$

$$\frac{125}{50} - 1 = \frac{\ell_0}{x}$$

$$\frac{3}{2} = \frac{\ell_0}{x}$$

$$\frac{x}{\ell_0} = \frac{2}{3}$$

20. The velocity time graph of a body moving in a straight line is shown in figure.



The ratio of displacement to distance travelled by the body in time 0 to 10 s is :
(1) 1: 1 (2) 1: 2 (3) 1: 3 (4) 1: 4

Sol. **3**
disp. = area
= 8 × 2 + (4 × 4) – 2 × 4 – 2 × 4
= 32 – 16
= 16
distance = 32 + 16
= 48

SECTION - B

21. A body of mass 1 kg begins to move under the action of a time dependent force $\vec{F} = (t\hat{i} + 3t^2\hat{j})$N, where $\hat{i}$ and $\hat{j}$ are the unit vectors along x and y axis. The power developed by above force, at the time $t = 2s$, will be _____ W.

Sol. **100**

$$\vec{v} = \int_0^2 t\,dt\,\hat{i} + 3\int_0^2 t^2\,dt\,\hat{j}$$

$= 2\hat{i} + 8\hat{j}$

$\vec{F} = 2\hat{i} + 12\hat{j}$

$P = \vec{F}.\vec{V}$

$= 4 + 96$

$= 100$ w

22. A convex lens of refractive index 1.5 and focal length 18 cm in air is immersed in water. The change in focal length of the lens will be _____ cm

(Given refractive index of water $= \frac{4}{3}$)

Sol. **54**

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{18} = (1.5 - 1)\frac{2}{R} \quad \ldots. (1)$$

$$\frac{1}{f} = \left(\frac{1.5}{\frac{4}{3}} - 1\right)\frac{2}{R} \quad \ldots.. (2)$$

Div eq. by eq. 2

$$\frac{f}{18} = \frac{0.5 \times 8}{1}$$

f = 72 cm

change = 72 – 18

= 54

23. The energy released per fission of nucleus of ^{240}X is 200MeV. The energy released if all the atoms in 120 g of pure ^{240}X undergo fission is _____ $\times 10^{25}$MeV (Given $N_A = 6 \times 10^{23}$)

Sol. **6**

no. of atoms $= \frac{120}{240} \times 6 \times 10^{23}$

$= 3 \times 10^{23}$

Energy rebased $= 200 \times 3 \times 10^{23}$

$= 6 \times 10^{25}$

24. A uniform solid cylinder with radius R and length L has moment of inertia I_1, about the axis of the cylinder. A concentric solid cylinder of radius $R' = \frac{R}{2}$ and length $L' = \frac{L}{2}$ is carved out of the original cylinder. If I_2 is the moment of inertia of the carved out portion of the cylinder then $\frac{I_1}{I_2} =$ _____

(Both I_1 and I_2 are about the axis of the cylinder)

Sol. **32**

$$I_1 = \frac{MR^2}{2}$$

$$\text{mass} = \rho\pi\frac{R^2}{4}.\frac{L}{2}$$

$$m_2 = \frac{M}{8}$$

$$I_2 = \frac{m_2R_2^2}{2} = \frac{MR^2}{8\times4\times2}$$

$$\frac{I_1}{I_2} = 32$$

25. A parallel plate capacitor with air between the plate has a capacitance of 15pF. The separation between the plate becomes twice and the space between them is filled with a medium of dielectric constant 3.5. Then the capacitance becomes $\frac{x}{4}$pF. The value of x is _____

Sol. **105**

$$C = \frac{A\varepsilon_0}{d}$$

$$C = \frac{KA\varepsilon_0}{2d}$$

$$= \frac{KC}{2}$$

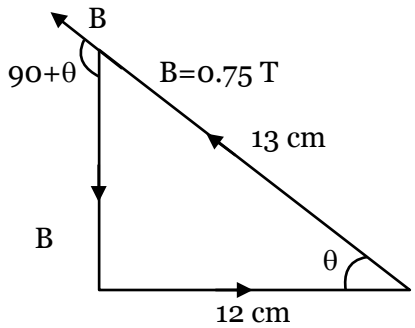
$$= \frac{3.5\times15}{2}$$

$$= \frac{105}{4}$$

$$= 105$$

26. A single turn current loop in the shape of a right angle triangle with sides 5 cm, 12 cm, 13 cm is carrying a current of 2 A. The loop is in a uniform magnetic field of magnitude 0.75 T whose direction is parallel to the current in the 13 cm side of the loop. The magnitude of the magnetic force on the 5 cm side will be $\frac{x}{130}$ N. The value of x is _____

Sol. **9**



Force on 5 cm length = $i\int d\vec{\ell}\times\vec{B}$

$$= i\times\left(\frac{5}{100}\right)\times0.75\times\sin(90+\theta)$$

$$= 2\times\frac{5}{100}\times0.75\times\cos\theta$$

$$= \frac{10}{100}\times0.75\times\frac{12}{13} = \frac{x}{130}$$

$$\Rightarrow x = 9$$

27. A mass *m* attached to free end of a spring executes SHM with a period of 1 s. If the mass is increased by 3 kg the period of oscillation increases by one second, the value of mass m is _____ kg.

Sol. **1**

$2\pi\sqrt{\frac{m}{k}} = 1$ ..... (1)

$2\pi\sqrt{\frac{m+3}{k}} = 2$ ..... (2)

(2) ÷ (1)

$\sqrt{\frac{m+3}{m}} = \frac{2}{1}$

$\frac{m+3}{m} = 4$

4 m = m + 3

m = 1 kg.

28. If a copper wire is stretched to increase its length by 20%. The percentage increase in resistance of the wire is _____ %

Sol. **44**

Length becomes = 1.2 times

$\ell' = 1.2\ell$

$R' = n^2 R$

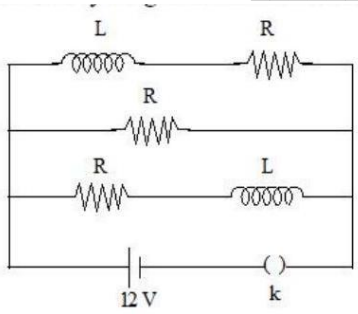
$= (1.2)^2 R$

$= 1.44\ R$

$\Delta R = 0.44\ R$

$\frac{\Delta R}{R} \times 100\ \% = 44\%$

29. Three identical resistors with resistance R = 12Ω and two identical inductors with self inductance L = 5mH are connected to an ideal battery with emf of 12 V as shown in figure. The current through the battery long after the switch has been closed will be _____ A.



Sol. **3**

Short all inductor

Req. = $\frac{R}{3} = \frac{12}{3} = 4\Omega$

$I = \frac{12}{4} = 3A$

30. A Spherical ball of radius 1 mm and density 10.5 g/cc is dropped in glycerine of coefficient of viscosity 9.8 poise and density 1.5 g/cc. Viscous force on the ball when it attains constant velocity is 3696×10^{-x} N. The value of x is (Given, $g = 9.8\ m/s^2$ and $\pi = \frac{22}{7}$)

Sol. 7

$$V_T = \frac{2r^2 g(\sigma_s - \rho_\ell)}{a_n}$$

$$\frac{2\times10^{-6}\times9.8\times(10.5-1.5)\times10^3}{9.8\times0.1\times9}$$

$= 2 \times 10^{-2}$ m/s

$F = 6\pi x\, rV_T$

$$= 6\times\frac{22}{7}\times9.8\times0.1\times10^{-3}\times18\times10^{-2}$$

$= 3696 \times 10^{-7}$

$= 7$

मोशन है, तो भरोसा है।

#RankBhiSelectionBhi

ADMISSION ANNOUNCEMENT

Session 2023-24 (English & हिन्दी Medium)

Target: JEE/NEET 2025
Nurture & प्रयास Batch
Class 10th to 11th Moving

Target: JEE/NEET 2024
Enthuse & प्रयास Batch
Class 11th to 12th Moving

Target: JEE/NEET 2024
Dropper & प्रयास Batch
Class 12th to 13th Moving

Target: PRE FOUNDATION
SIP, Evening & Tapasya Batch
Class 6th to 10th Students

MOTION®