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OAVS PGT Physics Previous Year Question

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10 Toughest Subject Content Questions (2019 – 2024) with Full Solutions



SUBJECT CONTENT – 10 TOUGHEST PYQ

Hand-picked from 2 OAVS PGT Physics papers (2019 and 2024) – mechanics, waves, optics, electricity, magnetism, electronics and modern physics – with the same step-by-step solutions you get in the full pack.

Q-1 A stationary man observes that the frequency ratio of the horn of the car travelling along a road is $\frac{3}{2}$ as it passes. The velocity of sound in air is 350 m/s. The speed of the car is:

[OAVS PGT Physics 2019]

- (A) 525 m/s
- (B) 233.3 m/s
- (C) 35 m/s
- (D) 70 m/s

Ans- (D) 70 m/s

Given:

→ Frequency ratio (approach : recede) = $\frac{3}{2}$; speed of sound $v = 350$ m/s



$$f_1/f_2 = (v+v_s)/(v-v_s) = 3/2, \quad v = 350 \text{ m/s}$$

$$v_s = 350 \times (3-2)/(3+2) = \mathbf{70 \text{ m/s ?}}$$

Concept:

→ Doppler effect for a moving source:

$$\frac{f_{\text{approach}}}{f_{\text{recede}}} = \frac{v + v_s}{v - v_s}$$

Solution:

$$\frac{350 + v_s}{350 - v_s} = \frac{3}{2}$$

$$\Rightarrow 700 + 2v_s = 1050 - 3v_s$$

$$\Rightarrow 5v_s = 350$$

$$\Rightarrow v_s = 70 \text{ m/s}$$

➤ Ans: (D) 70 m/s

Hint:

→ Shortcut with ratio $n = \frac{3}{2}$:

$$v_s = v \times \frac{n - 1}{n + 1} = 350 \times \frac{1}{5} = 70 \text{ m/s}$$



Q-2 The intensities due to two coherent monochromatic light sources placed at two vertices of equilateral triangle are 4 W m^{-2} and 9 W m^{-2} respectively at the third vertex. The resultant intensity due to both the sources at the third vertex is:

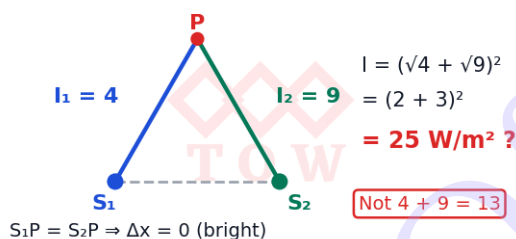
[OAVS PGT Physics 2019]

- (A) 5 W m^{-2}
(B) 13 W m^{-2}
(C) 97 W m^{-2}
(D) 25 W m^{-2}

Ans- (D) 25 W m^{-2}

Given:

→ $I_1 = 4 \text{ W/m}^2$, $I_2 = 9 \text{ W/m}^2$; coherent sources at two vertices of an equilateral triangle



Concept:

→ The third vertex is equidistant, so path difference = 0 and interference is constructive

→ $I = (\sqrt{I_1} + \sqrt{I_2})^2$

Solution:

➤ $I = (\sqrt{4} + \sqrt{9})^2 = (2 + 3)^2$

⇒ $I = 25 \text{ W/m}^2$

➤ Ans: (D) 25 W/m^2

Hint:

→ Coherent sources: add amplitudes, not intensities ($4 + 9 = 13$ is the trap)

Q-3 A ball dropped from height 'h', at the same time another ball is thrown up from ground. The ball which is thrown up reaches a height $8h$. At what time these two balls cross each other?

[OAVS PGT Physics 2019]

- (A) $\sqrt{\frac{h}{4g}}$
(B) $\sqrt{\frac{h}{16g}}$



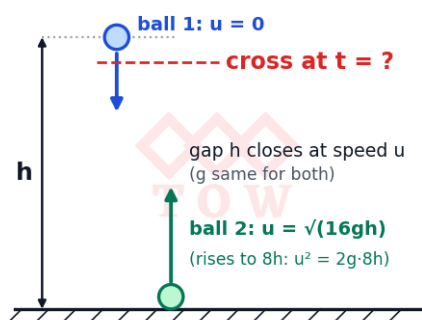
(C) $\sqrt{\frac{h}{8g}}$

(D) $\sqrt{\frac{h}{g}}$

Ans- (B) $\sqrt{\frac{h}{16g}}$

Given:

→ Ball 1 dropped from height h ; ball 2 thrown up at the same instant, reaching height $8h$



Concept:

→ $u^2 = 2g(8h)$; relative velocity is constant, so $t = \frac{h}{u}$

Solution:

➤ $u = \sqrt{16gh} = 4\sqrt{gh}$

➤ $t = \frac{h}{4\sqrt{gh}} = \frac{1}{4}\sqrt{\frac{h}{g}}$

⇒ $t = \sqrt{\frac{h}{16g}}$

➤ Ans: (B) $\sqrt{\frac{h}{16g}}$

Hint:

→ Both balls have the same acceleration g , so gravity cancels in the relative motion

Q-4 A sinusoidal voltage is applied to a series LCR circuit. If the frequency is 30 Hz, $L=32\text{mH}$, $C=1769 \mu\text{F}$ and $R=4\Omega$, then the Impedance of the circuit is:

[OAVS PGT Physics 2019]

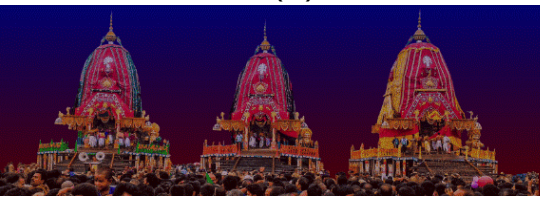
(A) 4Ω

(B) 16Ω

(C) 12Ω

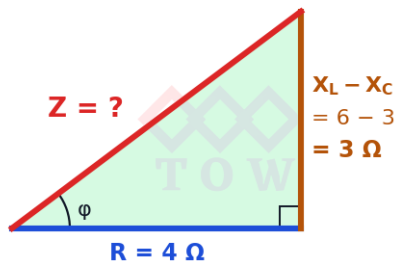
(D) 5Ω

Ans- (D) 5Ω



Given:

→ $f = 30 \text{ Hz}$, $L = 32 \text{ mH}$, $C = 1769 \mu\text{F}$, $R = 4 \Omega$



Concept:

→ $Z = \sqrt{R^2 + (X_L - X_C)^2}$, $X_L = 2\pi fL$, $X_C = \frac{1}{2\pi fC}$

Solution:

➤ $X_L = 2\pi \times 30 \times 0.032 \approx 6 \Omega$

➤ $X_C = \frac{1}{2\pi \times 30 \times 1769 \times 10^{-6}} \approx 3 \Omega$

➤ $Z = \sqrt{4^2 + 3^2} = 5 \Omega$

➤ Ans: (D) 5Ω

Hint:

→ A 3-4-5 triangle: $R = 4$, net reactance = 3 gives $Z = 5$ instantly

Q-5 A solenoid of 5000 turns and of cross sectional area $3 \times 10^{-4} \text{ m}^2$ is placed in an external magnetic field $141.4 \times 10^{-4} \text{ T}$ with its axis at 45° . The torque it experiences is 0.05 Nm. If, it has the same magnetic moment as a bar magnet, then the current flowing through it is:

[OAVS PGT Physics 2019]

(A) 0.33 A

(B) 3.3 A

(C) 33 A

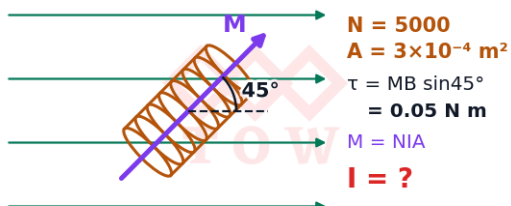
(D) 0.03 A

Ans- (B) 3.3 A

Given:

→ $N = 5000$, $A = 3 \times 10^{-4} \text{ m}^2$, $B = 141.4 \times 10^{-4} \text{ T}$, $\theta = 45^\circ$, $\tau = 0.05 \text{ N m}$

$B = 141.4 \times 10^{-4} \text{ T}$



Concept:

→ $\tau = MB \sin \theta$, $M = NIA$



Solution:

$$\text{► } M = \frac{0.05}{141.4 \times 10^{-4} \times 0.707} = \frac{0.05}{0.01} = 5 \text{ A m}^2$$

$$\text{► } I = \frac{M}{NA} = \frac{5}{5000 \times 3 \times 10^{-4}}$$

$$\Rightarrow I \approx 3.3 \text{ A}$$

► Ans: (B) 3.3 A

Hint:

→ $141.4 \times 10^{-4} \times \sin 45^\circ = 0.01$ exactly — the numbers are chosen to simplify

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Q-6 Consider a prism made of a flint glass ($\mu = \frac{3}{2}$) of refracting angle 60° . It is completely immersed in a liquid ($\mu = \frac{4}{3}$). The angle of minimum deviation for the prism is:

[OAVS PGT PHYSICS 2024]

(A) $2 \sin^{-1} \left(\frac{9}{16} \right) - \frac{\pi}{3}$

(B) $2 \sin^{-1} \left(\frac{9}{16} \right) + \frac{\pi}{3}$

(C) $2 \sin^{-1} \left(\frac{9}{16} \right) - \frac{\pi}{6}$

(D) $2 \sin^{-1} \left(\frac{9}{16} \right) + \frac{\pi}{6}$

ANS- (A) $2 \sin^{-1} \left(\frac{9}{16} \right) - \frac{\pi}{3}$

Given:

→ $\mu_g = \frac{3}{2}$ (flint glass), $\mu_l = \frac{4}{3}$ (liquid), $A = 60^\circ$

Concept:

→ In a liquid use the relative index: $\mu_r = \frac{\mu_g}{\mu_l} = \frac{\sin \left(\frac{A + \delta_m}{2} \right)}{\sin \left(\frac{A}{2} \right)}$

Solution:

► $\mu_r = \frac{3}{2} \times \frac{3}{4} = \frac{9}{8}$



$$\Rightarrow \sin\left(\frac{60^\circ + \delta_m}{2}\right) = \frac{9}{8} \times \sin 30^\circ = \frac{9}{16}$$

$$\Rightarrow \frac{60^\circ + \delta_m}{2} = \sin^{-1}\left(\frac{9}{16}\right)$$

$$\Rightarrow \delta_m = 2 \sin^{-1}\left(\frac{9}{16}\right) - \frac{\pi}{3}$$

► Ans: (A) $2 \sin^{-1}\left(\frac{9}{16}\right) - \frac{\pi}{3}$

Hint:

→ Immersing a prism in a liquid lowers its relative index, so the deviation becomes smaller.

Q-7 The ratio of the longest wavelength to the shortest wavelength in Paschen series of hydrogen spectrum is:

[OAVS PGT PHYSICS 2024]

(A) $\frac{144}{7}$

(B) $\frac{9}{7}$

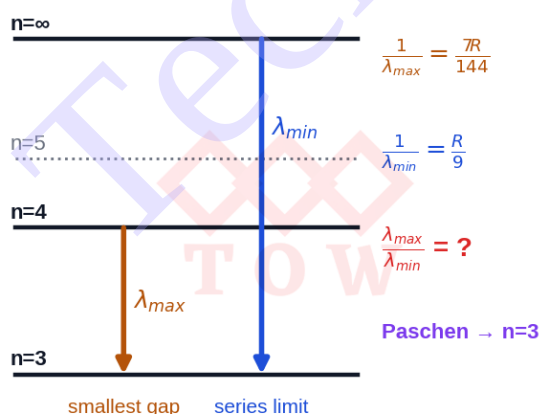
(C) $\frac{16}{7}$

(D) $\frac{12}{7}$

ANS- (C) $\frac{16}{7}$

Given:

→ Paschen series: transitions to $n_1 = 3$



Concept:

$$\rightarrow \frac{1}{\lambda} = R \left(\frac{1}{3^2} - \frac{1}{n_2^2} \right)$$

Solution:



► Longest λ ($n_2=4$): $\frac{1}{\lambda_{max}} = R \left(\frac{1}{9} - \frac{1}{16} \right) = \frac{7R}{144}$

⇒ Shortest λ ($n_2=\infty$): $\frac{1}{\lambda_{min}} = \frac{R}{9}$

► $\frac{\lambda_{max}}{\lambda_{min}} = \frac{144}{7R} \times \frac{R}{9} = \frac{16}{7}$

► Ans: (C) $\frac{16}{7}$

Hint:

→ Longest λ = smallest energy gap ($n+1 \rightarrow n$); shortest λ = series limit ($\infty \rightarrow n$).

Q-8 Suppose in a charge configuration, a point charge of strength $+54 \mu C$ is placed at a distance 30 cm above the centre of a square of length 60 cm . Hence the magnitude of the electric flux through the square is (consider $\epsilon_0 = 9 \times 10^{-12} \text{ N}^{-1} \text{ C}^2 \text{ m}^{-2}$):

[OAVS PGT PHYSICS 2024]

(A) $10^5 \text{ N m}^2 \text{ C}^{-1}$

(B) $10^4 \text{ N m}^2 \text{ C}^{-1}$

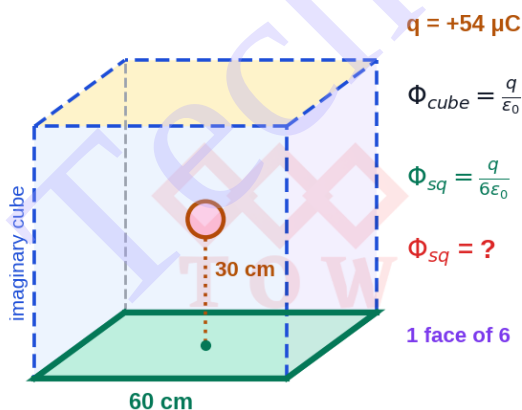
(C) $10^6 \text{ N m}^2 \text{ C}^{-1}$

(D) $10^7 \text{ N m}^2 \text{ C}^{-1}$

ANS- (C) $10^6 \text{ N m}^2 \text{ C}^{-1}$

Given:

→ $q = +54 \mu C$ at 30 cm above the centre of a square of side 60 cm ; $\epsilon_0 = 9 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$



Concept:

→ The charge is at the centre of an imaginary cube of side 60 cm ; the square is one of its 6 faces, so $\Phi = \frac{q}{6\epsilon_0}$ (Gauss's law)

Solution:



$$\begin{aligned} \Phi &= \frac{54 \times 10^{-6}}{6 \times 9 \times 10^{-12}} \\ \Rightarrow \Phi &= \frac{54 \times 10^{-6}}{54 \times 10^{-12}} \\ \Rightarrow \Phi &= 10^6 \text{ N m}^2 \text{ C}^{-1} \\ \text{Ans: (C) } &10^6 \text{ N m}^2 \text{ C}^{-1} \end{aligned}$$

Hint:

→ The cube trick works only when the charge is at half the side length (30 cm) above the square's centre.

Q-9 In a Zener regulated power supply, a Zener diode with $V_Z = 10.0 \text{ V}$ is used for regulation. The load current is to be 6.0 mA and the unregulated input is 20.0 V . What should be the value of series resistor R_S ?

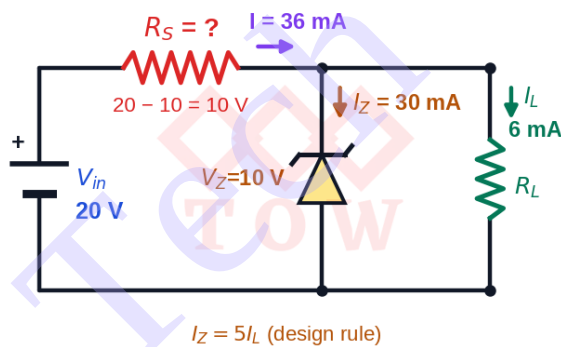
[OAVS PGT PHYSICS 2024]

- (A) 177Ω
- (B) 477Ω
- (C) 377Ω
- (D) 277Ω

ANS- (D) 277Ω

Given:

$$\rightarrow V_Z = 10.0 \text{ V}, V_{in} = 20.0 \text{ V}, I_L = 6.0 \text{ mA}$$



Concept:

→ Standard design rule (NCERT): take Zener current $I_Z = 5 I_L$; then $R_S = \frac{V_{in} - V_Z}{I_Z + I_L}$

Solution:

$$\begin{aligned} \rightarrow I_Z &= 5 \times 6 = 30 \text{ mA} \\ \Rightarrow \text{Total current} &= 30 + 6 = 36 \text{ mA} \\ \rightarrow R_S &= \frac{20 - 10}{36 \times 10^{-3}} \\ \Rightarrow R_S &\approx 277.8 \Omega \approx 277 \Omega \\ \text{Ans: (D) } &277 \Omega \end{aligned}$$



Hint:

→ Without the $5 \times I_L$ rule you would get 1667Ω — the options assume the NCERT rule.

Q-10 A radioactive nucleus (mass number A and atomic number Z) emits 2 alpha particles and 2 positrons. The ratio of the number of neutrons to that of the protons in the resultant nucleus is:

[OAVS PGT PHYSICS 2024]

(A) $\frac{(A - Z - 2)}{(Z - 6)}$

(B) $\frac{(A - Z - 8)}{(Z - 4)}$

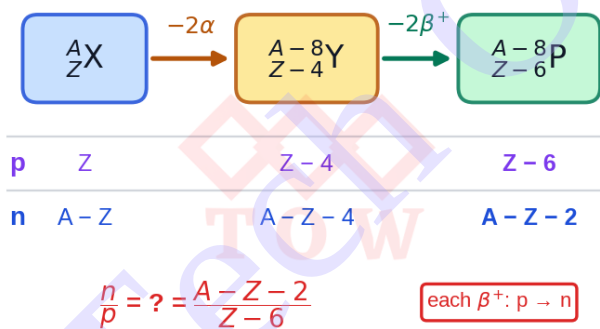
(C) $\frac{(A - Z - 8)}{(Z - 6)}$

(D) $\frac{(A - Z - 4)}{(Z - 4)}$

ANS- (A) $\frac{(A - Z - 2)}{(Z - 6)}$

Given:

→ Parent nucleus ${}_Z^AX$ emits 2 α -particles and 2 positrons (β^+)



Concept:

→ α emission: $A \rightarrow A - 4, Z \rightarrow Z - 2$

→ β^+ emission: A unchanged, $Z \rightarrow Z - 1$

Solution:

➤ ${}_Z^AX \xrightarrow{-2\alpha} {}_{Z-4}^{A-8}Y$

⇒ ${}_{Z-4}^{A-8}Y \xrightarrow{-2\beta^+} {}_{Z-6}^{A-8}P$

➤ Protons = $Z - 6$; neutrons = $(A - 8) - (Z - 6) = A - Z - 2$

➤ Ratio = $\frac{A - Z - 2}{Z - 6}$

➤ Ans: (A) $\frac{(A - Z - 2)}{(Z - 6)}$





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Why not others:

→ (B), (C) use $A - Z - 8$ — they forget that each positron turns a proton into a neutron.

→ (D) $Z - 4$ counts only the α -particles and ignores the two positrons.

Hint:

→ β^+ decay: $p \rightarrow n + e^+ + \nu$, so neutrons go up by 1 for each positron.

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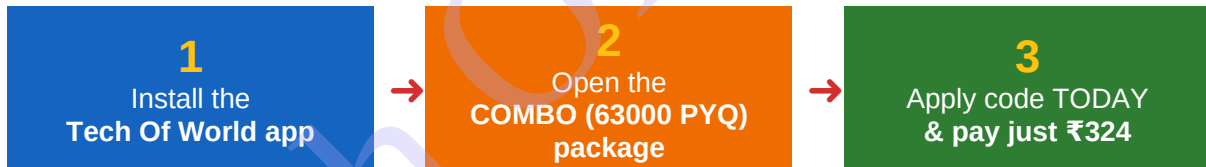
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