

AIPMT 2015 — Physics Question Paper with Solutions

34 Physics questions as set in the paper · answers checked by RankUp

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1. A radiation of energy 'E' falls normally on a perfectly reflecting surface. The momentum transferred to the surface is (C = Velocity of light):

- (A) E/C^2
- (B) E/C
- (C) $2E/C$
- (D) $2E/C^2$

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2. A ship A is moving Westwards with a speed of 10 km h^{-1} and a ship B 100 km South of A, is moving Northwards with a speed of 10 km h^{-1} . The time after which the distance between them becomes shortest, is:

- (A) $10\sqrt{2} \text{ h}$
- (B) 0 h
- (C) 5 h
- (D) $5\sqrt{2} \text{ h}$

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3. The electric field in a certain region is acting radially outward and is given by $E = Ar$. A charge contained in a sphere of radius 'a' centred at the origin of the field, will be given by:

- (A) $\epsilon_0 Aa^3$
- (B) $4\pi\epsilon_0 Aa^2$
- (C) $A\epsilon_0 a^2$
- (D) $4\pi\epsilon_0 Aa^3$

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4. In a double slit experiment, the two slits are 1 mm apart and the screen is placed 1 m away. A monochromatic light of wavelength 500 nm is used. What will be the width of each slit for obtaining ten maxima of double slit within the central maxima of single slit pattern?

- (A) 0.02 mm
- (B) 0.2 mm
- (C) 0.1 mm
- (D) 0.5 mm

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5. A rod of weight W is supported by two parallel knife edges A and B and is in equilibrium in a horizontal position. The knives are at a distance d from each other. The centre of mass of the rod is at distance x from A. The normal reaction on A is:

- (A) $W(d - x)/d$
- (B) Wx/d
- (C) Wd/x
- (D) $W(d - x)/x$

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6. Kepler's third law states that square of period of revolution (T) of a planet around the sun, is proportional to third power of average distance r between sun and planet, i.e. $T^2 = Kr^3$, here K is constant. If the masses of sun and planet are M and m respectively then as per Newton's law of gravitation force of attraction between them is $F = GMm/r^2$, here G is gravitational constant. The relation between G and K is described as:

- (A) $K = 1/G$
- (B) $GK = 4\pi^2$
- (C) $GMK = 4\pi^2$
- (D) $K = G$

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7. Two particles of masses m_1, m_2 move with initial velocities u_1 and u_2 . On collision, one of the particles get excited to higher level, after absorbing energy ϵ . If final velocities of particles be v_1 and v_2 then we must have:

- (A) $(1/2)m_1^2u_1^2 + (1/2)m_2^2u_2^2 + \epsilon = (1/2)m_1^2v_1^2 + (1/2)m_2^2v_2^2$
- (B) $m_1^2u_1 + m_2^2u_2 - \epsilon = m_1^2v_1 + m_2^2v_2$
- (C) $(1/2)m_1u_1^2 + (1/2)m_2u_2^2 = (1/2)m_1v_1^2 + (1/2)m_2v_2^2 - \epsilon$
- (D) $(1/2)m_1u_1^2 + (1/2)m_2u_2^2 = (1/2)m_1v_1^2 + (1/2)m_2v_2^2 + \epsilon$

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8. The approximate depth of an ocean is 2700 m. The compressibility of water is $45.4 \times 10^{-11} \text{ Pa}^{-1}$ and density of water is 10^3 kg/m^3 . What fractional compression of water will be obtained at the bottom of the ocean?

- (A) 1.4×10^{-2}
- (B) 0.8×10^{-2}
- (C) 1.0×10^{-2}
- (D) 1.2×10^{-2}

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9. The two ends of a metal rod are maintained at temperatures 100°C and 110°C . The rate of heat flow in the rod is found to be 4.0 J/s . If the ends are maintained at temperatures 200°C and 210°C , the rate of heat flow will be:

- (A) 4.0 J/s
- (B) 44.0 J/s
- (C) 16.8 J/s
- (D) 8.0 J/s

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10. A particle of unit mass undergoes one-dimensional motion such that its velocity varies according to $v(x) = \beta x^{-2n}$, where β and n are constants and x is the position of the particle. The acceleration of the particle as a function of x , is given by:

- (A) $-2n\beta^2e^{(-4n+1)}$
- (B) $-2n\beta^2x^{(-2n-1)}$
- (C) $-2n\beta^2x^{(-4n-1)}$
- (D) $-2\beta^2x^{(-2n+1)}$

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11. The refracting angle of a prism is A, and refractive index of the material of the prism is $\cot(A/2)$. The angle of minimum deviation is:

- (A) $180^\circ + 2A$
- (B) $180^\circ - 3A$
- (C) $180^\circ - 2A$
- (D) $90^\circ - A$

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12. A particle is executing SHM along a straight line. Its velocities at distances x_1 and x_2 from the mean position are V_1 and V_2 , respectively. Its time period is:

- (A) $2\pi v / ((V_1^2 - V_2^2) / (x_1^2 - x_2^2))$
- (B) $2\pi v / ((x_1^2 + x_2^2) / (V_1^2 + V_2^2))$
- (C) $2\pi v / ((x_2^2 - x_1^2) / (V_1^2 - V_2^2))$
- (D) $2\pi v / ((V_1^2 + V_2^2) / (x_1^2 + x_2^2))$

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13. Two similar springs P and Q have spring constants K_P and K_Q , such that $K_P > K_Q$. They are stretched, first by the same amount (case a), then by the same force (case b). The work done by the springs W_P and W_Q are related as, in case (a) and case (b), respectively:

- (A) $W_P < W_Q$; $W_Q < W_P$
- (B) $W_P = W_Q$; $W_P > W_Q$
- (C) $W_P = W_Q$; $W_P = W_Q$
- (D) $W_P > W_Q$; $W_Q > W_P$

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14. Consider 3rd orbit of He^+ (Helium), using non-relativistic approach, the speed of electron in this orbit will be [given $K = 9 \times 10^9$ constant, $Z = 2$ and h (Planck's Constant) = 6.6×10^{-34} J s]

- (A) 3.0×10^8 m/s
- (B) 2.92×10^6 m/s
- (C) 1.46×10^6 m/s
- (D) 0.73×10^6 m/s

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15. A particle of mass m is driven by a machine that delivers a constant power k watts. If the particle starts from rest the force on the particle at time t is:

- (A) $(1/2)\sqrt{(mk)} t^{(-1/2)}$
- (B) $\sqrt{(mk/2)} t^{(-1/2)}$
- (C) $\sqrt{(mk)} t^{(-1/2)}$
- (D) $\sqrt{(2mk)} t^{(-1/2)}$

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16. The fundamental frequency of a closed organ pipe of length 20 cm is equal to the second overtone of an organ pipe open at both the ends. The length of organ pipe open at both the ends is:

- (A) 140 cm
- (B) 80 cm
- (C) 100 cm
- (D) 120 cm

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17. An electron moving in a circular orbit of radius r makes n rotations per second. The magnetic field produced at the centre has magnitude:

- (A) $\mu_0 ne / (2r)$
- (B) $\mu_0 ne / (2\pi r)$
- (C) Zero
- (D) $\mu_0 n^2 e / r$

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18. Two identical thin plano-convex glass lenses (refractive index 1.5) each having radius of curvature of 20 cm are placed with their convex surfaces in contact at the centre. The intervening space is filled with oil of refractive index 1.7. The focal length of the combination is:

- (A) 50 cm
- (B) -20 cm
- (C) -25 cm
- (D) -50 cm

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19. On observing light from three different stars P, Q and R, it was found that intensity of violet colour is maximum in the spectrum of P, the intensity of green colour is maximum in the spectrum of R and the intensity of red colour is maximum in the spectrum of Q. If T_P , T_Q and T_R are the respective absolute temperatures of P, Q and R, then it can be concluded from the above observations that:

- (A) $T_P < T_Q < T_R$
- (B) $T_P > T_Q > T_R$
- (C) $T_P > T_R > T_Q$
- (D) $T_P < T_R < T_Q$

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20. If energy (E), velocity (V) and time (T) are chosen as the fundamental quantities, the dimensional formula of surface tension will be:

- (A) $[E^{-2} V^{-1} T^{-3}]$
- (B) $[E V^{-2} T^{-1}]$
- (C) $[E V^{-1} T^{-2}]$
- (D) $[E V^{-2} T^{-2}]$

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21. A Carnot engine, having an efficiency of $\eta = 1/10$ as heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is:

- (A) 1 J
- (B) 100 J
- (C) 99 J
- (D) 90 J

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22. For a parallel beam of monochromatic light of wavelength ' λ ', diffraction is produced by a single slit whose width 'a' is of the order of the wavelength of the light. If 'D' is the distance of the screen from the slit, the width of the central maxima will be:

- (A) $2Da/\lambda$
- (B) $2D\lambda/a$
- (C) $D\lambda/a$
- (D) Da/λ

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23. A wind with speed 40 m/s blows parallel to the roof of a house. The area of the roof is 250 m². Assuming that the pressure inside the house is atmospheric pressure, the force exerted by the wind on the roof and the direction of the force will be: ($\rho_{\text{air}} = 1.2 \text{ kg/m}^3$)

- (A) $2.4 \times 10^5 \text{ N}$, downwards
- (B) $4.8 \times 10^5 \text{ N}$, downwards
- (C) $4.8 \times 10^5 \text{ N}$, upwards
- (D) $2.4 \times 10^5 \text{ N}$, upwards

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24. The ratio of the specific heats $C_p/C_v = \gamma$ in terms of degrees of freedom (n) is given by:

- (A) $(1 + n/2)$
- (B) $(1 + 1/n)$
- (C) $(1 + n/3)$
- (D) $(1 + 2/n)$

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25. If radius of the $^{27}_{13}\text{Al}$ nucleus is taken to be R_{Al} , then the radius of $^{125}_{53}\text{Te}$ nucleus is nearly:

- (A) $(13/53)^{(1/3)} R_{\text{Al}}$
- (B) $(53/13)^{(1/3)} R_{\text{Al}}$
- (C) $(5/3) R_{\text{Al}}$
- (D) $(3/5) R_{\text{Al}}$

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26. A block of mass 10 kg, moving in x direction with a constant speed of 10 ms^{-1} , is subjected to a retarding force $F = 0.1x \text{ J/m}$ during its travel from $x = 20 \text{ m}$ to 30 m . Its final KE will be:

- (A) 250 J
- (B) 475 J
- (C) 450 J
- (D) 275 J

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27. A block A of mass m_1 rests on a horizontal table. A light string connected to it passes over a frictionless pulley at the edge of table and from its other end another block B of mass m_2 is suspended. The coefficient of kinetic friction between the block and the table is μ_k . When the block A is sliding on the table, the tension in the string is:

- (A) $m_1 m_2 (1 - \mu_k) g / (m_1 + m_2)$
- (B) $(m_2 + \mu_k m_1) g / (m_1 + m_2)$
- (C) $(m_2 - \mu_k m_1) g / (m_1 + m_2)$
- (D) $m_1 m_2 (1 + \mu_k) g / (m_1 + m_2)$

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28. A certain metallic surface is illuminated with monochromatic light of wavelength λ . The stopping potential for photo-electric current for this light is $3V_0$. If the same surface is illuminated with light of wavelength 2λ , the stopping potential is V_0 . The threshold wavelength for this surface for photo-electric effect is:

- (A) $\lambda/6$
- (B) 6λ
- (C) 4λ
- (D) $\lambda/4$

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29. When two displacements represented by $y_1 = a \sin(\omega t)$ and $y_2 = b \cos(\omega t)$ are superimposed the motion is:

- (A) simple harmonic with amplitude $(a + b)/2$
- (B) not a simple harmonic
- (C) simple harmonic with amplitude a/b
- (D) simple harmonic with amplitude $\sqrt{a^2 + b^2}$

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30. A potentiometer wire has length 4 m and resistance $8\ \Omega$. The resistance that must be connected in series with the wire and an accumulator of e.m.f. 2 V, so as to get a potential gradient 1 mV per cm on the wire is:

- (A) $48\ \Omega$
- (B) $32\ \Omega$
- (C) $40\ \Omega$
- (D) $44\ \Omega$

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31. Two spherical bodies of mass M and $5M$ and radii R and $2R$ are released in free space with initial separation between their centres equal to $12R$. If they attract each other due to gravitational force only, then the distance covered by the smaller body before collision is:

- (A) $1.5R$
- (B) $2.5R$
- (C) $4.5R$
- (D) $7.5R$

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32. A resistance ' R ' draws power ' P ' when connected to an AC source. If an inductance is now placed in series with the resistance, such that the impedance of the circuit becomes ' Z ', the power drawn will be:

- (A) P
- (B) $P(R/Z)^2$
- (C) $P\sqrt{R/Z}$
- (D) $P(R/Z)$

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33. Across a metallic conductor of non-uniform cross section a constant potential difference is applied. The quantity which remains constant along the conductor is:

- (A) electric field
- (B) current density
- (C) current
- (D) drift velocity

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34. A parallel plate air capacitor of capacitance C is connected to a cell of emf V and then disconnected from it. A dielectric slab of dielectric constant K , which can just fill the air gap of the capacitor, is now inserted in it. Which of the following is incorrect?

- (A) The charge on the capacitor is not conserved
- (B) The potential difference between the plates decreases K times
- (C) The energy stored in the capacitor decreases K times
- (D) The change in energy stored is $(1/2)CV^2(1/K - 1)$

Answer key and explanations

1. Answer: (C) $2E/C$

Radiation of energy E carries momentum E/c . A perfect reflector sends it back with the same magnitude, so the change in momentum is $E/c - (-E/c) = 2E/c$. E/c would be the answer only for a perfectly absorbing surface.

2. Answer: (C) 5 h

Take A as origin: B starts at $(0, -100)$ km and its velocity relative to A is $(10, 10)$ km/h, i.e. $10\sqrt{2}$ km/h at 45° . Time of closest approach $t = -(r \cdot v)/v^2 = (100 \times 10)/200 = 5$ h. The minimum separation is then $50\sqrt{2}$ km, which is the trap behind $5\sqrt{2}$ h.

3. Answer: (D) $4\pi\epsilon_0 Aa^3$

At $r = a$ the field is Aa , radial, so the flux through the sphere is $Aa \times 4\pi a^2 = 4\pi Aa^3$. By Gauss's law $q = \epsilon_0 \times \text{flux} = 4\pi\epsilon_0 Aa^3$. Forgetting the 4π gives $\epsilon_0 Aa^3$.

4. Answer: (B) 0.2 mm

Fringe width $\beta = \lambda D/d = 5 \times 10^{-7} \times 1/10^{-3} = 0.5$ mm. Ten fringes fill the central diffraction maximum: $2\lambda D/a = 10\beta = 5$ mm, so $a = 2 \times 5 \times 10^{-7} \times 1/(5 \times 10^{-3}) = 2 \times 10^{-4}$ m = 0.2 mm.

5. Answer: (A) $W(d - x)/d$

Take torques about knife edge B: $N_A \times d = W \times (d - x)$, so $N_A = W(d - x)/d$. Wx/d is the reaction at B, the usual mix-up.

6. Answer: (C) $GMK = 4\pi^2$

Gravity provides the centripetal force: $GMm/r^2 = m(2\pi/T)^2 r$, so $T^2 = (4\pi^2/GM)r^3$. Hence $K = 4\pi^2/GM$, i.e. $GMK = 4\pi^2$. $GK = 4\pi^2$ drops the Sun's mass.

7. Answer: (D) $(1/2)m_1u_1^2 + (1/2)m_2u_2^2 = (1/2)m_1v_1^2 + (1/2)m_2v_2^2 + \epsilon$

Total energy is conserved: the initial kinetic energy equals the final kinetic energy plus the energy ϵ absorbed in exciting the particle, so $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 + \epsilon$. Writing $-\epsilon$ on the final side would mean the system gained energy, which is wrong.

8. Answer: (D) 1.2×10^{-2}

Pressure at the bottom $\approx h\rho g = 2700 \times 10^3 \times 10 = 2.7 \times 10^7$ Pa. Fractional compression $\Delta V/V = \text{compressibility} \times \text{pressure} = 45.4 \times 10^{-11} \times 2.7 \times 10^7 \approx 1.2 \times 10^{-2}$ (1.20×10^{-2} with $g = 9.8$).

9. Answer: (A) 4.0 J/s

The conduction rate is $k\Delta T/L$ and depends on the temperature difference, not the actual temperatures. ΔT is 10°C in both cases, so the rate stays 4.0 J/s (ignoring change of k with temperature).

10. Answer: (C) $-2n\beta^2x^{(-4n-1)}$

$a = v dv/dx$. With $v = \beta x^{-2n}$, $dv/dx = -2n\beta x^{-2n-1}$, so $a = \beta x^{-2n} \times (-2n\beta x^{-2n-1}) = -2n\beta^2 x^{-4n-1}$. Using only dv/dx gives the $-2n-1$ power, which is not an acceleration.

11. Answer: (C) $180^\circ - 2A$

$\mu = \sin((A + \delta m)/2)/\sin(A/2) = \cot(A/2) = \cos(A/2)/\sin(A/2)$. So $\sin((A + \delta m)/2) = \cos(A/2) = \sin(90^\circ - A/2)$, giving $(A + \delta m)/2 = 90^\circ - A/2$ and $\delta m = 180^\circ - 2A$.

12. Answer: (C) $2\pi\sqrt{((x_2^2 - x_1^2)/(V_1^2 - V_2^2))}$

$V_1^2 = \omega^2(a^2 - x_1^2)$ and $V_2^2 = \omega^2(a^2 - x_2^2)$. Subtracting, $V_1^2 - V_2^2 = \omega^2(x_2^2 - x_1^2)$, so $\omega = \sqrt{((V_1^2 - V_2^2)/(x_2^2 - x_1^2))}$ and $T = 2\pi/\omega = 2\pi\sqrt{((x_2^2 - x_1^2)/(V_1^2 - V_2^2))}$. The inverted ratio gives $1/T$, not T .

13. Answer: (D) $W_P > W_Q$; $W_Q > W_P$

Same extension: $W = \frac{1}{2}kx^2$, so the stiffer spring P does more work ($W_P > W_Q$). Same force: $x = F/k$ and $W = F^2/2k$, so the softer spring Q does more work ($W_Q > W_P$).

14. Answer: (C) 1.46×10^6 m/s

Bohr speed $v = 2\pi KZe^2/(nh) = 2\pi \times 9 \times 10^9 \times 2 \times (1.6 \times 10^{-19})^2/(3 \times 6.6 \times 10^{-34}) \approx 1.46 \times 10^6$ m/s (equivalently $2.19 \times 10^6 \times Z/n$). 2.92×10^6 m/s would be the $n = 1.5$ value, i.e. a mistake in n .

15. Answer: (B) $\sqrt{(mk/2)} t^{(-1/2)}$

Constant power: $\frac{1}{2}mv^2 = kt$, so $v = \sqrt{(2kt/m)}$. Then $F = m dv/dt = m \times \sqrt{(2k/m)} \times \frac{1}{2}t^{(-1/2)} = \sqrt{(mk/2)} t^{(-1/2)}$. Forgetting the $\frac{1}{2}$ from differentiation gives $\sqrt{(2mk)} t^{(-1/2)}$.

16. Answer: (D) 120 cm

Closed pipe fundamental = $v/(4 \times 20 \text{ cm}) = v/80$. Second overtone of an open pipe is the third harmonic, $3v/(2L)$. Equating, $3v/(2L) = v/80$ gives $L = 120$ cm. Taking second overtone as the second harmonic gives 80 cm.

17. Answer: (A) $\mu_0 ne/(2r)$

The orbiting electron is a current loop with $I = \text{charge passing per second} = ne$. The field at the centre of a loop is $\mu_0 I/(2r) = \mu_0 ne/(2r)$. $\mu_0 ne/(2\pi r)$ is the formula for a long straight wire.

18. Answer: (D) -50 cm

Each plano-convex glass lens: $1/f = (1.5 - 1)/20 = 1/40 \text{ cm}^{-1}$. The oil forms a biconcave lens: $1/f = (1.7 - 1)(-1/20 - 1/20) = -0.07 \text{ cm}^{-1}$. Total $1/F = 2/40 - 0.07 = -0.02 \text{ cm}^{-1}$, so $F = -50$ cm.

19. Answer: (C) $T_P > T_R > T_Q$

By Wien's displacement law $\lambda_{\text{max}} T = \text{constant}$, so a shorter peak wavelength means a hotter star. $\lambda_{\text{violet}} < \lambda_{\text{green}} < \lambda_{\text{red}}$, hence $T_P > T_R > T_Q$.

20. Answer: (D) $[E V^{-2} T^{-2}]$

Surface tension has dimensions $[MT^{-2}]$. With $E = [ML^2T^{-2}]$ and $V = [LT^{-1}]$, $M = E V^{-2}$, so $[MT^{-2}] = [E V^{-2} T^{-2}]$.

21. Answer: (D) 90 J

For the Carnot cycle $\eta = W/Q_H = 1/10$, so with $W = 10$ J, $Q_H = 100$ J. The heat taken from the cold reservoir is $Q_L = Q_H - W = 90$ J. 100 J is the heat rejected to the hot reservoir, not that absorbed from the cold one.

22. Answer: (B) $2D\lambda/a$

The first minima are at $\sin \theta \approx \lambda/a$ on either side, so the central maximum spans $2D\lambda/a$ on the screen. $D\lambda/a$ is only the half-width.

23. Answer: (D) 2.4×10^5 N, upwards

By Bernoulli the pressure above the roof is lower by $\frac{1}{2}\rho v^2 = 0.5 \times 1.2 \times 40^2 = 960$ Pa. Force = $960 \times 250 = 2.4 \times 10^5$ N, acting upwards because the higher pressure is inside the house.

24. Answer: (D) $(1 + 2/n)$

With n degrees of freedom $C_v = (n/2)R$ and $C_p = (n/2 + 1)R$, so $\gamma = C_p/C_v = 1 + 2/n$. For a monatomic gas ($n = 3$) this gives $5/3$ as expected.

25. Answer: (C) $(5/3) R_{Al}$

Nuclear radius $R = R_0 A^{1/3}$, so $R_{Te}/R_{Al} = (125/27)^{1/3} = 5/3$. Using atomic numbers instead of mass numbers gives the $(53/13)^{1/3}$ trap.

26. Answer: (B) 475 J

Initial KE = $\frac{1}{2} \times 10 \times 10^2 = 500$ J. Work by the retarding force = $-\int_{20}^{30} 0.1x \, dx = -0.05(900 - 400) = -25$ J. Final KE = $500 - 25 = 475$ J.

27. Answer: (D) $m_1 m_2 (1 + \mu_k)g / (m_1 + m_2)$

$a = (m_2 - \mu_k m_1)g / (m_1 + m_2)$. For block A: $T - \mu_k m_1 g = m_1 a$, so $T = m_1 [(m_2 - \mu_k m_1)g / (m_1 + m_2) + \mu_k g] = m_1 m_2 (1 + \mu_k)g / (m_1 + m_2)$. Friction increases the tension compared with the frictionless value.

28. Answer: (C) 4λ

$hc/\lambda = \phi + 3eV_0$ and $hc/2\lambda = \phi + eV_0$. Subtracting, $hc/2\lambda = 2eV_0$, so $eV_0 = hc/4\lambda$ and $\phi = hc/2\lambda - hc/4\lambda = hc/4\lambda$. Threshold wavelength = $hc/\phi = 4\lambda$.

29. Answer: (D) simple harmonic with amplitude $\sqrt{a^2 + b^2}$

$a \sin \omega t + b \cos \omega t = \sqrt{a^2 + b^2} \sin(\omega t + \phi)$ with $\tan \phi = b/a$: a single SHM of the same ω . The two are 90° out of phase, so amplitudes add as $\sqrt{a^2 + b^2}$, not $(a + b)/2$.

30. Answer: (B) 32 Ω

$1 \text{ mV/cm} = 0.1 \text{ V/m}$, so 0.4 V must drop across the 4 m , 8Ω wire: $I = 0.4/8 = 0.05 \text{ A}$. Total resistance = $2/0.05 = 40 \Omega$, so the series resistance is $40 - 8 = 32 \Omega$. 40Ω is the total, not the added resistance.

31. Answer: (D) 7.5 R

Only internal forces act, so the centre of mass stays fixed. It is $5M \times 12R/6M = 10R$ from the small body initially. At contact the centres are $R + 2R = 3R$ apart and the small body is $2.5R$ from the centre of mass, so it moves $10R - 2.5R = 7.5R$.

32. Answer: (B) $P(R/Z)^2$

Without L : $P = V^2/R$. With L , $I = V/Z$ and power = $I^2 R = V^2 R/Z^2 = (V^2/R)(R/Z)^2 = P(R/Z)^2$. $P(R/Z)$ misses that both current and power factor fall by R/Z .

33. Answer: (C) current

The conductor is a single series path, so charge conservation makes the current the same at every cross-section. Current density, field and drift velocity all vary inversely with the local area.

34. Answer: (A) The charge on the capacitor is not conserved

After disconnection the plates are isolated, so the charge stays constant; the statement that charge is not conserved is the incorrect one. With Q fixed, $V = Q/KC$ falls K times and $U = Q^2/2KC$ falls K times, so the change is $\frac{1}{2}CV^2(1/K - 1)$.

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