

NEET 2016 Phase 2 — Physics Question Paper with Solutions

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

NEET 2016 Phase 2 · Q1

1. Planck's constant (h), speed of light in vacuum (c) and Newton's gravitational constant (G) are three fundamental constants. Which of the following combinations of these has the dimension of length?

- (A) $\sqrt{(hG)/c^{(3/2)}}$
- (B) $\sqrt{(hG)/c^{(5/2)}}$
- (C) $\sqrt{(hc/G)}$
- (D) $\sqrt{(Gc/h^{(3/2)})}$

NEET 2016 Phase 2 · Q2

2. Two cars P and Q start from a point at the same time in a straight line and their positions are represented by $x_P(t) = at + bt^2$ and $x_Q(t) = ft - t^2$. At what time do the cars have the same velocity?

- (A) $(a - f)/(1 + b)$
- (B) $(a + f)/(2(b - 1))$
- (C) $(a + f)/(2(1 + b))$
- (D) $(f - a)/(2(1 + b))$

NEET 2016 Phase 2 · Q5

3. A bullet of mass 10 g moving horizontally with a velocity of 400 m s^{-1} strikes a wooden block of mass 2 kg which is suspended by a light inextensible string of length 5 m. As a result, the centre of gravity of the block is found to rise a vertical distance of 10 cm. The speed of the bullet after it emerges out horizontally from the block will be

- (A) 100 m s^{-1}
- (B) 80 m s^{-1}
- (C) 120 m s^{-1}
- (D) 160 m s^{-1}

NEET 2016 Phase 2 · Q6

4. Two identical balls A and B having velocities of 0.5 m/s and -0.3 m/s respectively collide elastically in one dimension. The velocities of B and A after the collision respectively will be

- (A) -0.5 m/s and 0.3 m/s
- (B) 0.5 m/s and -0.3 m/s
- (C) -0.3 m/s and 0.5 m/s
- (D) 0.3 m/s and 0.5 m/s

NEET 2016 Phase 2 · Q7

5. A particle moves from a point $(-2\hat{i} + 5\hat{j})$ to $(4\hat{j} + 3\hat{k})$ when a force of $(4\hat{i} + 3\hat{j}) \text{ N}$ is applied. How much work has been done by the force?

- (A) 8 J
- (B) 11 J
- (C) 5 J
- (D) 2 J

NEET 2016 Phase 2 · Q8

6. Two rotating bodies A and B of masses m and $2m$ with moments of inertia I_A and I_B ($I_B > I_A$) have equal kinetic energy of rotation. If L_A and L_B be their angular momenta respectively, then

- (A) $L_A = L_B/2$
- (B) $L_A = 2L_B$
- (C) $L_B > L_A$
- (D) $L_A > L_B$

NEET 2016 Phase 2 · Q9

7. A solid sphere of mass m and radius R is rotating about its diameter. A solid cylinder of the same mass and same radius is also rotating about its geometrical axis with an angular speed twice that of the sphere. The ratio of their kinetic energies of rotation ($E_{\text{sphere}}/E_{\text{cylinder}}$) will be

- (A) 2 : 3
- (B) 1 : 5
- (C) 1 : 4
- (D) 3 : 1

NEET 2016 Phase 2 · Q10

8. A light rod of length l has two masses m_1 and m_2 attached to its two ends. The moment of inertia of the system about an axis perpendicular to the rod and passing through the centre of mass is

- (A) $(m_1 m_2 / (m_1 + m_2)) l^2$
- (B) $((m_1 + m_2) / (m_1 m_2)) l^2$
- (C) $(m_1 + m_2) l^2$
- (D) $\sqrt{(m_1 m_2)} l^2$

NEET 2016 Phase 2 · Q12

9. A satellite of mass m is orbiting the earth (of radius R) at a height h from its surface. The total energy of the satellite in terms of g_0 , the value of acceleration due to gravity at the earth's surface, is

- (A) $mg_0 R^2 / (2(R + h))$
- (B) $-mg_0 R^2 / (2(R + h))$
- (C) $2mg_0 R^2 / (R + h)$
- (D) $-2mg_0 R^2 / (R + h)$

NEET 2016 Phase 2 · Q13

10. A rectangular film of liquid is extended from $(4 \text{ cm} \times 2 \text{ cm})$ to $(5 \text{ cm} \times 4 \text{ cm})$. If the work done is $3 \times 10^{-4} \text{ J}$, the value of the surface tension of the liquid is

- (A) 0.250 N m^{-1}
- (B) 0.125 N m^{-1}
- (C) 0.2 N m^{-1}
- (D) 8.0 N m^{-1}

NEET 2016 Phase 2 · Q14

11. Three liquids of densities ρ_1 , ρ_2 and ρ_3 (with $\rho_1 > \rho_2 > \rho_3$), having the same value of surface tension T , rise to the same height in three identical capillaries. The angles of contact θ_1 , θ_2 and θ_3 obey

- (A) $\pi/2 > \theta_1 > \theta_2 > \theta_3 \geq 0$
- (B) $0 \leq \theta_1 < \theta_2 < \theta_3 < \pi/2$
- (C) $\pi/2 < \theta_1 < \theta_2 < \theta_3 < \pi$
- (D) $\pi > \theta_1 > \theta_2 > \theta_3 > \pi/2$

NEET 2016 Phase 2 · Q15

12. Two identical bodies are made of a material for which the heat capacity increases with temperature. One of these is at 100°C , while the other one is at 0°C . If the two bodies are brought into contact, then, assuming no heat loss, the final common temperature is

- (A) 50°C
- (B) more than 50°C
- (C) less than 50°C but greater than 0°C
- (D) 0°C

NEET 2016 Phase 2 · Q16

13. A body cools from a temperature $3T$ to $2T$ in 10 minutes. The room temperature is T . Assume that Newton's law of cooling is applicable. The temperature of the body at the end of next 10 minutes will be

- (A) $7T/4$
- (B) $3T/2$
- (C) $4T/3$
- (D) T

NEET 2016 Phase 2 · Q17

14. One mole of an ideal monatomic gas undergoes a process described by the equation $PV^3 = \text{constant}$. The heat capacity of the gas during this process is

- (A) $3R/2$
- (B) $5R/2$
- (C) $2R$
- (D) R

NEET 2016 Phase 2 · Q18

15. The temperature inside a refrigerator is $t_2^\circ\text{C}$ and the room temperature is $t_1^\circ\text{C}$. The amount of heat delivered to the room for each joule of electrical energy consumed ideally will be

- (A) $t_1/(t_1 - t_2)$
- (B) $(t_1 + 273)/(t_1 - t_2)$
- (C) $(t_2 + 273)/(t_1 - t_2)$
- (D) $(t_1 + t_2)/(t_1 + 273)$

NEET 2016 Phase 2 · Q19

16. A given sample of an ideal gas occupies a volume V at a pressure P and absolute temperature T . The mass of each molecule of the gas is m . Which of the following gives the density of the gas?

- (A) $P/(kT)$
- (B) $Pm/(kT)$
- (C) $P/(kTV)$
- (D) mkT

NEET 2016 Phase 2 · Q20

17. A body of mass m is attached to the lower end of a spring whose upper end is fixed. The spring has negligible mass. When the mass m is slightly pulled down and released, it oscillates with a time period of 3 s. When the mass m is increased by 1 kg, the time period of oscillations becomes 5 s. The value of m in kg is

- (A) $3/4$
- (B) $4/3$
- (C) $16/9$
- (D) $9/16$

NEET 2016 Phase 2 · Q21

18. The second overtone of an open organ pipe has the same frequency as the first overtone of a closed pipe L metre long. The length of the open pipe will be

- (A) L
- (B) 2L
- (C) L/2
- (D) 4L

NEET 2016 Phase 2 · Q23

19. An electric dipole is placed at an angle of 30° with an electric field intensity $2 \times 10^5 \text{ N/C}$. It experiences a torque equal to 4 N m. The charge on the dipole, if the dipole length is 2 cm, is

- (A) 8 mC
- (B) 2 mC
- (C) 5 mC
- (D) 7 μC

NEET 2016 Phase 2 · Q26

20. A filament bulb (500 W, 100 V) is to be used in a 230 V main supply. When a resistance R is connected in series, it works perfectly and the bulb consumes 500 W. The value of R is

- (A) 230 Ω
- (B) 46 Ω
- (C) 26 Ω
- (D) 13 Ω

NEET 2016 Phase 2 · Q27

21. A long wire carrying a steady current is bent into a circular loop of one turn. The magnetic field at the centre of the loop is B. It is then bent into a circular coil of n turns. The magnetic field at the centre of this coil of n turns will be

- (A) nB
- (B) n^2B
- (C) 2nB
- (D) $2n^2B$

NEET 2016 Phase 2 · Q28

22. A bar magnet is hung by a thin cotton thread in a uniform horizontal magnetic field and is in equilibrium state. The energy required to rotate it by 60° is W. Now the torque required to keep the magnet in this new position is

- (A) $W/\sqrt{3}$
- (B) $\sqrt{3}W$
- (C) $\sqrt{3}W/2$
- (D) $2W/\sqrt{3}$

NEET 2016 Phase 2 · Q29

23. An electron is moving in a circular path under the influence of a transverse magnetic field of $3.57 \times 10^{-2} \text{ T}$. If the value of e/m is $1.76 \times 10^{11} \text{ C/kg}$, the frequency of revolution of the electron is

- (A) 1 GHz
- (B) 100 MHz
- (C) 62.8 MHz
- (D) 6.28 MHz

NEET 2016 Phase 2 · Q30

24. Which of the following combinations should be selected for better tuning of an L-C-R circuit used for communication?

- (A) $R = 20 \, \Omega$, $L = 1.5 \, \text{H}$, $C = 35 \, \mu\text{F}$
- (B) $R = 25 \, \Omega$, $L = 2.5 \, \text{H}$, $C = 45 \, \mu\text{F}$
- (C) $R = 15 \, \Omega$, $L = 3.5 \, \text{H}$, $C = 30 \, \mu\text{F}$
- (D) $R = 25 \, \Omega$, $L = 1.5 \, \text{H}$, $C = 45 \, \mu\text{F}$

NEET 2016 Phase 2 · Q32

25. The potential differences across the resistance, capacitance and inductance are 80 V, 40 V and 100 V respectively in an L-C-R circuit. The power factor of this circuit is

- (A) 0.4
- (B) 0.5
- (C) 0.8
- (D) 1.0

NEET 2016 Phase 2 · Q33

26. A $100 \, \Omega$ resistance and a capacitor of $100 \, \Omega$ reactance are connected in series across a 220 V source. When the capacitor is 50% charged, the peak value of the displacement current is

- (A) 2.2 A
- (B) 11 A
- (C) 4.4 A
- (D) $11\sqrt{2}$ A

NEET 2016 Phase 2 · Q34

27. Two identical glass ($\mu_g = 3/2$) equiconvex lenses of focal length f each are kept in contact. The space between the two lenses is filled with water ($\mu_w = 4/3$). The focal length of the combination is

- (A) $f/3$
- (B) f
- (C) $4f/3$
- (D) $3f/4$

NEET 2016 Phase 2 · Q35

28. An air bubble in a glass slab with refractive index 1.5 (near normal incidence) is 5 cm deep when viewed from one surface and 3 cm deep when viewed from the opposite face. The thickness (in cm) of the slab is

- (A) 8
- (B) 10
- (C) 12
- (D) 16

NEET 2016 Phase 2 · Q36

29. The interference pattern is obtained with two coherent light sources of intensity ratio n . In the interference pattern, the ratio $(I_{\text{max}} - I_{\text{min}})/(I_{\text{max}} + I_{\text{min}})$ will be

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

NEET 2016 Phase 2 · Q37

30. A person can see clearly objects only when they lie between 50 cm and 400 cm from his eyes. In order to increase the maximum distance of distinct vision to infinity, the type and power of the correcting lens, the person has to use, will be

- (A) convex, +2.25 diopter
- (B) concave, -0.25 diopter
- (C) concave, -0.2 diopter
- (D) convex, +0.15 diopter

NEET 2016 Phase 2 · Q38

31. A linear aperture whose width is 0.02 cm is placed immediately in front of a lens of focal length 60 cm. The aperture is illuminated normally by a parallel beam of wavelength 5×10^{-5} cm. The distance of the first dark band of the diffraction pattern from the centre of the screen is

- (A) 0.10 cm
- (B) 0.25 cm
- (C) 0.20 cm
- (D) 0.15 cm

NEET 2016 Phase 2 · Q39

32. Electrons of mass m with de-Broglie wavelength λ fall on the target in an X-ray tube. The cutoff wavelength (λ_0) of the emitted X-ray is

- (A) $\lambda_0 = 2mc\lambda^2/h$
- (B) $\lambda_0 = 2h/(mc)$
- (C) $\lambda_0 = 2m^2c^2\lambda^3/h^2$
- (D) $\lambda_0 = \lambda$

NEET 2016 Phase 2 · Q40

33. Photons with energy 5 eV are incident on a cathode C in a photoelectric cell. The maximum energy of emitted photoelectrons is 2 eV. When photons of energy 6 eV are incident on C, no photoelectrons will reach the anode A, if the stopping potential of A relative to C is

- (A) +3 V
- (B) +4 V
- (C) -1 V
- (D) -3 V

NEET 2016 Phase 2 · Q41

34. If an electron in a hydrogen atom jumps from the 3rd orbit to the 2nd orbit, it emits a photon of wavelength λ . When it jumps from the 4th orbit to the 3rd orbit, the corresponding wavelength of the photon will be

- (A) $16\lambda/25$
- (B) $9\lambda/16$
- (C) $20\lambda/7$
- (D) $20\lambda/13$

NEET 2016 Phase 2 · Q42

35. The half-life of a radioactive substance is 30 minutes. The time (in minutes) taken between 40% decay and 85% decay of the same radioactive substance is

- (A) 15
- (B) 30
- (C) 45
- (D) 60

36. For CE transistor amplifier, the audio signal voltage across the collector resistance of $2\text{ k}\Omega$ is 4 V . If the current amplification factor of the transistor is 100 and the base resistance is $1\text{ k}\Omega$, then the input signal voltage is

- (A) 10 mV
- (B) 20 mV
- (C) 30 mV
- (D) 15 mV

Answer key and explanations

1. Answer: (A) $\sqrt{(hG)/c^{(3/2)}}$

Using $[h] = \text{ML}^2\text{T}^{-1}$, $[G] = \text{M}^{-1}\text{L}^3\text{T}^{-2}$, $[c] = \text{LT}^{-1}$: hG has dimensions L^5T^{-3} and c^3 has L^3T^{-3} , so $hG/c^3 = \text{L}^2$ and $\sqrt{(hG)/c^{(3/2)}} = \text{L}$ (the Planck length). With $c^{(5/2)}$ in the denominator the result would be T , not L .

2. Answer: (D) $(f - a)/(2(1 + b))$

Differentiating, $v_P = a + 2bt$ and $v_Q = f - 2t$. Setting them equal gives $2t(1 + b) = f - a$, so $t = (f - a)/(2(1 + b))$. Writing $a + f$ in the numerator comes from a sign slip when differentiating $-t^2$.

3. Answer: (C) 120 m s^{-1}

The block's speed just after impact is $\sqrt{2gh} = \sqrt{2 \times 10 \times 0.1} \approx 1.41\text{ m/s}$. Momentum conservation: $0.01 \times 400 = 0.01v + 2 \times 1.41$, so $0.01v = 4 - 2.83 = 1.17$ and $v \approx 117 \approx 120\text{ m/s}$. Energy is not conserved in the bullet-block collision, so equating kinetic energies is the trap.

4. Answer: (B) 0.5 m/s and -0.3 m/s

In a one-dimensional elastic collision between equal masses the velocities are exchanged, so B moves with 0.5 m/s and A with -0.3 m/s . The question asks for B first, so the order is 0.5 m/s and -0.3 m/s ; reversing the order is the common slip.

5. Answer: (C) 5 J

Displacement $d = (4\hat{j} + 3\hat{k}) - (-2\hat{i} + 5\hat{j}) = 2\hat{i} - \hat{j} + 3\hat{k}$. Work $W = \mathbf{F} \cdot \mathbf{d} = 4 \times 2 + 3 \times (-1) + 0 \times 3 = 8 - 3 = 5\text{ J}$. Forgetting the negative y-component gives 11 J .

6. Answer: (C) $L_B > L_A$

Rotational KE $= L^2/(2I)$, so $L = \sqrt{2IK}$. With equal K , the body with the larger moment of inertia has the larger angular momentum, so $L_B > L_A$. The masses alone do not fix an exact ratio such as 2, since only I enters.

7. Answer: (B) $1 : 5$

$E_{\text{sphere}} = \frac{1}{2}(2/5 mR^2)\omega^2 = mR^2\omega^2/5$ and $E_{\text{cylinder}} = \frac{1}{2}(\frac{1}{2}mR^2)(2\omega)^2 = mR^2\omega^2$. The ratio is $1 : 5$. Ignoring the doubled angular speed of the cylinder would give $4 : 5$.

8. Answer: (A) $(m_1m_2/(m_1 + m_2)) l^2$

The distances from the centre of mass are $r_1 = m_2l/(m_1 + m_2)$ and $r_2 = m_1l/(m_1 + m_2)$. Then $I = m_1r_1^2 + m_2r_2^2 = m_1m_2l^2/(m_1 + m_2)$, the reduced mass times l^2 . $(m_1 + m_2)l^2$ would be the value if both masses were at distance l .

9. Answer: (B) $-mg_0R^2/(2(R + h))$

Total energy of a circular orbit is $-GMm/(2r)$ with $r = R + h$. Using $GM = g_0R^2$ gives $E = -mg_0R^2/(2(R + h))$. The positive expression is the kinetic energy, not the total energy, which must be negative for a bound orbit.

10. Answer: (B) 0.125 N m^{-1}

Area increases from 8 cm^2 to 20 cm^2 , i.e. by $12 \times 10^{-4}\text{ m}^2$, and a film has two surfaces, so the total new surface is $24 \times 10^{-4}\text{ m}^2$. $T = W/\Delta A = 3 \times 10^{-4}/24 \times 10^{-4} = 0.125\text{ N/m}$. Forgetting the two surfaces gives 0.250 N/m .

11. Answer: (B) $0 \leq \theta_1 < \theta_2 < \theta_3 < \pi/2$

From $h = 2T \cos\theta/(r\rho g)$, equal h , T and r means $\cos\theta \propto \rho$. The densest liquid has the largest $\cos\theta$ and hence the smallest angle, so $\theta_1 < \theta_2 < \theta_3$; since the liquids rise, all angles are below $\pi/2$. Angles above $\pi/2$ would mean capillary depression.

12. Answer: (B) more than 50°C

The hot body has the larger heat capacity, so it gives out more heat per degree of cooling than the cold body absorbs per degree of warming. To balance heat lost and gained, the hot body cools through fewer degrees than the cold one warms, so the final temperature lies above 50°C . Exactly 50°C would need a constant heat capacity.

13. Answer: (B) $3T/2$

With the average form: $(3T - 2T)/10 = k(2.5T - T)$ gives $k = 1/15$ per minute; then $(2T - \theta)/10 = k((2T + \theta)/2 - T)$ gives $6T - 3\theta = \theta$, so $\theta = 3T/2$. The exponential form agrees: the excess over the room halves from $2T$ to T , so it becomes $T/2$ and $\theta = 1.5T$. Assuming equal fall per interval would wrongly give T .

14. Answer: (D) R

For a polytropic process $PV^n = \text{constant}$, $C = C_v + R/(1 - n)$. With $C_v = 3R/2$ and $n = 3$, $C = 3R/2 - R/2 = R$. $3R/2$ is just C_v , which applies only at constant volume.

15. Answer: (B) $(t_1 + 273)/(t_1 - t_2)$

For an ideal (Carnot) refrigerator, heat delivered to the hot reservoir per unit work is $Q_1/W = T_1/(T_1 - T_2)$, with $T_1 = t_1 + 273$ K and $T_1 - T_2 = t_1 - t_2$. The expression with $t_2 + 273$ in the numerator is the heat extracted from inside (coefficient of performance), not the heat delivered to the room.

16. Answer: (B) $Pm/(kT)$

$PV = NkT$ gives the number density $N/V = P/(kT)$. Multiplying by the mass of each molecule gives density $\rho = Pm/(kT)$. $P/(kT)$ alone is the number of molecules per unit volume, not mass per unit volume.

17. Answer: (D) $9/16$

$T \propto \sqrt{m}$, so $3/5 = \sqrt{(m/(m + 1))}$ and $9/25 = m/(m + 1)$. Then $9m + 9 = 25m$, giving $m = 9/16$ kg. Inverting the ratio leads to $16/9$ kg.

18. Answer: (B) $2L$

The first overtone of a closed pipe is $3v/(4L)$. The second overtone of an open pipe of length L' is the third harmonic $3v/(2L')$. Equating, $2L' = 4L$, so $L' = 2L$. Treating the second overtone as the second harmonic would give a different length.

19. Answer: (B) 2 mC

$\tau = pE \sin \theta = q(2a)E \sin \theta$, so $4 = q \times 0.02 \times 2 \times 10^5 \times 0.5 = 2000q$, giving $q = 2 \times 10^{-3} \text{ C} = 2 \text{ mC}$. Using $\sin 30^\circ$ as 1 by mistake gives 1 mC , and forgetting to convert cm to m gives a far smaller charge.

20. Answer: (C) 26Ω

Rated current $I = P/V = 500/100 = 5 \text{ A}$ and bulb resistance $= 100^2/500 = 20 \Omega$. To draw 5 A from 230 V the total resistance must be $230/5 = 46 \Omega$, so $R = 46 - 20 = 26 \Omega$. 46Ω is the total resistance, not the series resistor.

21. Answer: (B) n^2B

With the same wire, n turns means each turn has radius r/n . $B' = \mu_0 n I / (2(r/n)) = n^2 \times \mu_0 I / (2r) = n^2 B$. nB forgets that the radius also shrinks by a factor of n .

22. Answer: (B) $\sqrt{3}W$

Work to rotate from 0° to 60° is $W = MB(1 - \cos 60^\circ) = MB/2$, so $MB = 2W$. Torque at 60° is $MB \sin 60^\circ = 2W \times \sqrt{3}/2 = \sqrt{3}W$. Using $\sin 60^\circ$ with $MB = W$ gives $\sqrt{3}W/2$.

23. Answer: (A) 1 GHz

$f = (e/m)B/(2\pi) = (1.76 \times 10^{11} \times 3.57 \times 10^{-2})/(2\pi) = 6.28 \times 10^9/6.28 \approx 1 \times 10^9 \text{ Hz} = 1 \text{ GHz}$. 6.28×10^9 is the angular frequency ω , so dividing by 2π is essential; 100 MHz is off by a factor of 10.

24. Answer: (C) $R = 15 \Omega$, $L = 3.5 \text{ H}$, $C = 30 \mu\text{F}$

Better tuning means a sharper resonance, i.e. a larger quality factor $Q = (1/R)\sqrt{L/C}$. The values are about 10.4 for $20 \Omega/1.5 \text{ H}/35 \mu\text{F}$, 9.4 for $25 \Omega/2.5 \text{ H}/45 \mu\text{F}$, 22.8 for $15 \Omega/3.5 \text{ H}/30 \mu\text{F}$ and 7.3 for $25 \Omega/1.5 \text{ H}/45 \mu\text{F}$. The 15Ω , 3.5 H , $30 \mu\text{F}$ combination has the highest Q .

25. Answer: (C) 0.8

Net voltage $V = \sqrt{(V_R)^2 + (V_L - V_C)^2} = \sqrt{(80)^2 + (60)^2} = 100 \text{ V}$. Power factor $\cos \phi = V_R/V = 80/100 = 0.8$. Taking the ratio of V_C to V_L or assuming resonance gives the other values.

26. Answer: (A) 2.2 A

The displacement current between the plates equals the conduction current in the circuit. Impedance $Z = \sqrt{(100)^2 + (100)^2} = 100\sqrt{2} \Omega$, and the peak voltage of a 220 V (rms) supply is $220\sqrt{2} \text{ V}$, so the peak current is $220\sqrt{2}/(100\sqrt{2}) = 2.2 \text{ A}$. The '50% charged' detail does not change the peak value.

27. Answer: (D) $3f/4$

For each glass lens $1/f = (0.5)(2/R)$, so $R = f$. The water forms a concave lens with $1/f_w = (1/3)(-2/R) = -2/(3f)$. Combined: $1/F = 2/f - 2/(3f) = 4/(3f)$, so $F = 3f/4$. Ignoring the water lens gives $f/2$, and treating it as converging gives a shorter focal length.

28. Answer: (C) 12

Real depth = $\mu \times$ apparent depth, so the bubble is $1.5 \times 5 = 7.5$ cm from one face and $1.5 \times 3 = 4.5$ cm from the other. Thickness = $7.5 + 4.5 = 12$ cm. Just adding the apparent depths gives 8 cm.

29. Answer: (B) $2\sqrt{n/(n+1)}$

With $l_1 = nl_2$, $I_{\max} = (\sqrt{l_1} + \sqrt{l_2})^2$ and $I_{\min} = (\sqrt{l_1} - \sqrt{l_2})^2$. Their difference is $4\sqrt{l_1 l_2}$ and sum is $2(l_1 + l_2)$, so the ratio is $2\sqrt{l_1 l_2}/(l_1 + l_2) = 2\sqrt{n/(n+1)}$. Dropping the factor 2 gives $\sqrt{n/(n+1)}$.

30. Answer: (B) concave, -0.25 diopter

To see distant objects the lens must form the image of an object at infinity at the far point, 400 cm, so $f = -400$ cm = -4 m. Power $P = 1/f = -0.25$ D, a concave lens. A convex lens would correct the near point, not the far point.

31. Answer: (D) 0.15 cm

For single-slit diffraction the first minimum is at $\sin\theta = \lambda/a$, and on the focal plane $y = f\lambda/a = 60 \times 5 \times 10^{-5}/0.02 = 0.15$ cm. Using $2\lambda/a$ would give the width of the central maximum (0.30 cm), not the position of the first dark band.

32. Answer: (A) $\lambda_0 = 2mc\lambda^2/h$

The electron's kinetic energy is $K = p^2/(2m) = h^2/(2m\lambda^2)$. The shortest X-ray wavelength carries all of this energy: $hc/\lambda_0 = h^2/(2m\lambda^2)$, so $\lambda_0 = 2mc\lambda^2/h$. The cutoff wavelength is not equal to the electron's de Broglie wavelength.

33. Answer: (D) -3 V

Work function $\phi = 5 - 2 = 3$ eV. For 6 eV photons the maximum kinetic energy is $6 - 3 = 3$ eV, so the anode must be at least 3 V negative with respect to the cathode: -3 V. A positive potential would attract the electrons rather than stop them.

34. Answer: (C) $20\lambda/7$

$1/\lambda \propto (1/2^2 - 1/3^2) = 5/36$ and $1/\lambda' \propto (1/3^2 - 1/4^2) = 7/144$. So $\lambda'/\lambda = (5/36)/(7/144) = 20/7$, giving $\lambda' = 20\lambda/7$. The $4 \rightarrow 3$ photon has less energy, so its wavelength must be longer than λ , which rules out the fractions smaller than 1.

35. Answer: (D) 60

After 40% decay 60% remains; after 85% decay 15% remains. $60\% \rightarrow 15\%$ is a factor of $4 = 2^2$, i.e. two half-lives = $2 \times 30 = 60$ minutes. Subtracting the percentages (45%) and treating decay as linear is the trap.

36. Answer: (B) 20 mV

Collector current $i_c = 4$ V/2 k Ω = 2 mA, so base current $i_b = i_c/\beta = 20$ μ A. Input voltage = $i_b \times R_B = 20 \times 10^{-6} \times 1000 = 20$ mV. Equivalently voltage gain = $\beta R_C/R_B = 200$, and 4 V/200 = 20 mV.

Questions as set in the AIPMT/NEET papers conducted by CBSE and NTA. Answers checked and explanations written by the RankUp team. RankUp is not affiliated with CBSE or NTA.