

AIPMT 2006 Prelims — Physics Question Paper with Solutions

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

AIPMT 2006 Prelims · Q3

1. A rectangular block of mass m and area of cross-section A floats in a liquid of density ρ . If it is given a small vertical displacement from equilibrium it undergoes oscillation with a time period T . Then :

- (A) $T \propto \sqrt{\rho}$
- (B) $T \propto 1/\sqrt{A}$
- (C) $T \propto 1/\rho$
- (D) $T \propto 1/\sqrt{m}$

AIPMT 2006 Prelims · Q4

2. A Carnot engine whose sink is at 300 K has an efficiency of 40%. By how much should the temperature of source be increased so as to increase its efficiency by 50% of original efficiency ?

- (A) 275 K
- (B) 175 K
- (C) 250 K
- (D) 225 K

AIPMT 2006 Prelims · Q5

3. When a charged particle moving with velocity $\vec{v}$ is subjected to a magnetic field of induction $\vec{B}$, the force on it is non-zero. This implies that :

- (A) angle between $\vec{v}$ and $\vec{B}$ is necessarily 90°
- (B) angle between $\vec{v}$ and $\vec{B}$ can have any value other than 90°
- (C) angle between $\vec{v}$ and $\vec{B}$ can have any value other than zero and 180°
- (D) angle between $\vec{v}$ and $\vec{B}$ is either zero or 180°

AIPMT 2006 Prelims · Q6

4. Two cells, having the same emf, are connected in series through an external resistance R . Cells have internal resistances r_1 and r_2 ($r_1 > r_2$) respectively. When the circuit is closed, the potential difference across the first cell is zero. The value of R is :

- (A) $r_1 - r_2$
- (B) $(r_1 + r_2)/2$
- (C) $(r_1 - r_2)/2$
- (D) $r_1 + r_2$

AIPMT 2006 Prelims · Q7

5. A black body at 1227°C emits radiations with maximum intensity at a wavelength of $5000 \text{ \AA}$. If the temperature of the body is increased by 1000°C , the maximum intensity will be observed at :

- (A) $7500 \text{ \AA}$
- (B) $1500 \text{ \AA}$
- (C) $6000 \text{ \AA}$
- (D) $3000 \text{ \AA}$

AIPMT 2006 Prelims · Q9

6. A transistor-oscillator using a resonant circuit with an inductor L (of negligible resistance) and a capacitor C in series produce oscillations of frequency f . If L is doubled and C is changed to $4C$, the frequency will be :

- (A) $f/4$
- (B) $8f$
- (C) $f/(2\sqrt{2})$
- (D) $2f$

7. The binding energy of deuteron is 2.2 MeV and that of ${}^4_2\text{He}$ is 28 MeV. If two deuterons are fused to form one ${}^4_2\text{He}$ then the energy released is :

- (A) 21.6 MeV
- (B) 23.6 MeV
- (C) 17.2 MeV
- (D) 28.2 MeV

8. In a radioactive material the activity at time t_1 is R_1 and at a later time t_2 , it is R_2 . If the decay constant of the material is λ , then :

- (A) $R_1 = R_2 e^{(-\lambda(t_1 - t_2))}$
- (B) $R_1 = R_2 e^{(\lambda(t_1 - t_2))}$
- (C) $R_1 = R_2 e^{(t_2/t_1)}$
- (D) $R_1 = R_2$

9. Ionization potential of hydrogen atom is 13.6 eV. Hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.1 eV. According to Bohr's theory, the spectral lines emitted by hydrogen will be :

- (A) two
- (B) three
- (C) four
- (D) one

10. The potential energy of a long spring when stretched by 2 cm is U . If the spring is stretched by 8 cm the potential energy stored in it is :

- (A) $4U$
- (B) $U/8$
- (C) $16U$
- (D) $U/4$

11. For angles of projection of a projectile at angles $(45^\circ - \theta)$ and $(45^\circ + \theta)$, the horizontal ranges described by the projectile are in the ratio of :

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

12. A body of mass 3 kg is under a constant force which causes a displacement s in metres in it, given by the relation $s = (1/3)t^2$, where t is in s. Work done by the force in 2 s is :

- (A) $17/3$ J
- (B) $3/8$ J
- (C) $8/3$ J
- (D) $3/17$ J

13. The velocity v of a particle at time t is given by $v = at + b/(t + c)$, where a , b and c are constants. The dimensions of a , b and c are respectively :

- (A) $[LT^{-2}]$, $[L]$ and $[T]$
- (B) $[L]$, $[T]$ and $[LT^2]$
- (C) $[L^2T^2]$, $[LT]$ and $[L]$
- (D) $[L]$, $[LT]$ and $[T^2]$

AIPMT 2006 Prelims · Q18

14. A microscope is focussed on a mark on a piece of paper and then a slab of glass of thickness 3 cm and refractive index 1.5 is placed over the mark. How should the microscope be moved to get the mark in focus again ?

- (A) 1 cm upward
- (B) 0.5 cm downward
- (C) 1 cm downward
- (D) 0.5 cm upward

AIPMT 2006 Prelims · Q19

15. 300 J of work is done in sliding a 2 kg block up an inclined plane of height 10 m. Taking $g = 10 \text{ m/s}^2$, work done against friction is :

- (A) 50 J
- (B) 100 J
- (C) zero
- (D) 150 J

AIPMT 2006 Prelims · Q20

16. A transistor is operated in common emitter configuration at constant collector voltage $V_c = 1.5 \text{ V}$ such that a change in the base current from $100 \mu\text{A}$ to $150 \mu\text{A}$ produces a change in the collector current from 5 mA to 10 mA. The current gain (β) is :

- (A) 50
- (B) 75
- (C) 100
- (D) 125

AIPMT 2006 Prelims · Q22

17. A photo-cell employs photoelectric effect to convert :

- (A) change in the frequency of light into a change in electric voltage
- (B) change in the intensity of illumination into a change in photoelectric current
- (C) change in the intensity of illumination into a change in the work function of the photocathode
- (D) change in the frequency of light into a change in the electric current

AIPMT 2006 Prelims · Q23

18. The core of a transformer is laminated because :

- (A) energy losses due to eddy currents may be minimised
- (B) the weight of the transformer may be reduced
- (C) rusting of the core may be prevented
- (D) ratio of voltage in primary and secondary may be increased

AIPMT 2006 Prelims · Q24

19. Two coils of self-inductances 2 mH and 8 mH are placed so close together that the effective flux in one coil is completely linked with the other. The mutual inductance between these coils is :

- (A) 8 mH
- (B) 12 mH
- (C) 4 mH
- (D) 16 mH

AIPMT 2006 Prelims · Q25

20. In a discharge tube ionization of enclosed gas is produced due to collisions between :

- (A) positive ions and neutral atoms/molecules
- (B) negative electrons and neutral atoms/molecules
- (C) photons and neutral atoms/molecules
- (D) neutral gas atoms/molecules

21. When photons of energy $h\nu$ fall on an aluminium plate (of work function E_0), photoelectrons of maximum kinetic energy K are ejected. If the frequency of the radiation is doubled, the maximum kinetic energy of the ejected photoelectrons will be :

- (A) $K + E_0$
- (B) $2K$
- (C) K
- (D) $K + h\nu$

22. A coil of inductive reactance $31\ \Omega$ has a resistance of $8\ \Omega$. It is placed in series with a condenser of capacitive reactance $25\ \Omega$. The combination is connected to an a.c. source of 110 V . The power factor of the circuit is :

- (A) 0.40
- (B) 0.128
- (C) 0.80
- (D) 0.66

23. A 0.5 kg ball moving with a speed of 12 m/s strikes a hard wall at an angle of 30° with the wall. It is reflected with the same speed and at the same angle. If the ball is in contact with the wall for 0.25 s , the average force acting on the wall is :

- (A) 8 N
- (B) 24 N
- (C) 16 N
- (D) 96 N

24. The momentum of a photon of energy 1 MeV in kg m/s , will be :

- (A) 0.33×10^6
- (B) 8×10^{-24}
- (C) 5×10^{-23}
- (D) 5×10^{-22}

25. The radius of germanium (Ge) nuclide is measured to be twice the radius of ${}^9_4\text{Be}$. The number of nucleons in Ge are :

- (A) 73
- (B) 74
- (C) 76
- (D) 72

26. The molar specific heat at constant pressure of an ideal gas is $(7/2)R$. The ratio of specific heat at constant pressure to that at constant volume is :

- (A) $7/5$
- (B) $6/7$
- (C) $9/7$
- (D) $4/7$

27. The earth is assumed to be a sphere of radius R . A platform is arranged at a height R from the surface of the earth. The escape velocity of a body from this platform is fv_e , where v_e is its escape velocity from the surface of the earth. The value of f is :

- (A) 2
- (B) $1/\sqrt{2}$
- (C) $1/3$
- (D) 1

28. Two sound waves with wavelengths 5.0 m and 5.5 m respectively, each propagate in a gas with velocity 330 m/s. We expect the following number of beats per second :

- (A) 12
- (B) 0
- (C) 3
- (D) 6

29. Kirchhoff's first and second laws for electrical circuits are consequences of :

- (A) conservation of energy
- (B) conservation of electric charge and energy respectively
- (C) conservation of electric charge
- (D) conservation of energy and electric charge respectively

30. A transverse wave propagating along x-axis is represented by : $y(x, t) = 8.0 \sin (0.5\pi x - 4\pi t - \pi/4)$

where x is in metres and t is in seconds. The speed of the wave is :

- (A) 8π m/s
- (B) 0.5π m/s
- (C) $\pi/4$ m/s
- (D) 8 m/s

31. The time of reverberation of a room A is one second. What will be the time (in seconds) of reverberation of a room, having all the dimensions double of those of room A ?

- (A) 2
- (B) 4
- (C) $1/2$
- (D) 8

32. Which one of the following statements is true ?

- (A) Both light and sound waves in air are transverse
- (B) The sound waves in air are longitudinal while the light waves are transverse
- (C) Both light and sound waves in air are longitudinal
- (D) Both light and sound waves can travel in vacuum

33. Above Curie temperature :

- (A) a ferromagnetic substance becomes paramagnetic
- (B) a paramagnetic substance becomes diamagnetic
- (C) a diamagnetic substance becomes paramagnetic
- (D) a paramagnetic substance becomes ferromagnetic

34. A convex lens and a concave lens, each having same focal length of 25 cm, are put in contact to form a combination of lenses. The power in diopters of the combination is :

- (A) 25
- (B) 50
- (C) infinite
- (D) zero

35. An electric dipole of moment $\vec{p}$ is lying along a uniform electric field E . The work done in rotating the dipole by 90° is :

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

36. A parallel plate air capacitor is charged to a potential difference of V volts. After disconnecting the charging battery the distance between the plates of the capacitor is increased using an insulating handle. As a result the potential difference between the plates :

- (A) decreases
- (B) does not change
- (C) becomes zero
- (D) increases

37. A car runs at a constant speed on a circular track of radius 100 m, taking 62.8 s for every circular lap. The average velocity and average speed for each circular lap respectively is :

- (A) 0, 0
- (B) 0, 10 m/s
- (C) 10 m/s, 20 m/s
- (D) 20 m/s, 0

38. A tube of length L is filled completely with an incompressible liquid of mass M and closed at both the ends. The tube is then rotated in a horizontal plane about one of its ends with a uniform angular velocity ω . The force exerted by the liquid at the other end is :

- (A) $ML\omega^2/2$
- (B) $ML^2\omega/2$
- (C) $2ML\omega^2$
- (D) $ML^2\omega^2/2$

39. A uniform rod of length l and mass m is free to rotate in a vertical plane about A. The rod initially in horizontal position is released. The initial angular acceleration of the rod is : (Moment of inertia of rod about A is $ml^2/3$)

- (A) $3g/2l$
- (B) $2l/3g$
- (C) $3g/2l^2$
- (D) $mg(l/2)$

40. The vectors $\vec{A}$ and $\vec{B}$ are such that $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$. The angle between the two vectors is :

- (A) 90°
- (B) 60°
- (C) 30°
- (D) 0°

41. Two bodies, A (of mass 1 kg) and B (of mass 3 kg) are dropped from heights of 16 m and 25 m, respectively. The ratio of the time taken by them to reach the ground is :

- (A) 5/4
- (B) 8/5
- (C) 5/8
- (D) 4/5

Answer key and explanations

1. Answer: (B) $T \propto 1/\sqrt{A}$

When the block is pushed down by y , the extra buoyant force is $A\rho gy$, so it behaves like a spring of constant $k = A\rho g$. Hence $T = 2\pi\sqrt{m/(A\rho g)}$, which varies as $1/\sqrt{A}$ (and as $1/\sqrt{\rho}$, $1/\sqrt{m}$). T is not proportional to $\sqrt{\rho}$ or $1/\rho$, and it increases, not decreases, with m .

2. Answer: (C) 250 K

With the sink at 300 K, $0.4 = 1 - 300/T_1$ gives $T_1 = 500$ K. The new efficiency is $0.4 + 0.5 \times 0.4 = 0.6$, so $300/T_1' = 0.4$ and $T_1' = 750$ K. The source must be raised by $750 - 500 = 250$ K; reading '50% more' as an efficiency of 90% gives an impossible value.

3. Answer: (C) angle between $\vec{v}$ and $\vec{B}$ can have any value other than zero and 180°

The magnetic force is $F = qvB \sin \theta$, which vanishes only when $\theta = 0^\circ$ or 180° . So a non-zero force tells us only that θ is anything other than 0° and 180° . It need not be exactly 90° ; 90° simply gives the maximum force.

4. Answer: (A) $r_1 - r_2$

The current is $I = 2E/(R + r_1 + r_2)$. The p.d. across the first cell is $E - Ir_1 = 0$, so $I = E/r_1$. Equating: $2r_1 = R + r_1 + r_2$, giving $R = r_1 - r_2$. Setting the second cell's p.d. to zero would give $r_2 - r_1$, which is negative here.

5. Answer: (D) 3000 Å

By Wien's law $\lambda_m T$ is constant. $T_1 = 1227 + 273 = 1500$ K and $T_2 = 2500$ K, so $\lambda_2 = 5000 \times 1500/2500 = 3000$ Å. Using Celsius temperatures (1227 and 2227) would give a wrong ratio; the peak must shift to a shorter wavelength as the body gets hotter.

6. Answer: (C) $f/(2\sqrt{2})$

The resonant frequency is $f = 1/(2\pi\sqrt{LC})$. Replacing L by $2L$ and C by $4C$ multiplies LC by 8, so the frequency becomes $f/\sqrt{8} = f/(2\sqrt{2})$. The frequency decreases; it does not increase to $8f$.

7. Answer: (B) 23.6 MeV

Energy released = binding energy of products – binding energy of reactants = $28 - 2 \times 2.2 = 23.6$ MeV. Subtracting the binding energy of only one deuteron gives 25.8 MeV, and adding them gives 32.4 MeV, neither of which applies.

8. Answer: (A) $R_1 = R_2 e^{(-\lambda(t_1 - t_2))}$

Activity decays as $R = R_0 e^{(-\lambda t)}$, so $R_1 = R_0 e^{(-\lambda t_1)}$ and $R_2 = R_0 e^{(-\lambda t_2)}$. Dividing, $R_1 = R_2 e^{(-\lambda(t_1 - t_2))}$; since $t_1 < t_2$ the exponent is positive and $R_1 > R_2$, as expected for the earlier time. The form with $e^{(\lambda(t_1 - t_2))}$ would make the earlier activity smaller.

9. Answer: (B) three

After absorbing 12.1 eV the electron's energy is $-13.6 + 12.1 = -1.51$ eV, which is the $n = 3$ level ($-13.6/9$). From $n = 3$ the possible downward transitions are $3 \rightarrow 2$, $3 \rightarrow 1$ and $2 \rightarrow 1$, i.e. $n(n-1)/2 = 3$ lines. Counting only the direct jump to the ground state would give one line.

10. Answer: (C) 16U

Spring energy is $U = \frac{1}{2}kx^2$, so $U \propto x^2$. Increasing the stretch from 2 cm to 8 cm (4 times) multiplies the energy by $4^2 = 16$, giving 16U. Assuming $U \propto x$ would give only 4U.

11. Answer: (A) 1 : 1

The range is $R = u^2 \sin 2\theta/g$. For $(45^\circ - \theta)$, $\sin(90^\circ - 2\theta) = \cos 2\theta$; for $(45^\circ + \theta)$, $\sin(90^\circ + 2\theta) = \cos 2\theta$. The two ranges are therefore equal, a ratio of 1 : 1, for any θ .

12. Answer: (C) 8/3 J

From $s = t^2/3$, $v = ds/dt = 2t/3$ and $a = 2/3 \text{ m s}^{-2}$, so the force is $F = 3 \times 2/3 = 2 \text{ N}$. At $t = 2 \text{ s}$, $s = 4/3 \text{ m}$, so $W = 2 \times 4/3 = 8/3 \text{ J}$; this equals the gain in kinetic energy $\frac{1}{2} \times 3 \times (4/3)^2 = 8/3 \text{ J}$. The reciprocal $3/8 \text{ J}$ is a slip in the algebra.

13. Answer: (A) $[LT^{-2}]$, $[L]$ and $[T]$

Every term must have the dimensions of velocity $[LT^{-1}]$. From at , $a = [LT^{-2}]$. In $b/(t + c)$, c is added to time so $c = [T]$; then $b/[T] = [LT^{-1}]$ gives $b = [L]$. The other choices fail the rule that only like quantities can be added.

14. Answer: (A) 1 cm upward

A slab of thickness t and refractive index μ makes the mark appear raised by $t(1 - 1/\mu) = 3(1 - 1/1.5) = 1 \text{ cm}$. Since the image of the mark is now 1 cm higher, the microscope must be raised by 1 cm. Moving it down would take it further out of focus.

15. Answer: (B) 100 J

Work against gravity is $mgh = 2 \times 10 \times 10 = 200 \text{ J}$. The remaining $300 - 200 = 100 \text{ J}$ of the work done is spent against friction (assuming no gain in kinetic energy). Zero would be true only on a frictionless incline.

16. Answer: (C) 100

Current gain in CE mode is $\beta = \Delta I_C/\Delta I_B = (10 - 5) \text{ mA}/(150 - 100) \mu\text{A} = 5 \times 10^{-3}/50 \times 10^{-6} = 100$. Dividing the final values $(10 \text{ mA}/150 \mu\text{A} \approx 67)$ instead of the changes does not give β .

17. Answer: (B) change in the intensity of illumination into a change in photoelectric current

Above the threshold, the photoelectric current is proportional to the intensity of the incident light, so a photocell turns changes in illumination into changes in photocurrent. Frequency changes alter the kinetic energy of the electrons, not the current, and the work function is a fixed property of the cathode.

18. Answer: (A) energy losses due to eddy currents may be minimised

A solid iron core lets large eddy currents circulate, wasting energy as heat. Thin insulated laminations break up these current paths and minimise eddy-current loss. Lamination does not change the turns ratio, and its purpose is not to reduce weight or prevent rusting.

19. Answer: (C) 4 mH

With all the flux of one coil linking the other (coupling coefficient 1), $M = \sqrt{L_1 L_2} = \sqrt{(2 \times 8)} = 4 \text{ mH}$. Adding the inductances (10 mH) or taking the larger one (8 mH) is incorrect.

20. Answer: (B) negative electrons and neutral atoms/molecules

In a discharge tube the strong electric field accelerates the free electrons, which knock electrons off neutral gas atoms or molecules and ionise them. Positive ions are heavy and gain much less speed between collisions, so they are not the main cause of ionisation.

21. Answer: (D) $K + h\nu$

Einstein's equation gives $K = h\nu - E_0$. At frequency 2ν , $K' = 2h\nu - E_0 = (h\nu - E_0) + h\nu = K + h\nu$. The kinetic energy does not simply double, because the work function is subtracted only once.

22. Answer: (C) 0.80

The net reactance is $X_L - X_C = 31 - 25 = 6 \Omega$, so $Z = \sqrt{(8^2 + 6^2)} = 10 \Omega$. The power factor is $\cos \phi = R/Z = 8/10 = 0.80$. Using $X_L + X_C$ would give a much smaller value; the supply voltage is not needed.

23. Answer: (B) 24 N

The ball meets the wall at 30° to the wall, so its velocity component normal to the wall is $12 \sin 30^\circ = 6 \text{ m/s}$; this component reverses while the parallel component is unchanged. $\Delta p = 2 \times 0.5 \times 6 = 6 \text{ kg m/s}$ and $F = 6/0.25 = 24 \text{ N}$. Using $\cos 30^\circ$ (treating the angle as measured from the normal) gives about 41.6 N, which is not offered.

24. Answer: (D) 5×10^{-22}

$E = 1 \text{ MeV} = 1.6 \times 10^{-13} \text{ J}$ and $p = E/c = 1.6 \times 10^{-13}/(3 \times 10^8) \approx 5.3 \times 10^{-22} \text{ kg m/s}$. Skipping the MeV-to-joule conversion gives a meaningless number, and 5×10^{-23} is off by a factor of ten.

25. Answer: (D) 72

Nuclear radius $R = R_0 A^{1/3}$, so doubling R needs A to increase by $2^3 = 8$. The Ge nucleus therefore has $8 \times 9 = 72$ nucleons. The other numbers are other germanium isotopes, not the one fixed by this radius.

26. Answer: (A) 7/5

For an ideal gas $C_v = C_p - R = (7/2)R - R = (5/2)R$. Hence $\gamma = C_p/C_v = (7/2)/(5/2) = 7/5$, as for a diatomic gas. A ratio below 1 is impossible because C_p is always larger than C_v .

27. Answer: (B) $1/\sqrt{2}$

Escape velocity from a point at distance r from the centre is $\sqrt{2GM/r}$. The platform is at $r = R + R = 2R$, so the escape velocity is $v_e/\sqrt{2}$ and $f = 1/\sqrt{2}$. Escape becomes easier, not harder, so f cannot exceed 1.

28. Answer: (D) 6

The frequencies are $330/5.0 = 66$ Hz and $330/5.5 = 60$ Hz. The beat frequency is the difference, $66 - 60 = 6$ per second. Adding or halving these does not give the beat count.

29. Answer: (B) conservation of electric charge and energy respectively

Kirchhoff's junction law (sum of currents at a node is zero) expresses conservation of charge. The loop law (sum of potential changes round a loop is zero) expresses conservation of energy. The reverse pairing swaps the two laws.

30. Answer: (D) 8 m/s

Comparing with $y = A \sin(kx - \omega t + \phi)$, $k = 0.5\pi$ rad/m and $\omega = 4\pi$ rad/s. The wave speed is $v = \omega/k = 4\pi/0.5\pi = 8$ m/s. The value 8π m/s comes from mixing the amplitude with ω and is wrong.

31. Answer: (A) 2

Sabine's formula gives reverberation time $T \propto V/(aS)$, volume over absorbing surface area. Doubling every dimension makes V eight times and S four times, so T doubles to 2 s. Scaling with volume alone would wrongly give 8 s.

32. Answer: (B) The sound waves in air are longitudinal while the light waves are transverse

Sound in air travels as compressions and rarefactions, so it is longitudinal; light is an electromagnetic wave with transverse fields. Light can travel through vacuum but sound needs a material medium, so the statement that both travel in vacuum is false.

33. Answer: (A) a ferromagnetic substance becomes paramagnetic

Above its Curie temperature a ferromagnet loses its domain alignment because thermal agitation wins, and it behaves as a paramagnet. Curie temperature is a property of ferromagnets; paramagnets do not turn ferromagnetic or diamagnetic on heating.

34. Answer: (D) zero

The powers are $+1/0.25 = +4$ D for the convex lens and -4 D for the concave lens. In contact the total power is $4 - 4 = 0$, so the combination acts like a plane glass plate. Zero power means infinite focal length, not infinite power.

35. Answer: (D) pE

Work done in rotating a dipole in a uniform field is $W = pE(\cos \theta_1 - \cos \theta_2)$. From $\theta = 0^\circ$ to 90° , $W = pE(1 - 0) = pE$. The value $2pE$ applies to rotating it through 180° .

36. Answer: (D) increases

With the battery disconnected, the charge Q stays constant. Increasing the plate separation lowers $C = \epsilon_0 A/d$, so $V = Q/C$ increases. The p.d. would stay constant only if the battery remained connected.

37. Answer: (B) 0, 10 m/s

After a complete lap the car is back at its start, so displacement and hence average velocity are zero. Average speed = distance/time = $2\pi \times 100/62.8 = 10$ m/s. Average speed cannot be zero for a moving car.

38. Answer: (A) $ML\omega^2/2$

The liquid moves in circles about the axis and its centre of mass is at $L/2$, so the net centripetal force needed is $M\omega^2(L/2)$. This force is provided by the closed far end of the tube, so the liquid presses on it with $ML\omega^2/2$. Expressions with L^2 have the wrong dimensions for a force.

39. Answer: (A) $3g/2l$

The weight acts at the centre, $l/2$ from A, giving torque $\tau = mgl/2$. With $I = ml^2/3$, $\alpha = \tau/I = (mgl/2)/(ml^2/3) = 3g/(2l)$. The expression $mg(l/2)$ is the torque itself, not the angular acceleration.

40. Answer: (A) 90°

Squaring both sides, $A^2 + B^2 + 2A \cdot B = A^2 + B^2 - 2A \cdot B$, so $A \cdot B = 0$. The vectors are therefore perpendicular, at 90° . At 0° the sum would be larger than the difference.

41. Answer: (D) $4/5$

In free fall from rest, $h = \frac{1}{2}gt^2$, so $t = \sqrt{2h/g}$ and does not depend on mass. $t_A/t_B = \sqrt{16/25} = 4/5$. Inverting the ratio or including the masses gives the wrong options.

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