KIITEE Physics Sample Paper – 1

Duration: 50 Minutes **Maximum Marks: 160**

Instructions

- This paper contains **40** Multiple Choice Questions (Single Correct Answer), modelled on the Physics portion of **KIITEE** entrance.
- Each correct answer carries **+4 marks**. There is -1 **mark per wrong answer**; unattempted questions score **0**.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11 & 12 (10+2) Physics — Mechanics, Heat & Thermodynamics, Electrodynamics, Optics and Modern Physics.**
- The test is computer based. Personal calculators, log tables, mobile phones, and other electronic gadgets are strictly prohibited.

Q1. The coefficient of viscosity η appears in the relation $F = \eta A \frac{dv}{dx}$. The dimensional formula of η is:

(A) $[\mathrm{M\,L^{-1}\,T^{-1}}]$

(B) $[\mathrm{M\,L\,T^{-2}}]$

(C) $[\mathrm{M\,L^{-1}\,T^{-2}}]$

(D) $[\mathrm{M\,L^{0}\,T^{-1}}]$

Q2. A projectile is launched with speed $30\ \mathrm{m\,s^{-1}}$ at 45° to the horizontal. Taking $g = 10\ \mathrm{m\,s^{-2}}$, its horizontal range is:

(A) $45\ \mathrm{m}$

(B) $60\ \mathrm{m}$

(C) $90\ \mathrm{m}$

(D) $120\ \mathrm{m}$

Q3. A car starts from rest and moves with a uniform acceleration of $4\ \mathrm{m\,s^{-2}}$. The distance it covers in the first $3\ \mathrm{s}$ is:

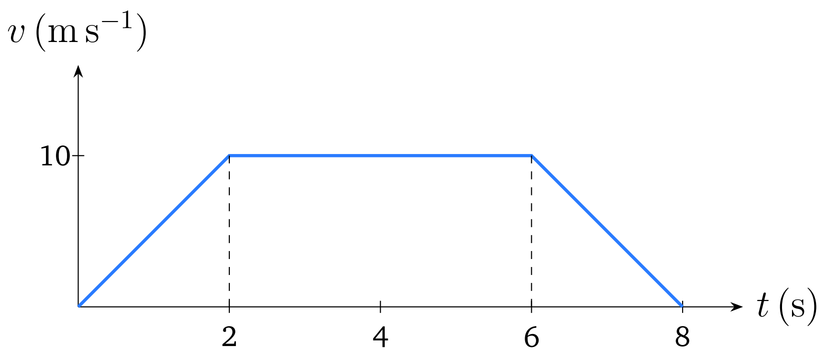
(A) $12\ \mathrm{m}$

(B) $18\ \mathrm{m}$

(C) $24\ \mathrm{m}$

(D) $36\ \mathrm{m}$

Q4. The velocity–time graph of a particle moving in a straight line is shown. The total displacement of the particle in $8\ \mathrm{s}$ is:



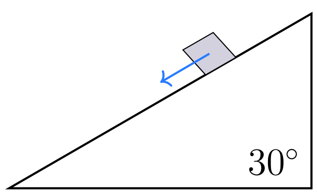
(A) $30\ \mathrm{m}$

(B) $40\ \mathrm{m}$

(C) $50\ \mathrm{m}$

(D) $60\ \mathrm{m}$

Q5. A block slides down a smooth (frictionless) inclined plane of inclination 30°. Taking $g = 10\ \mathrm{m\,s^{-2}}$, the acceleration of the block down the incline is:



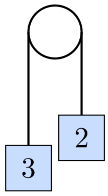
(A) $2.5\ \mathrm{m\,s^{-2}}$

(B) $5\ \mathrm{m\,s^{-2}}$

(C) $7.5\ \mathrm{m\,s^{-2}}$

(D) $10\ \mathrm{m\,s^{-2}}$

Q6. Two blocks of masses $3\ \mathrm{kg}$ and $2\ \mathrm{kg}$ hang from a light inextensible string over a frictionless pulley as shown. With $g = 10\ \mathrm{m\,s^{-2}}$, the acceleration of the system is:



(A) $2\ \mathrm{m\,s^{-2}}$

(B) $4\ \mathrm{m\,s^{-2}}$

(C) $5\ \mathrm{m\,s^{-2}}$

(D) $10\ \mathrm{m\,s^{-2}}$

Q7. A block of mass $10\ \mathrm{kg}$ rests on a rough horizontal floor with coefficient of static friction $\mu = 0.4$. The minimum horizontal force needed to just start the block moving is ($g = 10\ \mathrm{m\,s^{-2}}$):

(A) 10 N

(B) 20 N

(C) 25 N

(D) 40 N

Q8. A spring of force constant $200\ \mathrm{N\,m^{-1}}$ is compressed by $0.10\ \mathrm{m}$. The elastic potential energy stored in the spring is:

(A) 0.25 J

(B) 0.5 J

(C) 1 J

(D) 2 J

Q9. A pump lifts $2\ \mathrm{kg}$ of water per second to a height of $10\ \mathrm{m}$. The minimum power of the pump is ($g = 10\ \mathrm{m\,s^{-2}}$):

(A) $200\ \mathrm{W}$

(B) $400\ \mathrm{W}$

(C) $100\ \mathrm{W}$

(D) $2000\ \mathrm{W}$

Q10. Two point masses of $2\ \mathrm{kg}$ each are fixed at the two ends of a light rod of length $2\ \mathrm{m}$. The moment of inertia of the system about an axis through the centre of the rod and perpendicular to it is:

(A) $2\ \mathrm{kg\,m^2}$

(B) $4\ \mathrm{kg\,m^2}$

(C) $8\ \mathrm{kg\,m^2}$

(D) $16\ \mathrm{kg\,m^2}$

Q11. A uniform disc of mass $2\ \mathrm{kg}$ and radius $0.5\ \mathrm{m}$ is free to rotate about its central axis. A torque of $1\ \mathrm{N\,m}$ is applied. The angular acceleration produced is:

(A) $1\ \mathrm{rad\,s^{-2}}$

(B) $2\ \mathrm{rad\,s^{-2}}$

(C) $3\ \mathrm{rad\,s^{-2}}$

(D) $4\ \mathrm{rad\,s^{-2}}$

Q12. A spinning skater pulls in her arms so that her moment of inertia becomes half its initial value. If no external torque acts, the ratio of her final rotational kinetic energy to the initial value is:

(A) $\frac{1}{2}$

(B) 1

(C) 2

(D) 4

Q13. The orbital speed of a satellite revolving in a circular orbit very close to the Earth's surface is (take $g = 10\ \text{m s}^{-2}$, $R = 6.4 \times 10^6\ \text{m}$):

(A) $8\ \text{km s}^{-1}$

(B) $11.2\ \text{km s}^{-1}$

(C) $5\ \text{km s}^{-1}$

(D) $16\ \text{km s}^{-1}$

Q14. The acceleration due to gravity at a depth equal to half the Earth's radius (assuming uniform density), where the surface value is $g = 10\ \text{m s}^{-2}$, is:

(A) $2.5\ \text{m s}^{-2}$

(B) $5\ \text{m s}^{-2}$

(C) $7.5\ \text{m s}^{-2}$

(D) $10\ \text{m s}^{-2}$

Q15. A steel wire of length $2\ \text{m}$ and cross-sectional area $1\ \text{mm}^2$ carries a load that produces a tension of $100\ \text{N}$. If Young's modulus $Y = 2 \times 10^{11}\ \text{N m}^{-2}$, the elongation of the wire is:

(A) $0.25\ \text{mm}$

(B) $0.5\ \text{mm}$

(C) $1\ \text{mm}$

(D) $2\ \text{mm}$

Q16. Water flows steadily through a horizontal pipe whose cross-sectional area at one point is twice that at a narrower point. If the speed in the wider part is $2\ \text{m s}^{-1}$, the speed in the narrower part is:

(A) $1\ \text{m s}^{-1}$

(B) $2\ \text{m s}^{-1}$

(C) $3\ \mathrm{m\,s^{-1}}$

(D) $4\ \mathrm{m\,s^{-1}}$

Q17. A block of mass 2 kg attached to a spring of force constant $8\ \mathrm{N\,m^{-1}}$ executes simple harmonic motion on a frictionless surface. The time period of oscillation is:

(A) $\frac{\pi}{2}$ s

(B) π s

(C) 2π s

(D) 4π s

Q18. A particle executes SHM of amplitude A. At the instant its displacement is $A/2$, the fraction of the total energy that is kinetic is:

(A) $\frac{3}{4}$

(B) $\frac{1}{4}$

(C) $\frac{1}{2}$

(D) 1

Q19. A source emitting sound of frequency 600 Hz moves towards a stationary observer at $30\ \mathrm{m\,s^{-1}}$. If the speed of sound is $330\ \mathrm{m\,s^{-1}}$, the frequency heard by the observer is:

(A) 600 Hz

(B) 630 Hz

(C) 660 Hz

(D) 550 Hz

Q20. A stretched string of length 0.5 m supports transverse waves of speed $200\ \mathrm{m\,s^{-1}}$. The fundamental frequency of vibration of the string is:

(A) 100 Hz

(B) 50 Hz

(C) 400 Hz

(D) 200 Hz

Q21. One mole of an ideal gas expands isothermally and reversibly at 300 K to twice its initial volume. The work done by the gas is ($R = 8.314\ \mathrm{J\,mol^{-1}K^{-1}}$, $\ln 2 = 0.693$):

(A) 1.73 kJ

(B) 2.40 kJ

(C) 0.69 kJ

(D) 3.00 kJ

Q22. A Carnot engine operates between a source at 400 K and a sink at 300 K. Its efficiency is:

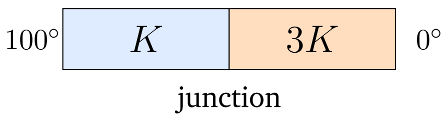
(A) 20%

(B) 25%

(C) 30%

(D) 75%

Q23. Two rods of identical length and cross-section but thermal conductivities K and $3K$ are joined end to end. The free ends are kept at $100°$C and $0°$C as shown. In the steady state, the temperature of the junction is:



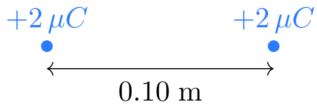
(A) $50°$C

(B) $75°$C

(C) $40°$C

(D) $25°$C

Q24. Two point charges of $+2\ \mu\text{C}$ each are placed $0.10\ \text{m}$ apart in vacuum as shown. The magnitude of the electrostatic force between them is ($\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\ \text{N m}^2\ \text{C}^{-2}$):



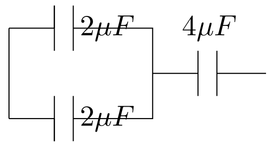
(A) $1.8\ \text{N}$

(B) $0.9\ \text{N}$

(C) $3.6\ \text{N}$

(D) $7.2\ \text{N}$

Q25. In the network shown, two capacitors of $2\ \mu\text{F}$ each are connected in parallel, and this combination is in series with a $4\ \mu\text{F}$ capacitor. The equivalent capacitance between the terminals is:



(A) $2\ \mu\text{F}$

(B) $4\ \mu\text{F}$

(C) $8\ \mu\text{F}$

(D) $1\ \mu\text{F}$

Q26. The electrostatic potential energy of a system of two point charges $+3\ \mu\text{C}$ and $-2\ \mu\text{C}$ separated by $0.06\ \text{m}$ in vacuum is ($\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\ \text{N m}^2\ \text{C}^{-2}$):

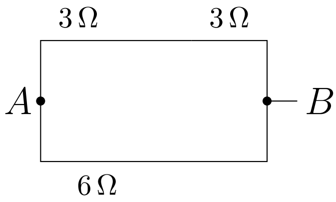
(A) $-1.8\ \text{J}$

(B) $-0.9\ \text{J}$

(C) $+0.9\ \text{J}$

(D) $-0.45\ \text{J}$

Q27. In the circuit shown, two $3\ \Omega$ resistors are connected in series, and this combination is in parallel with a $6\ \Omega$ resistor. The equivalent resistance between A and B is:



(A) $1.5\ \Omega$

(B) $6\ \Omega$

(C) $3\ \Omega$

(D) $12\ \Omega$

Q28. A wire of resistance $2\ \Omega$ is stretched uniformly until its length is doubled, its volume remaining constant. The new resistance of the wire is:

(A) $2\ \Omega$

(B) $4\ \Omega$

(C) $1\ \Omega$

(D) $8\ \Omega$

Q29. A cell of emf $12\ \mathrm{V}$ and internal resistance $1\ \Omega$ is connected to an external resistance of $5\ \Omega$. The current drawn from the cell is:

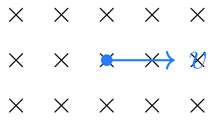
(A) $1\ \mathrm{A}$

(B) $2\ \mathrm{A}$

(C) $2.4\ \mathrm{A}$

(D) $12\ \mathrm{A}$

Q30. A charge of $2\ \mathrm{C}$ moves with speed $3\ \mathrm{m\,s^{-1}}$ perpendicular to a uniform magnetic field of $4\ \mathrm{T}$ (directed into the page) as shown. The magnitude of the magnetic force on the charge is:



(A) 24 N

(B) 12 N

(C) 6 N

(D) 48 N

Q31. A long straight wire carries a current of 10 A. The magnitude of the magnetic field at a perpendicular distance of 2 cm from the wire is ($\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}):

(A) 25 μT

(B) 50 μT

(C) 200 μT

(D) 100 μT

Q32. A coil of 100 turns and area 0.01 m^2 is placed in a magnetic field that increases uniformly from 0 to 0.5 T in 0.1 s, with its plane perpendicular to the field. The magnitude of the induced emf is:

(A) 1 V

(B) 2.5 V

(C) 5 V

(D) 50 V

Q33. A series LCR circuit has $L = 2$ H and $C = 8$ μF. The resonant angular frequency of the circuit is:

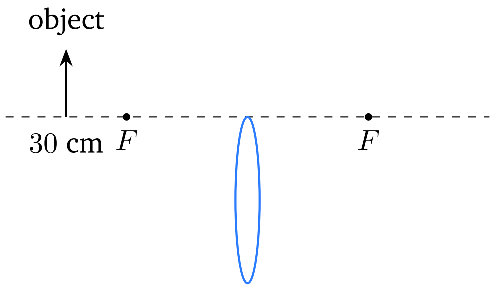
(A) 125 rad s^{-1}

(B) 250 rad s^{-1}

(C) 500 rad s^{-1}

(D) 50 rad s^{-1}

Q34. An object is placed 30 cm in front of a thin convex lens of focal length 20 cm, as shown. The image is formed at a distance of:



(A) 60 cm

(B) 30 cm

(C) 12 cm

(D) 20 cm

Q35. The refractive index of a transparent medium with respect to air is 2. The critical angle for total internal reflection at the medium–air interface is:

(A) 60°

(B) 45°

(C) 15°

(D) 30°

Q36. In a Young's double-slit experiment, light of wavelength 600 nm illuminates two slits 1 mm apart. On a screen 1 m away, the fringe width is:

(A) 0.2 mm

(B) 0.4 mm

(C) 0.6 mm

(D) 1.2 mm

Q37. Among the following electromagnetic radiations, the one with the highest frequency is:

(A) Gamma rays

(B) Radio waves

(C) Microwaves

(D) Visible light

Q38. Light of photon energy $5\ \mathrm{eV}$ falls on a metal of work function $2\ \mathrm{eV}$. The maximum kinetic energy of the emitted photoelectrons is:

(A) $2\ \mathrm{eV}$

(B) $3\ \mathrm{eV}$

(C) $5\ \mathrm{eV}$

(D) $7\ \mathrm{eV}$

Q39. A radioactive sample of initial mass $80\ \mathrm{g}$ has a half-life of $5\ \mathrm{years}$. The mass of the sample remaining undecayed after $15\ \mathrm{years}$ is:

(A) $40\ \mathrm{g}$

(B) $20\ \mathrm{g}$

(C) $5\ \mathrm{g}$

(D) $10\ \mathrm{g}$

Q40. A digital logic gate gives an output of 1 only when *both* of its inputs are 1; otherwise the output is 0. This gate is a(n):

(A) OR gate

(B) NOT gate

(C) AND gate

(D) NOR gate

Detailed Solutions

Q1.

Solution

Concept — Dimensional analysis: The dimensions of a derived quantity are found by isolating it in its defining equation and substituting the dimensions of each known quantity.

Step 1 — Rearrange the defining relation: From $F = \eta A \dfrac{dv}{dx}$, we get $\eta = \dfrac{F}{A\,(dv/dx)}$.

Step 2 — Write the dimensions of each factor: Force $F = [\mathrm{M\,L\,T^{-2}}]$. Area $A = [\mathrm{L^2}]$. Velocity gradient $\dfrac{dv}{dx} = \dfrac{[\mathrm{L\,T^{-1}}]}{[\mathrm{L}]} = [\mathrm{T^{-1}}]$.

Step 3 — Combine:

$$\eta = \frac{[\mathrm{M\,L\,T^{-2}}]}{[\mathrm{L^2}]\,[\mathrm{T^{-1}}]} = [\mathrm{M\,L^{1-2}\,T^{-2+1}}] = [\mathrm{M\,L^{-1}\,T^{-1}}].$$

Why other options are wrong:

- Option B $[\mathrm{MLT^{-2}}]$ is the dimension of force, not viscosity.
- Option C $[\mathrm{ML^{-1}T^{-2}}]$ is the dimension of pressure or stress.
- Option D omits the correct length power.

Final Answer: The coefficient of viscosity has dimensions $[\mathrm{M\,L^{-1}\,T^{-1}}] \Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept — Projectile range: For a projectile launched on level ground, the horizontal range is $R = \dfrac{u^2 \sin 2\theta}{g}$.

Step 1 — List the data: $u = 30\ \mathrm{m\,s^{-1}}$, $\theta = 45^\circ$, $g = 10\ \mathrm{m\,s^{-2}}$.

Step 2 — Evaluate $\sin 2\theta$: $2\theta = 90^\circ$, so $\sin 90^\circ = 1$.

Step 3 — Substitute into the range formula:

$$R = \frac{(30)^2 \times 1}{10} = \frac{900}{10} = 90\ \mathrm{m}.$$

Why other options are wrong:

- Options A and B use an incorrect value of $\sin 2\theta$ or wrong u.
- Option D $(120\ \text{m})$ corresponds to a larger launch speed.

Final Answer: The range is $90\ \text{m} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Uniformly accelerated motion: Starting from rest, the distance covered in time t is $s = \frac{1}{2}at^2$.

Step 1 — List the data: $u = 0$, $a = 4\ \text{m}\,\text{s}^{-2}$, $t = 3\ \text{s}$.

Step 2 — Substitute into $s = ut + \frac{1}{2}at^2$:

$$s = 0 + \tfrac{1}{2} \times 4 \times (3)^2.$$

Step 3 — Simplify:

$$s = \tfrac{1}{2} \times 4 \times 9 = 2 \times 9 = 18\ \text{m}.$$

Why other options are wrong:

- Option A uses $t = 2.45\ \text{s}$ or a wrong factor.
- Option C $(24\ \text{m})$ forgets the factor $\frac{1}{2}$ on part of the term.
- Option D $(36\ \text{m})$ drops the factor $\frac{1}{2}$ entirely.

Final Answer: The distance covered is $18\ \text{m} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q3

Q4.

Solution

Concept — Displacement from a v–t graph: The displacement equals the area enclosed between the velocity–time graph and the time axis.

Step 1 — Break the area into simple shapes: The graph rises from 0 to $10\ \text{m}\,\text{s}^{-1}$ over 0 to $2\ \text{s}$, stays constant until $6\ \text{s}$, then falls to 0 at $8\ \text{s}$.

Step 2 — Area of the first triangle (0 to 2 s):

$$A_1 = \tfrac{1}{2} \times 2 \times 10 = 10 \text{ m}.$$

Step 3 — Area of the rectangle (2 to 6 s):

$$A_2 = 4 \times 10 = 40 \text{ m}.$$

Step 4 — Area of the last triangle (6 to 8 s):

$$A_3 = \tfrac{1}{2} \times 2 \times 10 = 10 \text{ m}.$$

Step 5 — Add the areas:

$$s = A_1 + A_2 + A_3 = 10 + 40 + 10 = 60 \text{ m}.$$

Why other options are wrong:

- Option B (40 m) counts only the rectangle.
- Option C (50 m) omits one triangle.

Final Answer: The displacement is 60 m $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Motion on a smooth incline: On a frictionless incline of angle θ, the only force along the surface is the component of gravity, giving acceleration $a = g\sin\theta$.

Step 1 — List the data: $\theta = 30^\circ$, $g = 10\ \text{m s}^{-2}$.

Step 2 — Apply $a = g\sin\theta$:

$$a = 10 \times \sin 30^\circ.$$

Step 3 — Evaluate:

$$a = 10 \times \tfrac{1}{2} = 5\ \text{m s}^{-2}.$$

Why other options are wrong:

- Option A uses $\sin 30^\circ$ halved again.
- Option C uses $\cos 30^\circ$ incorrectly.
- Option D is the full value of g, ignoring the incline.

Final Answer: The acceleration is $5\ \mathrm{m\,s^{-2}} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q5

Q6.

Solution

Concept — Atwood machine: For two masses over a frictionless pulley, the acceleration is $a = \dfrac{(m_1 - m_2)g}{m_1 + m_2}$.

Step 1 — List the data: $m_1 = 3$ kg, $m_2 = 2$ kg, $g = 10\ \mathrm{m\,s^{-2}}$.

Step 2 — Substitute into the formula:

$$a = \frac{(3-2)\times 10}{3+2}.$$

Step 3 — Simplify:

$$a = \frac{1\times 10}{5} = \frac{10}{5} = 2\ \mathrm{m\,s^{-2}}.$$

Why other options are wrong:

- Option B uses the wrong mass difference.
- Option C divides by the difference instead of the sum.
- Option D ignores the lighter mass.

Final Answer: The acceleration is $2\ \mathrm{m\,s^{-2}} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept — Limiting static friction: A block on a horizontal surface begins to move when the applied force just exceeds the limiting friction $f = \mu mg$.

Step 1 — List the data: $m = 10$ kg, $\mu = 0.4$, $g = 10\ \mathrm{m\,s^{-2}}$.

Step 2 — Compute the normal reaction: On a horizontal floor, $N = mg = 10 \times 10 = 100$ N.

Step 3 — Compute the limiting friction:

$$f = \mu N = 0.4 \times 100 = 40 \text{ N}.$$

Why other options are wrong:

- Options A and B use a smaller μ or mass.
- Option C corresponds to $\mu = 0.25$.

Final Answer: The minimum force is $40 \text{ N} \Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q7**

Q8.

Solution

Concept — Elastic potential energy of a spring: A spring of force constant k compressed (or stretched) by x stores energy $U = \frac{1}{2}kx^2$.

Step 1 — List the data: $k = 200 \text{ N m}^{-1}$, $x = 0.10 \text{ m}$.

Step 2 — Square the compression: $x^2 = (0.10)^2 = 0.01 \text{ m}^2$.

Step 3 — Substitute:

$$U = \frac{1}{2} \times 200 \times 0.01 = 100 \times 0.01 = 1 \text{ J}.$$

Why other options are wrong:

- Option A uses $x = 0.05$ m.
- Option B forgets to square x correctly.
- Option D drops the factor $\frac{1}{2}$.

Final Answer: The stored energy is $1 \text{ J} \Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q8**

Q9.

Solution

Concept — Power against gravity: The power needed to lift mass at a steady rate is $P = \frac{mgh}{t}$, i.e. (mass lifted per second) $\times g \times h$.

Step 1 — List the data: mass rate $= 2\ \mathrm{kg\,s^{-1}}$, $h = 10$ m, $g = 10\ \mathrm{m\,s^{-2}}$.

Step 2 — Substitute:

$$P = 2 \times 10 \times 10.$$

Step 3 — Simplify:

$$P = 200\ \mathrm{W}.$$

Why other options are wrong:

- Option B doubles the height or rate.
- Option C halves the mass rate.
- Option D multiplies by 10 too many.

Final Answer: The power is 200 W $\Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Moment of inertia of point masses: For point masses, $I = \sum m_i r_i^2$, where r_i is the distance of each mass from the axis.

Step 1 — Find each distance: The axis passes through the centre, so each 2 kg mass is at $r = \frac{2}{2} = 1$ m.

Step 2 — Apply the formula for both masses:

$$I = mr^2 + mr^2 = 2(1)^2 + 2(1)^2.$$

Step 3 — Simplify:

$$I = 2 + 2 = 4\ \mathrm{kg\,m^2}.$$

Why other options are wrong:

- Option A counts only one mass.
- Option C uses $r = 2$ m (full length) instead of 1 m.

- Option D uses both errors together.

Final Answer: The moment of inertia is $4\ \mathrm{kg\,m^2} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Rotational dynamics: The angular acceleration is $\alpha = \dfrac{\tau}{I}$, where I for a uniform disc about its centre is $\frac{1}{2}MR^2$.

Step 1 — Compute the moment of inertia:

$$I = \tfrac{1}{2}MR^2 = \tfrac{1}{2} \times 2 \times (0.5)^2 = 1 \times 0.25 = 0.25\ \mathrm{kg\,m^2}.$$

Step 2 — Apply $\alpha = \tau/I$:

$$\alpha = \frac{1}{0.25}.$$

Step 3 — Simplify:

$$\alpha = 4\ \mathrm{rad\,s^{-2}}.$$

Why other options are wrong:

- Options A, B, C arise from using $I = MR^2$ or $2MR^2$ instead of $\frac{1}{2}MR^2$.

Final Answer: The angular acceleration is $4\ \mathrm{rad\,s^{-2}} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept — Conservation of angular momentum: With no external torque, $L = I\omega$ is constant, so reducing I increases ω. The kinetic energy is $\mathrm{KE} = \frac{1}{2}I\omega^2 = \dfrac{L^2}{2I}$.

Step 1 — Use constant L: Since L is fixed, $\mathrm{KE} = \dfrac{L^2}{2I}$, so $\mathrm{KE} \propto \dfrac{1}{I}$.

Step 2 — Apply the change in I: The new moment of inertia is $I' = \frac{1}{2}I$.

Step 3 — Form the ratio:

$$\frac{\mathrm{KE}'}{\mathrm{KE}} = \frac{1/I'}{1/I} = \frac{I}{I'} = \frac{I}{I/2} = 2.$$

Why other options are wrong:

- Option A assumes KE falls, which would need external work removal.
- Option B assumes KE is conserved; it is not, because the skater does work pulling her arms in.
- Option D uses ω^2 scaling without the I factor.

Final Answer: The kinetic energy doubles $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — Orbital speed near a planet: For a low circular orbit, the gravitational pull supplies the centripetal force, giving $v = \sqrt{gR}$.

Step 1 — List the data: $g = 10\ \mathrm{m\,s^{-2}}$, $R = 6.4 \times 10^6$ m.

Step 2 — Compute the product:

$$gR = 10 \times 6.4 \times 10^6 = 6.4 \times 10^7\ \mathrm{m^2\,s^{-2}}.$$

Step 3 — Take the square root:

$$v = \sqrt{6.4 \times 10^7} = 8 \times 10^3\ \mathrm{m\,s^{-1}} = 8\ \mathrm{km\,s^{-1}}.$$

Why other options are wrong:

- Option B ($11.2\ \mathrm{km\,s^{-1}}$) is the escape speed, which is $\sqrt{2}$ times the orbital speed.
- Options C and D do not satisfy $v = \sqrt{gR}$.

Final Answer: The orbital speed is $8\ \mathrm{km\,s^{-1}} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — Variation of g with depth: At depth d below the surface (uniform density), $g_d = g\left(1 - \dfrac{d}{R}\right)$.

Step 1 — Substitute the depth: Here $d = \frac{R}{2}$, so $\dfrac{d}{R} = \frac{1}{2}$.

Step 2 — Apply the formula:

$$g_d = 10\left(1 - \tfrac{1}{2}\right).$$

Step 3 — Simplify:

$$g_d = 10 \times \tfrac{1}{2} = 5\ \mathrm{m\,s^{-2}}.$$

Why other options are wrong:

- Option A uses depth $= \frac{3R}{4}$.
- Option C uses the height formula instead of the depth formula.
- Option D ignores the depth correction.

Final Answer: The value of g at depth $R/2$ is $5\ \mathrm{m\,s^{-2}} \Rightarrow \boxed{\mathrm{B}}$

Answer: (B) Go Back to Q14

Q15.

Solution

Concept — Young's modulus: The elongation of a wire under tension is $\Delta L = \dfrac{FL}{AY}$.

Step 1 — List the data in SI units: $F = 100\ \mathrm{N}$, $L = 2\ \mathrm{m}$, $A = 1\ \mathrm{mm^2} = 1 \times 10^{-6}\ \mathrm{m^2}$, $Y = 2 \times 10^{11}\ \mathrm{N\,m^{-2}}$.

Step 2 — Compute the denominator:

$$AY = (1 \times 10^{-6})(2 \times 10^{11}) = 2 \times 10^{5}\ \mathrm{N}.$$

Step 3 — Compute the numerator: $FL = 100 \times 2 = 200\ \mathrm{N\,m}$.

Step 4 — Divide:

$$\Delta L = \frac{200}{2 \times 10^5} = 1 \times 10^{-3}\ \mathrm{m} = 1\ \mathrm{mm}.$$

Why other options are wrong:

- Options A and B come from using a wrong area or load.
- Option D doubles the length contribution.

Final Answer: The elongation is $1\ \mathrm{mm} \Rightarrow \boxed{\mathrm{C}}$

Answer: (C) Go Back to Q15

Q16.

Solution

Concept — Equation of continuity: For an incompressible fluid, $A_1v_1 = A_2v_2$, so the speed rises where the pipe narrows.

Step 1 — Relate the areas: The wider area is twice the narrow one, so $A_1 = 2A_2$.

Step 2 — Apply continuity:

$$A_1v_1 = A_2v_2 \ \Rightarrow\ (2A_2)(2) = A_2v_2.$$

Step 3 — Solve for v_2:

$$v_2 = \frac{2A_2 \times 2}{A_2} = 4\ \mathrm{m\,s^{-1}}.$$

Why other options are wrong:

- Option A inverts the area ratio.
- Option B assumes the speed is unchanged.
- Option C uses an area ratio of 1.5.

Final Answer: The speed in the narrow part is $4\ \mathrm{m\,s^{-1}} \Rightarrow \boxed{\mathrm{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — SHM of a spring–mass system: The time period is $T = 2\pi\sqrt{\frac{m}{k}}$.

Step 1 — List the data: $m = 2$ kg, $k = 8\ \mathrm{N\,m^{-1}}$.

Step 2 — Compute the ratio under the root:

$$\frac{m}{k} = \frac{2}{8} = 0.25\ \mathrm{s}^2.$$

Step 3 — Take the root and multiply:

$$T = 2\pi\sqrt{0.25} = 2\pi \times 0.5 = \pi\ \mathrm{s}.$$

Why other options are wrong:

- Option A halves the period.
- Options C and D use $k = 2$ or $m = 8$.

Final Answer: The time period is π s $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q17

Q18.

Solution

Concept — Energy in SHM: The total energy is $E = \frac{1}{2}kA^2$. The potential energy at displacement x is $\frac{1}{2}kx^2$, and the kinetic energy is the remainder.

Step 1 — Write the potential-energy fraction:

$$\frac{U}{E} = \frac{\frac{1}{2}kx^2}{\frac{1}{2}kA^2} = \left(\frac{x}{A}\right)^2.$$

Step 2 — Substitute $x = A/2$:

$$\frac{U}{E} = \left(\frac{A/2}{A}\right)^2 = \left(\tfrac{1}{2}\right)^2 = \tfrac{1}{4}.$$

Step 3 — Find the kinetic fraction:

$$\frac{K}{E} = 1 - \frac{U}{E} = 1 - \tfrac{1}{4} = \tfrac{3}{4}.$$

Why other options are wrong:

- Option B gives the potential fraction, not the kinetic one.
- Option C corresponds to $x = A/\sqrt{2}$.

Final Answer: The kinetic fraction is $\frac{3}{4} \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q18

Q19.

Solution

Concept — Doppler effect (source approaching): For a source moving towards a stationary observer, $f' = f\dfrac{v}{v - v_s}$.

Step 1 — List the data: $f = 600$ Hz, $v = 330\ \mathrm{m\,s^{-1}}$, $v_s = 30\ \mathrm{m\,s^{-1}}$.

Step 2 — Compute the denominator: $v - v_s = 330 - 30 = 300\ \mathrm{m\,s^{-1}}$.

Step 3 — Substitute:

$$f' = 600 \times \frac{330}{300} = 600 \times 1.1 = 660\ \text{Hz}.$$

Why other options are wrong:

- Option A assumes no motion.
- Option D uses $v + v_s$ (source receding) instead of $v - v_s$.

Final Answer: The observed frequency is 660 Hz $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Fundamental frequency of a string: A string fixed at both ends has fundamental frequency $f = \frac{v}{2L}$.

Step 1 — List the data: $L = 0.5$ m, $v = 200$ m s^{-1}.

Step 2 — Compute $2L$: $2L = 2 \times 0.5 = 1$ m.

Step 3 — Substitute:

$$f = \frac{200}{1} = 200 \text{ Hz}.$$

Why other options are wrong:

- Option A uses $L = 1$ m.
- Option C doubles the frequency (first overtone).

Final Answer: The fundamental frequency is 200 Hz $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Isothermal work: For an isothermal reversible expansion of an ideal gas, $W = nRT \ln \frac{V_2}{V_1}$.

Step 1 — List the data: $n = 1$, $R = 8.314$ J mol^{-1}K^{-1}, $T = 300$ K, $\frac{V_2}{V_1} = 2$.

Step 2 — Substitute, using $\ln 2 = 0.693$:

$$W = 1 \times 8.314 \times 300 \times 0.693.$$

Step 3 — Multiply step by step:

$$8.314 \times 300 = 2494.2, \qquad 2494.2 \times 0.693 \approx 1728 \text{ J}.$$

Step 4 — Express in kilojoules: $W \approx 1.73$ kJ.

Why other options are wrong:

- Option C drops the temperature factor.

- Options B and D use a wrong logarithm value.

Final Answer: The work done is $1.73\text{ kJ} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q21

Q22.

Solution

Concept — Carnot efficiency: The efficiency of a Carnot engine is $\eta = 1 - \dfrac{T_C}{T_H}$, with temperatures in kelvin.

Step 1 — List the data: $T_H = 400\text{ K}$, $T_C = 300\text{ K}$.

Step 2 — Form the temperature ratio:

$$\frac{T_C}{T_H} = \frac{300}{400} = 0.75.$$

Step 3 — Subtract from one:

$$\eta = 1 - 0.75 = 0.25 = 25\%.$$

Why other options are wrong:

- Option D (75%) is the ratio T_C/T_H itself, not the efficiency.
- Options A and C use wrong temperatures.

Final Answer: The efficiency is $25\% \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept — Steady-state heat conduction through rods in series: In the steady state the same heat current flows through both rods, so $\dfrac{K_1 A(\theta_1 - \theta)}{L} = \dfrac{K_2 A(\theta - \theta_2)}{L}$.

Step 1 — Substitute the conductivities and end temperatures: With $K_1 = K$,

$K_2 = 3K$, $\theta_1 = 100°$, $\theta_2 = 0°$:

$$K(100 - \theta) = 3K(\theta - 0).$$

Step 2 — Cancel K and expand:

$$100 - \theta = 3\theta.$$

Step 3 — Solve for θ:

$$100 = 4\theta \;\Rightarrow\; \theta = 25°\text{C}.$$

Why other options are wrong:

- Option A ($50°$) ignores the unequal conductivities.
- Option B places the junction nearer the hot end, the opposite of the correct trend.

Final Answer: The junction temperature is $25°\text{C} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q23

Q24.

Solution

Concept — Coulomb's law: The force between two point charges is $F = \dfrac{1}{4\pi\varepsilon_0}\dfrac{q_1 q_2}{r^2}$.

Step 1 — List the data: $q_1 = q_2 = 2 \times 10^{-6}$ C, $r = 0.10$ m, $k = 9 \times 10^9$.

Step 2 — Compute the charge product: $q_1 q_2 = (2 \times 10^{-6})^2 = 4 \times 10^{-12}\ \text{C}^2$.

Step 3 — Compute r^2: $r^2 = (0.10)^2 = 0.01\ \text{m}^2$.

Step 4 — Substitute:

$$F = 9 \times 10^9 \times \frac{4 \times 10^{-12}}{0.01} = \frac{3.6 \times 10^{-2}}{0.01} = 3.6\ \text{N}.$$

Why other options are wrong:

- Option A halves the force.
- Option D uses $r = 0.07$ m.

Final Answer: The force is $3.6\ \text{N} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — Combination of capacitors: Capacitors in parallel add directly; capacitors in series combine as reciprocals.

Step 1 — Combine the two parallel capacitors:

$$C_p = 2 + 2 = 4\ \mu\text{F}.$$

Step 2 — Put C_p in series with the $4\ \mu\text{F}$ capacitor:

$$\frac{1}{C_{eq}} = \frac{1}{4} + \frac{1}{4} = \frac{2}{4} = \frac{1}{2}.$$

Step 3 — Invert:

$$C_{eq} = 2\ \mu\text{F}.$$

Why other options are wrong:

- Option B is the parallel combination alone.
- Option C adds everything in parallel.
- Option D uses a wrong series step.

Final Answer: The equivalent capacitance is $2\ \mu\text{F} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Potential energy of two charges: The electrostatic potential energy is $U = \dfrac{1}{4\pi\varepsilon_0}\dfrac{q_1q_2}{r}$, carrying the sign of the charges.

Step 1 — List the data: $q_1 = +3 \times 10^{-6}$ C, $q_2 = -2 \times 10^{-6}$ C, $r = 0.06$ m, $k = 9 \times 10^9$.

Step 2 — Compute the charge product: $q_1q_2 = (3 \times 10^{-6})(-2 \times 10^{-6}) = -6 \times 10^{-12}\ \text{C}^2$.

Step 3 — Substitute:

$$U = 9 \times 10^9 \times \frac{-6 \times 10^{-12}}{0.06} = \frac{-5.4 \times 10^{-2}}{0.06}.$$

Step 4 — Simplify:

$$U = -0.9 \text{ J}.$$

Why other options are wrong:

- Option C has the wrong sign (it ignores the negative charge).
- Option D uses $r = 0.12$ m.

Final Answer: The potential energy is -0.9 J $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — Series and parallel resistors: Resistors in series add; two resistors in parallel give $R_p = \dfrac{R_1 R_2}{R_1 + R_2}$.

Step 1 — Combine the two series resistors:

$$R_s = 3 + 3 = 6\ \Omega.$$

Step 2 — Put R_s in parallel with the $6\ \Omega$ resistor:

$$R_{eq} = \frac{6 \times 6}{6 + 6} = \frac{36}{12}.$$

Step 3 — Simplify:

$$R_{eq} = 3\ \Omega.$$

Why other options are wrong:

- Option B is the series branch alone.
- Option D adds all three in series.
- Option A halves the result once more.

Final Answer: The equivalent resistance is $3\ \Omega \Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — Resistance of a stretched wire: At constant volume, $R \propto L^2$, because stretching to length L reduces the area so that $R = \frac{\rho L^2}{V}$.

Step 1 — Note the length change: The length is doubled, so $L \to 2L$.

Step 2 — Apply $R \propto L^2$:

$$\frac{R'}{R} = \left(\frac{2L}{L}\right)^2 = 4.$$

Step 3 — Compute the new resistance:

$$R' = 4 \times 2 = 8\ \Omega.$$

Why other options are wrong:

- Option B assumes $R \propto L$ (forgetting the area change).
- Option A assumes no change.

Final Answer: The new resistance is $8\ \Omega \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Cell with internal resistance: The current in the circuit is $I = \frac{\varepsilon}{R + r}$.

Step 1 — List the data: $\varepsilon = 12$ V, $R = 5\ \Omega$, $r = 1\ \Omega$.

Step 2 — Add the resistances: $R + r = 5 + 1 = 6\ \Omega$.

Step 3 — Apply Ohm's law for the full circuit:

$$I = \frac{12}{6} = 2\ \text{A}.$$

Why other options are wrong:

- Option C ignores the internal resistance $(12/5)$.
- Option D ignores all resistance.

Final Answer: The current is $2\ \text{A} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q29

Q30.

Solution

Concept — Magnetic force on a moving charge: For velocity perpendicular to the field, $F = qvB$.

Step 1 — List the data: $q = 2$ C, $v = 3\ \mathrm{m\,s^{-1}}$, $B = 4$ T.

Step 2 — Substitute (the angle is $90°$, so $\sin\theta = 1$):

$$F = qvB = 2 \times 3 \times 4.$$

Step 3 — Multiply:

$$F = 24\ \mathrm{N}.$$

Why other options are wrong:

- Option B drops one factor of 2.
- Option C uses only $v \times B$.
- Option D doubles the result.

Final Answer: The magnetic force is 24 N $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q30

Q31.

Solution

Concept — Magnetic field of a long straight wire: At distance r from a long straight wire, $B = \dfrac{\mu_0 I}{2\pi r}$.

Step 1 — List the data: $I = 10$ A, $r = 2$ cm $= 0.02$ m, $\mu_0 = 4\pi \times 10^{-7}$.

Step 2 — Substitute:

$$B = \frac{(4\pi \times 10^{-7})(10)}{2\pi(0.02)}.$$

Step 3 — Cancel π and simplify:

$$B = \frac{4 \times 10^{-7} \times 10}{2 \times 0.02} = \frac{4 \times 10^{-6}}{0.04} = 1 \times 10^{-4}\ \mathrm{T} = 100\ \mu\mathrm{T}.$$

Why other options are wrong:

- Option A uses $r = 8$ cm.
- Option C uses $r = 1$ cm.

Final Answer: The magnetic field is $100\ \mu\text{T} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept — Faraday's law of induction: The induced emf is $\varepsilon = N\dfrac{\Delta\Phi}{\Delta t} = NA\dfrac{\Delta B}{\Delta t}$ when the area is fixed and perpendicular to B.

Step 1 — List the data: $N = 100$, $A = 0.01\ \text{m}^2$, $\Delta B = 0.5$ T, $\Delta t = 0.1$ s.

Step 2 — Compute the rate of change of field:

$$\frac{\Delta B}{\Delta t} = \frac{0.5}{0.1} = 5\ \text{T}\,\text{s}^{-1}.$$

Step 3 — Substitute:

$$\varepsilon = 100 \times 0.01 \times 5 = 5\ \text{V}.$$

Why other options are wrong:

- Option A drops the number of turns appropriately but mis-multiplies.
- Option D forgets the area factor.

Final Answer: The induced emf is $5\ \text{V} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept — Resonance in a series LCR circuit: The resonant angular frequency is $\omega_0 = \dfrac{1}{\sqrt{LC}}$.

Step 1 — List the data: $L = 2$ H, $C = 8\ \mu\text{F} = 8 \times 10^{-6}$ F.

Step 2 — Compute the product LC:

$$LC = 2 \times 8 \times 10^{-6} = 16 \times 10^{-6} = 1.6 \times 10^{-5}\ \text{s}^2.$$

Step 3 — Take the square root:

$$\sqrt{LC} = \sqrt{1.6 \times 10^{-5}} = 4 \times 10^{-3}\ \text{s}.$$

Step 4 — Invert:

$$\omega_0 = \frac{1}{4 \times 10^{-3}} = 250\ \text{rad}\,\text{s}^{-1}.$$

Why other options are wrong:

- Options A and C come from arithmetic slips in $\sqrt{LC}$.
- Option D uses LC ten times too large.

Final Answer: The resonant frequency is $250\ \text{rad}\,\text{s}^{-1} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q33

Q34.

Solution

Concept — Thin lens formula: Using the convention $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ with u negative for a real object.

Step 1 — Assign signs: $u = -30$ cm, $f = +20$ cm (convex lens).

Step 2 — Rearrange for $\frac{1}{v}$:

$$\frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{20} + \frac{1}{-30}.$$

Step 3 — Use a common denominator 60:

$$\frac{1}{v} = \frac{3}{60} - \frac{2}{60} = \frac{1}{60}.$$

Step 4 — Invert:

$$v = 60\ \text{cm}.$$

The positive sign shows a real image on the far side of the lens.

Why other options are wrong:

- Option B treats the object as at $2f$.
- Option C inverts the focal length step.

Final Answer: The image is 60 cm from the lens $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q34

Q35.

Solution

Concept — Critical angle: For total internal reflection, $\sin\theta_c = \dfrac{1}{n}$, where n is the refractive index of the denser medium relative to air.

Step 1 — Substitute $n = 2$:

$$\sin\theta_c = \frac{1}{2}.$$

Step 2 — Take the inverse sine:

$$\theta_c = \sin^{-1}\left(\tfrac{1}{2}\right) = 30^\circ.$$

Why other options are wrong:

- Option A (60°) is $\cos^{-1}(1/2)$.
- Option B corresponds to $\sin\theta_c = 1/\sqrt{2}$, i.e. $n = \sqrt{2}$.

Final Answer: The critical angle is $30^\circ \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q35

Q36.

Solution

Concept — Fringe width in YDSE: The fringe width is $\beta = \dfrac{\lambda D}{d}$.

Step 1 — List the data in SI units: $\lambda = 600$ nm $= 6 \times 10^{-7}$ m, $D = 1$ m, $d = 1$ mm $= 1 \times 10^{-3}$ m.

Step 2 — Substitute:

$$\beta = \frac{(6 \times 10^{-7})(1)}{1 \times 10^{-3}}.$$

Step 3 — Simplify:

$$\beta = 6 \times 10^{-4}\ \text{m} = 0.6\ \text{mm}.$$

Why other options are wrong:

- Option A uses $\lambda = 200\ \text{nm}$.
- Option D doubles the wavelength.

Final Answer: The fringe width is $0.6\ \text{mm} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q36

Q37.

Solution

Concept — Electromagnetic spectrum: Frequency increases (and wavelength decreases) in the order: radio $<$ microwave $<$ infrared $<$ visible $<$ ultraviolet $<$ X-rays $<$ gamma rays.

Step 1 — Rank the listed radiations: Among gamma rays, radio waves, microwaves and visible light, gamma rays sit at the high-frequency end of the spectrum.

Step 2 — Identify the maximum: Therefore gamma rays have the highest frequency of the four.

Why other options are wrong:

- Option B (radio) has the lowest frequency.
- Options C and D lie between radio and gamma but well below gamma.

Final Answer: Gamma rays have the highest frequency $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q37

Q38.

Solution

Concept — Einstein's photoelectric equation: The maximum kinetic energy of emitted electrons is $K_{\text{max}} = E_{\text{photon}} - \phi$, where ϕ is the work function.

Step 1 — List the data: $E_{\text{photon}} = 5\ \text{eV}$, $\phi = 2\ \text{eV}$.

Step 2 — Subtract:

$$K_{\text{max}} = 5 - 2 = 3\ \text{eV}.$$

Why other options are wrong:

- Option A gives the work function, not the kinetic energy.
- Option C gives the photon energy.
- Option D adds the two energies.

Final Answer: The maximum kinetic energy is $3\ \text{eV} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q38

Q39.

Solution

Concept — Radioactive decay by half-lives: After n half-lives, the remaining amount is $N = N_0 \left(\frac{1}{2}\right)^n$.

Step 1 — Find the number of half-lives:

$$n = \frac{15\ \text{years}}{5\ \text{years}} = 3.$$

Step 2 — Compute the surviving fraction:

$$\left(\tfrac{1}{2}\right)^3 = \tfrac{1}{8}.$$

Step 3 — Apply to the initial mass:

$$N = 80 \times \tfrac{1}{8} = 10\ \text{g}.$$

Why other options are wrong:

- Option A corresponds to one half-life.
- Option B corresponds to two half-lives.

- Option C corresponds to four half-lives.

Final Answer: The remaining mass is 10 g $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q39

Q40.

Solution

Concept — Logic gates: The AND gate outputs 1 only when every input is 1; for any other input combination the output is 0.

Step 1 — Match the truth table: The given condition "output 1 only when both inputs are 1" is exactly the AND truth table.

Step 2 — Contrast with the others: The OR gate outputs 1 if at least one input is 1. The NOT gate has a single input and inverts it. The NOR gate outputs 1 only when both inputs are 0.

Why other options are wrong:

- Option A (OR) would also output 1 for a single 1 input.
- Option B (NOT) takes one input, not two.
- Option D (NOR) is the inverse pattern.

Final Answer: The gate is an AND gate $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q40

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	2	C	3	B	4	D	5	B
6	A	7	D	8	C	9	A	10	B
11	D	12	C	13	A	14	B	15	C
16	D	17	B	18	A	19	C	20	D
21	A	22	B	23	D	24	C	25	A
26	B	27	C	28	D	29	B	30	A
31	D	32	C	33	B	34	A	35	D
36	C	37	A	38	B	39	D	40	C