NEST Physics Sample Paper – 9

Duration: 45 Minutes **Maximum Marks: 60**

Instructions

- This paper contains **20 Multiple Choice Questions (single correct answer)**, modelled on the Physics section of **NEST 2026**.
- Each correct answer carries **+3 marks**. There is a deduction of -1 **mark** for each incorrect answer; **no marks** are deducted for an unattempted question.
- Every question has exactly **four options**, of which only **one** is correct. Choose carefully.
- Personal calculators, log tables, mobile phones, and other electronic gadgets are strictly prohibited in the examination hall.
- A simple on-screen (virtual) calculator is provided in the computer-based test interface and may be used; blank sheets for rough work are supplied at the exam centre.

Q1. A Vernier callipers has a main-scale division of 1 mm, and its Vernier scale has 20 divisions which coincide exactly with 19 main-scale divisions. While measuring a rod, the main scale reads 4.5 cm and the 6th Vernier division coincides with a main-scale mark (zero error is nil). The least count and the measured length of the rod are

(A) 0.01 mm and 4.506 cm

(B) 0.05 mm and 4.530 cm

(C) 0.05 mm and 4.506 cm

(D) 0.10 mm and 4.560 cm

Q2. A body is released from rest and falls freely under gravity (take $g = 10$ m s^{-2}). The distance it travels during the 5th second of its motion is

(A) 25 m

(B) 50 m

(C) 40 m

(D) 45 m

Q3. A block of mass $m = 2$ kg rests on top of a block of mass $M = 8$ kg which lies on a frictionless floor. The coefficient of friction between the two blocks is $\mu = 0.4$. A horizontal force F is applied to the *lower* block. Take $g = 10\ \mathrm{m\,s^{-2}}$. The maximum value of F for which the two blocks move together (without the upper one slipping) is

(A) 40 N

(B) 8 N

(C) 32 N

(D) 80 N

Q4. Two bodies P and Q have masses in the ratio $m_P : m_Q = 1 : 4$ but carry the *same* linear momentum. Using $\mathrm{KE} = \dfrac{p^2}{2m}$, the ratio of their kinetic energies $\mathrm{KE}_P : \mathrm{KE}_Q$ is

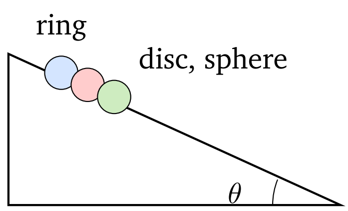
(A) $1 : 4$

(B) $1 : 2$

(C) $4 : 1$

(D) $2 : 1$

Q5. A ring, a solid disc and a solid sphere, all of the same mass and radius, are released from rest from the top of the same inclined plane and roll down without slipping. Which body reaches the bottom *first* (greatest linear acceleration)?



(A) the ring

(B) the solid sphere

(C) the solid disc

(D) all three arrive together

Q6. The acceleration due to gravity at the surface of the Earth (radius R) is g. At a height $h = \frac{R}{2}$ above the surface, the ratio $\frac{g_h}{g}$ is

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

(B) $\frac{2}{3}$

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

(D) $\frac{4}{9}$

Q7. A metal wire is stretched so that the tensile stress in it is 2×10^8 N m^{-2} and the corresponding longitudinal strain is 1×10^{-3}. The elastic potential energy stored per unit volume of the wire ($\frac{1}{2}$ × stress × strain) is

(A) 1×10^5 J m^{-3}

(B) 2×10^5 J m^{-3}

(C) 1×10^8 J m^{-3}

(D) 2×10^{11} J m^{-3}

Q8. 2 moles of an ideal *monatomic* gas are heated at *constant volume* so that the temperature rises by 30 K. Take $R = 8.31$ J mol^{-1}K^{-1}. The heat supplied to the gas is

(A) 249 J

(B) 498 J

(C) 748 J

(D) 1246 J

Q9. The total internal energy of 3 moles of an ideal monatomic gas at a temperature of 400 K is (take $R = 8.31\ \mathrm{J\,mol^{-1}K^{-1}}$, use $U = \frac{3}{2}nRT$)

(A) 9972 J

(B) 14958 J

(C) 4986 J

(D) 24930 J

Q10. A particle executes simple harmonic motion of amplitude A. When the particle is at displacement $x = \dfrac{A}{2}$ from the mean position, the fraction of its total mechanical energy that is kinetic is

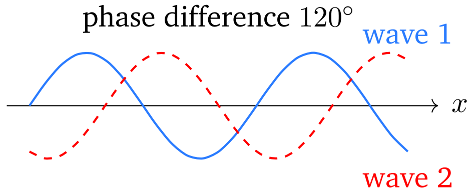
(A) $\dfrac{3}{4}$

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

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

(D) $\dfrac{2}{3}$

Q11. Two harmonic waves of equal amplitude $a = 3$ cm travelling in the same direction superpose with a constant phase difference of $\phi = 120°$. The amplitude of the resultant wave, $A = \sqrt{a^2 + a^2 + 2a^2\cos\phi}$, is



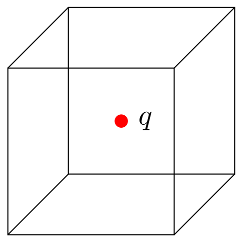
(A) 6 cm

(B) 0

(C) $3\sqrt{3}$ cm

(D) 3 cm

Q12. A point charge q is placed at the exact centre of a cube. By symmetry, the electric flux passing through *one* face of the cube is



(A) $\dfrac{q}{\varepsilon_0}$

(B) $\dfrac{q}{8\varepsilon_0}$

(C) $\dfrac{q}{6\varepsilon_0}$

(D) $\dfrac{q}{24\varepsilon_0}$

Q13. In a region of uniform electric field, point P is at a potential of $+50$ V and point Q is at a potential of $+10$ V. The work done by an external agent in moving a charge $q = +2\ \mu$C slowly from Q to P (without changing its kinetic energy) is

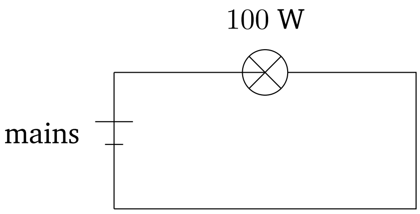
(A) -8×10^{-5} J

(B) 1.2×10^{-4} J

(C) 2.0×10^{-5} J

(D) 8×10^{-5} J

Q14. A household bulb rated 100 W is connected to the mains and kept switched on for 5 hours every day. If electrical energy costs Rs. 6 per kWh, the cost of running the bulb for 30 days is



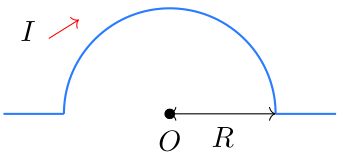
(A) Rs. 30

(B) Rs. 90

(C) Rs. 15

(D) Rs. 150

Q15. A wire carrying a steady current $I = 4$ A is bent into a semicircular arc of radius $R = 0.2$ m (the straight portions lie along the line through the centre and produce no field there). Take $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}. The magnitude of the magnetic field at the centre O of the semicircle, $B = \frac{\mu_0 I}{4R}$, is



(A) $2\pi \times 10^{-6}$ T

(B) $4\pi \times 10^{-6}$ T

(C) $\pi \times 10^{-6}$ T

(D) $8\pi \times 10^{-6}$ T

Q16. A coil of total resistance 5 Ω links a magnetic flux that decreases steadily from 0.40 Wb to 0.15 Wb. The total charge that flows through the coil during this change, $q = \frac{\Delta\Phi}{R}$, is

(A) 0.025 C

(B) 0.11 C

(C) 0.05 C

(D) 1.25 C

Q17. A series LCR circuit has $L = 2$ H, $C = 8$ μF and resistance $R = 20$ Ω. The quality (Q) factor of the circuit at resonance, $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$, is

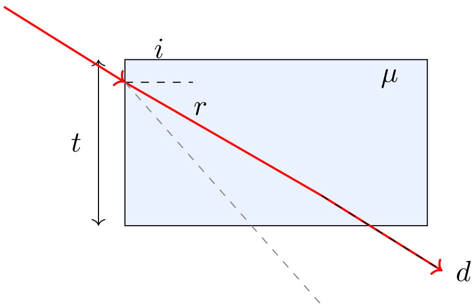
(A) 12.5

(B) 25

(C) 50

(D) 5

Q18. A ray of light is incident at 60° on a parallel-sided glass slab of thickness t and refractive index μ. Inside the slab the ray travels at a refraction angle $r = 30^\circ$. The lateral displacement of the emergent ray, $d = \dfrac{t\ \sin(i - r)}{\cos r}$, for $t = 6$ cm is



(A) 6 cm

(B) 3 cm

(C) $3\sqrt{3}$ cm

(D) $2\sqrt{3}$ cm

Q19. Unpolarised light travelling in air is incident on the flat surface of a transparent medium of refractive index $\mu = \sqrt{3}$. The reflected light is found to be completely plane polarised when the angle of incidence (Brewster's angle θ_B, with $\tan\theta_B = \mu$) equals

(A) 60°

(B) 30°

(C) 45°

(D) 57°

Q20. A radioactive sample contains 2×10^{18} undecayed nuclei of a nuclide whose decay constant is $\lambda = 4 \times 10^{-6}$ s^{-1}. The activity of the sample, $A = \lambda N$, is

(A) 8×10^{24} disintegrations s^{-1}

(B) 5×10^{23} disintegrations s^{-1}

(C) 8×10^{12} disintegrations s^{-1}

(D) 2×10^{12} disintegrations s^{-1}

Detailed Solutions

Q1.

Solution

Concept — Vernier least count: Least count = (1 main-scale division) − (1 Vernier-scale division). When n Vernier divisions match $(n-1)$ main divisions, LC $= \dfrac{1\text{ MSD}}{n}$.

Step 1 — Least count: 20 VSD = 19 MSD, so 1 VSD = $\frac{19}{20}$ MSD. Hence LC = $1\,\text{MSD} - 1\,\text{VSD} = \frac{1}{20}$ MSD $= \frac{1}{20} \times 1$ mm $= 0.05$ mm.

Step 2 — Reading: Length = main-scale reading + (coinciding division × LC) $= 4.5$ cm $+ 6 \times 0.05$ mm $= 45.0$ mm $+ 0.30$ mm $= 45.30$ mm $= 4.530$ cm.

Why other options are wrong:

- (A) 0.01 mm is a screw-gauge-style LC, not this Vernier.
- (C) Uses the right LC but adds 6×0.01 mm by mistake.
- (D) Takes LC = 0.10 mm (treats 10 divisions instead of 20).

Final Answer: LC = 0.05 mm, length = 4.530 cm ⇒ $\boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Distance in the nth second: For uniform acceleration from rest, the distance covered in the nth second is $s_n = u + \frac{a}{2}(2n-1)$. For free fall $u = 0$, $a = g$.

Step 1 — Apply with $n = 5$: $s_5 = 0 + \frac{g}{2}(2 \times 5 - 1) = \frac{10}{2}(9)$.

Step 2 — Compute: $s_5 = 5 \times 9 = 45$ m.

Why other options are wrong:

- (A) 25 m uses $(2n-1)$ with $n = 3$ or confuses with total distance formula.
- (B) 50 m is the total distance in 5 s wrongly, or $\frac{1}{2}gt$ slip.
- (C) 40 m uses $(2n-1) = 8$ (i.e. $2n$ instead of $2n-1$).

Final Answer: $s_5 = 45$ m ⇒ $\boxed{\text{D}}$

Answer: (D) Go Back to Q2

Q3.

Solution

Concept — Friction limits common acceleration: The only horizontal force on the upper block is friction from the lower block. The blocks move together until that friction reaches its maximum value μmg.

Step 1 — Maximum acceleration of the top block: The largest friction the surface can supply on m is $f_{\text{max}} = \mu mg = 0.4(2)(10) = 8$ N, giving $a_{\text{max}} = \frac{f_{\text{max}}}{m} = \frac{8}{2} = 4\ \text{m s}^{-2}$.

Step 2 — Force on the whole system: Both blocks accelerate together at a_{max}, so the floor being frictionless,

$$F_{\text{max}} = (M + m)\, a_{\text{max}} = (8 + 2)(4) = 40\ \text{N}.$$

Why other options are wrong:

- (B) 8 N is the limiting friction force, not the applied force.
- (C) 32 N uses only the lower mass $M = 8$ (8×4).
- (D) 80 N doubles the acceleration or uses $\mu(M + m)g$ incorrectly.

Final Answer: $F_{\text{max}} = 40\ \text{N} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Kinetic energy in terms of momentum: $\text{KE} = \frac{p^2}{2m}$. For equal momenta, $\text{KE} \propto \frac{1}{m}$.

Step 1 — Equal momentum: With $p_P = p_Q = p$,

$$\frac{\text{KE}_P}{\text{KE}_Q} = \frac{p^2/(2m_P)}{p^2/(2m_Q)} = \frac{m_Q}{m_P}.$$

Step 2 — Substitute the mass ratio: $\frac{m_Q}{m_P} = \frac{4}{1}$, so $\text{KE}_P : \text{KE}_Q = 4 : 1$.

Why other options are wrong:

- (A) $1 : 4$ is the (inverted) mass ratio, valid only for $\text{KE} \propto m$.

- (B) $1:2$ and (D) $2:1$ wrongly use $\sqrt{m}$ scaling.

Final Answer: $\text{KE}_P : \text{KE}_Q = 4:1 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q4

Q5.

Solution

Concept — Rolling without slipping: For a body of moment of inertia $I = \beta m R^2$ rolling down an incline of angle θ, the linear acceleration is $a = \dfrac{g\sin\theta}{1+\beta}$. The body with the *smallest* β accelerates fastest.

Step 1 — Compare β values: ring $\beta = 1$, solid disc $\beta = \frac{1}{2}$, solid sphere $\beta = \frac{2}{5}$. The sphere has the smallest β.

Step 2 — Accelerations: $a_{\text{sphere}} = \dfrac{g\sin\theta}{1+2/5} = \dfrac{5}{7}g\sin\theta$, larger than disc $(\frac{2}{3}g\sin\theta)$ and ring $(\frac{1}{2}g\sin\theta)$. So the solid sphere reaches the bottom first.

Why other options are wrong:

- (A) The ring has the largest β, so it is slowest, not fastest.
- (C) The disc is intermediate, faster than the ring but slower than the sphere.
- (D) Different β values mean different accelerations, so they cannot tie.

Final Answer: the solid sphere arrives first $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q5

Q6.

Solution

Concept — Variation of g with height: At height h above the surface, $g_h = g\dfrac{R^2}{(R+h)^2}$, so $\dfrac{g_h}{g} = \left(\dfrac{R}{R+h}\right)^2$.

Step 1 — Substitute $h = R/2$:

$$\frac{g_h}{g} = \left(\frac{R}{R+R/2}\right)^2 = \left(\frac{R}{\frac{3R}{2}}\right)^2 = \left(\frac{2}{3}\right)^2 = \frac{4}{9}.$$

Why other options are wrong:

- (A) $\frac{1}{2}$ ignores the square (linear in $R/(R+h)$).

- (B) $\frac{2}{3}$ is $\dfrac{R}{R+h}$ before squaring.
- (C) $\frac{1}{4}$ uses $h = R$ instead of $h = R/2$.

Final Answer: $\dfrac{g_h}{g} = \dfrac{4}{9} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q6

Q7.

Solution

Concept — Elastic energy density: The energy stored per unit volume in a stretched wire is $u = \dfrac{1}{2} \times \text{stress} \times \text{strain}$.

Step 1 — Substitute:

$$u = \frac{1}{2}(2 \times 10^8)(1 \times 10^{-3}).$$

Step 2 — Compute: $u = \frac{1}{2} \times 2 \times 10^5 = 1 \times 10^5\ \text{J m}^{-3}$.

Why other options are wrong:

- (B) 2×10^5 forgets the factor $\frac{1}{2}$.
- (C) 1×10^8 multiplies stress by $\frac{1}{2}$ only (drops the strain).
- (D) 2×10^{11} multiplies stress by Young's modulus instead of strain.

Final Answer: $u = 1 \times 10^5\ \text{J m}^{-3} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — Isochoric (constant-volume) process: No volume change means no work ($W = 0$), so by the first law all the heat goes into internal energy: $Q = \Delta U = nC_V\Delta T$, with $C_V = \frac{3}{2}R$ for a monatomic gas.

Step 1 — Set up: $Q = n\left(\frac{3}{2}R\right)\Delta T = 2 \times \frac{3}{2} \times 8.31 \times 30$.

Step 2 — Compute: $Q = 2 \times 1.5 \times 8.31 \times 30 = 3 \times 8.31 \times 30 = 747.9 \approx 748$ J.

Why other options are wrong:

- (A) 249 J uses $n = 1$ and $C_V = \frac{1}{2}R$.
- (B) 498 J uses $C_V = R$ instead of $\frac{3}{2}R$.

- (D) 1246 J uses $C_P = \frac{5}{2}R$ (constant-pressure value).

Final Answer: $Q \approx 748$ J $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q8

Q9.

Solution

Concept — Internal energy of a monatomic ideal gas: Each molecule has 3 translational degrees of freedom, giving $U = \frac{3}{2}nRT$.

Step 1 — Substitute: $U = \frac{3}{2}(3)(8.31)(400)$.

Step 2 — Compute: $\frac{3}{2} \times 3 = 4.5$; $4.5 \times 8.31 = 37.395$; $37.395 \times 400 = 14958$ J.

Why other options are wrong:

- (A) 9972 J uses $U = nRT$ (drops the $\frac{3}{2}$).
- (C) 4986 J takes $n = 1$.
- (D) 24930 J uses $\frac{5}{2}nRT$ (a diatomic-style factor).

Final Answer: $U \approx 14958$ J $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q9

Q10.

Solution

Concept — Energy in SHM: Total energy $E = \frac{1}{2}m\omega^2A^2$; potential energy at displacement x is $U = \frac{1}{2}m\omega^2x^2$; kinetic energy is $K = E - U$.

Step 1 — Potential-energy fraction: $\dfrac{U}{E} = \dfrac{x^2}{A^2} = \left(\dfrac{A/2}{A}\right)^2 = \dfrac{1}{4}$.

Step 2 — Kinetic-energy fraction: $\dfrac{K}{E} = 1 - \dfrac{U}{E} = 1 - \dfrac{1}{4} = \dfrac{3}{4}$.

Why other options are wrong:

- (B) $\frac{1}{4}$ is the potential-energy fraction, not kinetic.
- (C) $\frac{1}{2}$ holds at $x = A/\sqrt{2}$, not at $A/2$.
- (D) $\frac{2}{3}$ does not arise from $x = A/2$.

Final Answer: $\dfrac{K}{E} = \dfrac{3}{4} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q10

Q11.

Solution

Concept — Superposition of two waves: Two waves of equal amplitude a with phase difference ϕ give a resultant amplitude $A = \sqrt{a^2 + a^2 + 2a^2 \cos\phi} = 2a \cos\dfrac{\phi}{2}$.

Step 1 — Substitute $\phi = 120°$: $\cos 120° = -\frac{1}{2}$, so

$$A = \sqrt{2a^2 + 2a^2(-\tfrac{1}{2})} = \sqrt{2a^2 - a^2} = \sqrt{a^2} = a.$$

Step 2 — Value: $A = a = 3$ cm. (Check: $2a \cos 60° = 2(3)(\frac{1}{2}) = 3$ cm.)

Why other options are wrong:

- (A) 6 cm is the in-phase result ($\phi = 0$).
- (B) 0 is the fully destructive result ($\phi = 180°$).
- (C) $3\sqrt{3}$ cm uses $\cos\phi = +\frac{1}{2}$ (i.e. $\phi = 60°$).

Final Answer: $A = 3$ cm $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept — Gauss's law with symmetry: The total flux through a closed surface enclosing charge q is $\dfrac{q}{\varepsilon_0}$. For a charge at the centre of a cube, the six faces are equivalent.

Step 1 — Total flux: $\Phi_{\text{total}} = \dfrac{q}{\varepsilon_0}$.

Step 2 — One face: By symmetry each of the 6 faces carries an equal share:

$$\Phi_{\text{face}} = \frac{1}{6} \cdot \frac{q}{\varepsilon_0} = \frac{q}{6\varepsilon_0}.$$

Why other options are wrong:

- (A) $\dfrac{q}{\varepsilon_0}$ is the total flux through all six faces.
- (B) $\dfrac{q}{8\varepsilon_0}$ applies when the charge sits at a *corner* shared by 8 cubes (a different setup).

- (D) $\frac{q}{24\varepsilon_0}$ would be one face for a corner charge, not a centred one.

Final Answer: $\Phi_{\text{face}} = \frac{q}{6\varepsilon_0} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — Work and potential difference: The work done by an external agent moving a charge slowly from Q to P is $W_{\text{ext}} = q\,(V_P - V_Q) = q\,\Delta V$.

Step 1 — Potential difference: $V_P - V_Q = 50 - 10 = 40$ V.

Step 2 — Work: $W_{\text{ext}} = q\,\Delta V = (2 \times 10^{-6})(40) = 8 \times 10^{-5}$ J. It is positive, since a positive charge is pushed toward higher potential.

Why other options are wrong:

- (A) -8×10^{-5} J has the wrong sign (that is the work done by the field).
- (B) 1.2×10^{-4} J uses $\Delta V = 60$ V ($50 + 10$ instead of $50 - 10$).
- (C) 2.0×10^{-5} J uses $\Delta V = 10$ V only.

Final Answer: $W_{\text{ext}} = 8 \times 10^{-5}$ J $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q13

Q14.

Solution

Concept — Energy in kWh and cost: Energy (kWh) $=$ power (kW) $\times$ time (h); cost $=$ energy $\times$ rate.

Step 1 — Energy per day: $P = 100$ W $= 0.1$ kW; in 5 h, $E_{\text{day}} = 0.1 \times 5 = 0.5$ kWh.

Step 2 — Over 30 days: $E = 0.5 \times 30 = 15$ kWh. Cost $= 15 \times 6 =$ Rs. 90.

Why other options are wrong:

- (A) Rs. 30 leaves out the rate (counts only kWh-style number).
- (C) Rs. 15 is the energy in kWh, not the cost.
- (D) Rs. 150 treats the bulb as 100 W run continuously or wrong hours.

Final Answer: cost $=$ Rs. $90 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q14

Q15.

Solution

Concept — Field of a semicircular arc: A full circular loop gives $B = \frac{\mu_0 I}{2R}$ at its centre; a semicircle (half the loop) gives half that, $B = \frac{\mu_0 I}{4R}$.

Step 1 — Substitute:

$$B = \frac{\mu_0 I}{4R} = \frac{(4\pi \times 10^{-7})(4)}{4(0.2)}.$$

Step 2 — Simplify: $\frac{4}{4(0.2)} = \frac{4}{0.8} = 5$, so $B = (4\pi \times 10^{-7})(5) = 20\pi \times 10^{-7} = 2\pi \times 10^{-6}$ T.

Why other options are wrong:

- (B) $4\pi \times 10^{-6}$ T uses the full-loop formula $\frac{\mu_0 I}{2R}$.
- (C) $\pi \times 10^{-6}$ T uses $\frac{\mu_0 I}{8R}$ (a quarter loop).
- (D) $8\pi \times 10^{-6}$ T drops the factor of 4 in the denominator.

Final Answer: $B = 2\pi \times 10^{-6}$ T $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q15

Q16.

Solution

Concept — Charge from changing flux: The induced charge is independent of the rate of change: $q = \frac{|\Delta\Phi|}{R}$ (from $q = \int i\,dt = \int \frac{\varepsilon}{R} dt$).

Step 1 — Flux change: $|\Delta\Phi| = 0.40 - 0.15 = 0.25$ Wb.

Step 2 — Charge: $q = \frac{0.25}{5} = 0.05$ C.

Why other options are wrong:

- (A) 0.025 C uses $|\Delta\Phi| = 0.125$ Wb (halves the change).
- (B) 0.11 C divides the sum 0.55 Wb by 5.
- (D) 1.25 C multiplies 0.25 by 5 instead of dividing.

Final Answer: $q = 0.05$ C $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q16

Q17.

Solution

Concept — Quality factor of series LCR: The sharpness of resonance is measured by $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$ (equivalently $\frac{\omega_0 L}{R}$).

Step 1 — Evaluate $\sqrt{L/C}$: $\frac{L}{C} = \frac{2}{8 \times 10^{-6}} = 2.5 \times 10^5$, so $\sqrt{L/C} = \sqrt{2.5 \times 10^5} = 500$.

Step 2 — Quality factor: $Q = \frac{500}{20} = 25$.

Why other options are wrong:

- (A) 12.5 uses $R = 40\ \Omega$.
- (C) 50 uses $R = 10\ \Omega$.
- (D) 5 takes $\sqrt{L/C} = 100$ (a power-of-ten slip in C).

Final Answer: $Q = 25 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q17

Q18.

Solution

Concept — Lateral shift through a slab: A parallel-sided slab shifts the ray sideways without changing its direction, by $d = \frac{t\ \sin(i-r)}{\cos r}$.

Step 1 — Angles: $i = 60°$, $r = 30°$, so $i - r = 30°$.

$$d = \frac{t\ \sin(i-r)}{\cos r} = \frac{6\ \sin 30°}{\cos 30°}.$$

Step 2 — Evaluate: $\sin 30° = \frac{1}{2}$ and $\cos 30° = \frac{\sqrt{3}}{2}$, so

$$d = \frac{6 \cdot \frac{1}{2}}{\sqrt{3}/2} = \frac{3}{\sqrt{3}/2} = \frac{6}{\sqrt{3}} = 2\sqrt{3} \approx 3.46\ \text{cm}.$$

Why other options are wrong:

- (A) 6 cm equals the slab thickness t, not the shift.

- (B) 3 cm drops the $\cos r$ in the denominator ($t\sin(i-r)$).
- (C) $3\sqrt{3}$ cm wrongly takes $d = t\,\sin i$.

Final Answer: $d = 2\sqrt{3}$ cm $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept — Brewster's law: Reflected light is completely plane polarised when the angle of incidence equals Brewster's angle θ_B, where $\tan\theta_B = \mu$.

Step 1 — Apply: $\tan\theta_B = \mu = \sqrt{3}$.

Step 2 — Solve: $\theta_B = \tan^{-1}(\sqrt{3}) = 60^\circ$.

Why other options are wrong:

- (B) 30° has $\tan 30^\circ = \frac{1}{\sqrt{3}}$ (the reciprocal).
- (C) 45° has $\tan 45^\circ = 1$ ($\mu = 1$, i.e. no medium).
- (D) 57° is Brewster's angle for $\mu \approx 1.5$ (glass), not $\sqrt{3}$.

Final Answer: $\theta_B = 60^\circ \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept — Activity of a radioactive sample: The activity (rate of disintegration) is $A = \lambda N$, where N is the number of undecayed nuclei and λ the decay constant.

Step 1 — Substitute: $A = \lambda N = (4\times10^{-6})(2\times10^{18})$.

Step 2 — Compute: $A = 8\times10^{12}$ disintegrations s^{-1}.

Why other options are wrong:

- (A) 8×10^{24} multiplies the exponents wrongly ($+$ sign on 10^{-6}).
- (B) 5×10^{23} divides N by λ instead of multiplying.
- (D) 2×10^{12} divides N by 4 rather than multiplying by 4.

Final Answer: $A = 8\times10^{12}$ $s^{-1} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q20

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	D	3	A	4	C	5	B
6	D	7	A	8	C	9	B	10	A
11	D	12	C	13	D	14	B	15	A
16	C	17	B	18	D	19	A	20	C