

# AIIMS B.Sc Nursing Physics

## Sample Paper – 11

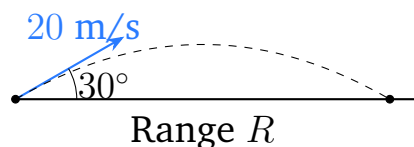
Duration: 36 Minutes

Maximum Marks: 30

### Instructions

- This paper contains **30** Multiple Choice Questions (Single Correct Answer), modelled on the Physics section of the **AIIMS B.Sc Nursing (Hons)** entrance.
- Each correct answer carries **+1 mark**. **1/3 mark** is deducted for every incorrect answer. Unattempted questions carry **no penalty**.
- Syllabus level: **Class 11–12 (NCERT) Physics**.
- Only **one** option is correct.
- The actual exam is a **computer-based test**.
- Use of mobile phones, calculators, or other electronic gadgets is strictly prohibited.

**Q1.** A ball is projected from the ground with speed  $20 \text{ m/s}$  at an angle of  $30^\circ$  to the horizontal, as shown. Taking  $g = 10 \text{ m/s}^2$ , the horizontal range is:



- (A)  $40 \text{ m}$
- (B)  $20\sqrt{3} \text{ m}$  ( $\approx 34.6 \text{ m}$ )
- (C)  $30 \text{ m}$
- (D)  $10\sqrt{3} \text{ m}$

**Q2.** A person of mass  $60 \text{ kg}$  stands on a weighing scale inside a lift that accelerates upward at  $2 \text{ m/s}^2$ . Taking  $g = 10 \text{ m/s}^2$ , the reading of the scale is:

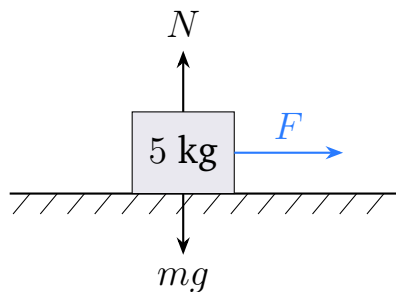


- (A) 480 N
- (B) 600 N
- (C) 720 N
- (D) 120 N

**Q3.** A body of mass 2 kg moving at 3 m/s is accelerated to 6 m/s. The work done on it equals:

- (A) 27 J
- (B) 9 J
- (C) 36 J
- (D) 18 J

**Q4.** A block of mass 5 kg rests on a horizontal surface. A horizontal force  $F$  is applied as shown. If the coefficient of static friction is 0.4 and  $g = 10 \text{ m/s}^2$ , the minimum force needed to just start moving the block is:



- (A) 50 N
- (B) 10 N
- (C) 25 N
- (D) 20 N

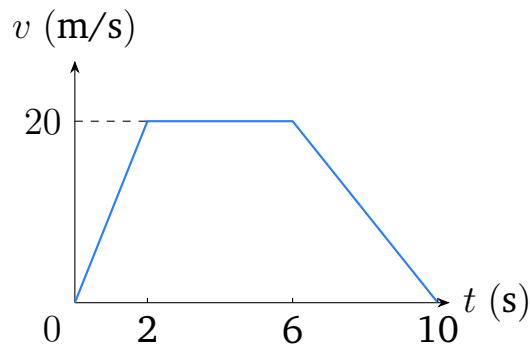
**Q5.** At a height equal to the radius of the Earth above its surface, the acceleration due to gravity becomes (where  $g$  is the surface value):

- (A)  $\frac{g}{2}$



- (B)  $\frac{g}{4}$
- (C)  $\frac{g}{3}$
- (D)  $g$

**Q6.** The velocity-time graph of a particle moving in a straight line is shown. The total distance covered in the 10 s shown is:



- (A) 200 m
- (B) 120 m
- (C) 140 m
- (D) 100 m

**Q7.** A pump raises 600 kg of water through a height of 10 m in 20 s. Taking  $g = 10 \text{ m/s}^2$ , the power of the pump is:

- (A) 3000 W
- (B) 6000 W
- (C) 1500 W
- (D) 300 W

**Q8.** A gas absorbs 200 J of heat and does 80 J of work on its surroundings. The change in its internal energy is:

- (A) 280 J
- (B) 200 J



- (C) 80 J
- (D) 120 J

**Q9.** In a hydraulic lift, the small piston has area  $0.01 \text{ m}^2$  and the large piston has area  $0.5 \text{ m}^2$ . A force of 20 N on the small piston can lift a maximum load of:

- (A) 500 N
- (B) 1000 N
- (C) 400 N
- (D) 2000 N

**Q10.** If the absolute temperature of an ideal gas is made four times its original value, the root-mean-square speed of its molecules becomes:

- (A) half
- (B) four times
- (C) twice
- (D) unchanged

**Q11.** How much heat is required to raise the temperature of 200 g of water from  $20^\circ\text{C}$  to  $70^\circ\text{C}$ ? (Specific heat of water =  $4.2 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$ .)

- (A) 42000 J
- (B) 21000 J
- (C) 4200 J
- (D) 8400 J

**Q12.** The length of a simple pendulum is increased to four times its original length. Its time period becomes:

- (A) four times
- (B) twice



- (C) half
- (D) unchanged

**Q13.** A wave of frequency 500 Hz travels with a speed of 350 m/s. The wavelength of the wave is:

- (A) 1.4 m
- (B) 0.5 m
- (C) 2.0 m
- (D) 0.7 m

**Q14.** A particle executes simple harmonic motion with amplitude  $A$ . At what displacement from the mean position is its kinetic energy equal to its potential energy?

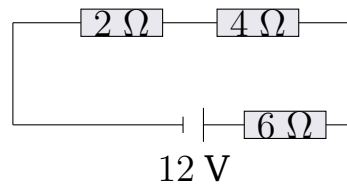
- (A)  $\frac{A}{2}$
- (B)  $A$
- (C)  $\frac{A}{\sqrt{2}}$
- (D)  $\frac{A}{4}$

**Q15.** Two point charges of  $+2 \mu\text{C}$  and  $+3 \mu\text{C}$  are placed 30 cm apart in air. The magnitude of the force between them is (take  $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2\text{C}^{-2}$ ):

- (A) 0.6 N
- (B) 0.06 N
- (C) 6 N
- (D) 0.3 N

**Q16.** In the circuit shown, three resistors are connected in series with a 12 V battery of negligible internal resistance. The current drawn from the battery is:





- (A) 3 A
- (B) 2 A
- (C) 0.5 A
- (D) 1 A

**Q17.** An electric bulb is rated 60 W, 220 V. The resistance of its filament when operating is approximately:

- (A) 367  $\Omega$
- (B) 807  $\Omega$
- (C) 220  $\Omega$
- (D) 60  $\Omega$

**Q18.** A capacitor of capacitance 4  $\mu\text{F}$  is charged to a potential difference of 50 V. The energy stored in it is:

- (A)  $2 \times 10^{-3}$  J
- (B)  $1 \times 10^{-2}$  J
- (C)  $5 \times 10^{-3}$  J
- (D)  $1 \times 10^{-3}$  J

**Q19.** Two resistors of 6  $\Omega$  and 3  $\Omega$  are connected in parallel. Their equivalent resistance is:

- (A) 2  $\Omega$
- (B) 9  $\Omega$
- (C) 4.5  $\Omega$
- (D) 18  $\Omega$



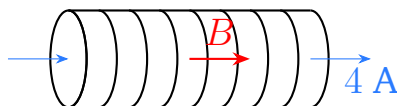
**Q20.** The electric field at a distance of 0.3 m from a point charge of  $3 \mu\text{C}$  in air is (take  $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$  SI units):

- (A)  $9 \times 10^4$  N/C
- (B)  $9 \times 10^5$  N/C
- (C)  $3 \times 10^5$  N/C
- (D)  $1 \times 10^5$  N/C

**Q21.** A charge of 2 C moves with a velocity of 5 m/s perpendicular to a uniform magnetic field of 0.4 T. The force on the charge is:

- (A) 2 N
- (B) 4 N
- (C) 10 N
- (D) 0.8 N

**Q22.** A long solenoid has 500 turns per metre and carries a current of 4 A, as sketched. The magnetic field inside it is ( $\mu_0 = 4\pi \times 10^{-7}$  T m A<sup>-1</sup>):



- (A)  $1 \times 10^{-3}$  T
- (B)  $2.5 \times 10^{-3}$  T
- (C)  $2.51 \times 10^{-3}$  T
- (D)  $4 \times 10^{-3}$  T

**Q23.** The magnetic flux through a coil of 200 turns changes from 0.02 Wb to 0.05 Wb in 0.1 s. The magnitude of the induced emf is:

- (A) 60 V
- (B) 6 V
- (C) 0.6 V



(D) 30 V

**Q24.** An alternating voltage has a peak value of 311 V. Its root-mean-square (rms) value is approximately:

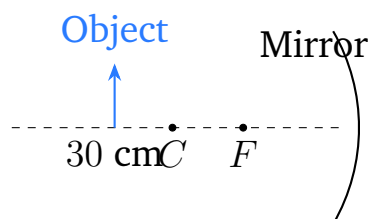
(A) 311 V

(B) 440 V

(C) 155 V

(D) 220 V

**Q25.** An object is placed 30 cm in front of a concave mirror of focal length 20 cm, as shown. The image is formed at a distance of:



(A) 30 cm

(B) 60 cm

(C) 12 cm

(D) 20 cm

**Q26.** Light travels from air into a medium of refractive index 1.5. If the angle of incidence is  $30^\circ$ , the angle of refraction is given by  $\sin r =$ :

(A) 0.75

(B) 0.5

(C) 0.33

(D) 0.67

**Q27.** In Young's double-slit experiment, the slit separation is 1 mm, the screen is 1 m away, and light of wavelength 600 nm is used. The fringe width is:



- (A) 0.6 mm
- (B) 6 mm
- (C) 0.06 mm
- (D) 1.2 mm

**Q28.** The energy of a photon of light of wavelength 600 nm is approximately (take  $hc = 1240$  eV nm):

- (A) 1.0 eV
- (B) 3.1 eV
- (C) 1.5 eV
- (D) 2.07 eV

**Q29.** A radioactive sample has a half-life of 5 years. The fraction of the original sample remaining after 15 years is:

- (A)  $\frac{1}{4}$
- (B)  $\frac{1}{8}$
- (C)  $\frac{1}{16}$
- (D)  $\frac{1}{2}$

**Q30.** In a p-n junction diode under forward bias, the:

- (A) width of the depletion region increases.
- (B) diode offers very high resistance.
- (C) width of the depletion region decreases and current flows easily.
- (D) no current flows at all.



## Detailed Solutions

**Q1.**

### Solution

**Concept — Projectile range:** For a projectile launched with speed  $u$  at angle  $\theta$ , the horizontal range is  $R = \frac{u^2 \sin 2\theta}{g}$ .

**Step 1 — List the data:**  $u = 20 \text{ m/s}$ ,  $\theta = 30^\circ$ ,  $g = 10 \text{ m/s}^2$ .

**Step 2 — Substitute:**  $2\theta = 60^\circ$ , so  $\sin 2\theta = \sin 60^\circ = \frac{\sqrt{3}}{2}$ .

**Step 3 — Compute:**

$$R = \frac{(20)^2 \times \frac{\sqrt{3}}{2}}{10} = \frac{400 \times \frac{\sqrt{3}}{2}}{10} = \frac{200\sqrt{3}}{10} = 20\sqrt{3} \approx 34.6 \text{ m.}$$

**Why other options are wrong:**

- 40 m would need  $\sin 2\theta = 1$  (i.e.  $\theta = 45^\circ$ );  $10\sqrt{3}$  m halves the correct value.

**Final Answer:**  $R = 20\sqrt{3} \approx 34.6 \text{ m} \Rightarrow$  B

Answer: (B) [Go Back to Q1](#)

**Q2.**

### Solution

**Concept — Apparent weight in a lift:** When a lift accelerates upward with acceleration  $a$ , the scale reads  $N = m(g + a)$ .

**Step 1 — Data:**  $m = 60 \text{ kg}$ ,  $g = 10 \text{ m/s}^2$ ,  $a = 2 \text{ m/s}^2$ .

**Step 2 — Substitute:**

$$N = 60 \times (10 + 2) = 60 \times 12 = 720 \text{ N.}$$

**Why other options are wrong:**

- 480 N uses  $(g - a)$ ; 600 N ignores the acceleration; 120 N uses  $ma$  only.

**Final Answer:**  $N = 720 \text{ N} \Rightarrow$  C

Answer: (C) [Go Back to Q2](#)



Q3.

**Solution**

**Concept — Work-energy theorem:** Work done equals the change in kinetic energy,  $W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$ .

**Step 1 — Data:**  $m = 2 \text{ kg}$ ,  $u = 3 \text{ m/s}$ ,  $v = 6 \text{ m/s}$ .

**Step 2 — Compute:**

$$W = \frac{1}{2}(2)(6^2) - \frac{1}{2}(2)(3^2) = 36 - 9 = 27 \text{ J.}$$

**Why other options are wrong:**

- 9 J is only the initial KE; 36 J is only the final KE; 18 J comes from a wrong subtraction.

**Final Answer:**  $W = 27 \text{ J} \Rightarrow \boxed{\text{A}}$

**Answer: (A)** [Go Back to Q3](#)

Q4.

**Solution**

**Concept — Limiting friction:** The block just starts to move when the applied force equals the maximum static friction,  $F = \mu_s N = \mu_s mg$ .

**Step 1 — Normal force:** On a horizontal surface,  $N = mg = 5 \times 10 = 50 \text{ N}$ .

**Step 2 — Limiting friction:**

$$F = \mu_s N = 0.4 \times 50 = 20 \text{ N.}$$

**Why other options are wrong:**

- 50 N is the weight itself; 10 N and 25 N use the wrong coefficient or force.

**Final Answer:**  $F = 20 \text{ N} \Rightarrow \boxed{\text{D}}$

**Answer: (D)** [Go Back to Q4](#)



Q5.

**Solution**

**Concept — Variation of  $g$  with height:** At height  $h$  above the surface,  $g_h = \frac{gR^2}{(R+h)^2}$ .

**Step 1 — Put  $h = R$ :**

$$g_h = \frac{gR^2}{(R+R)^2} = \frac{gR^2}{(2R)^2} = \frac{gR^2}{4R^2} = \frac{g}{4}$$

**Why other options are wrong:**

- $g/2$  and  $g/3$  would need different heights;  $g$  is the surface value, not the value at height  $R$ .

**Final Answer:**  $g_h = \frac{g}{4} \Rightarrow$   B

**Answer: (B)** [Go Back to Q5](#)

Q6.

**Solution**

**Concept — Area under a  $v-t$  graph:** The distance travelled equals the area between the graph and the time axis.

**Step 1 — Read the graph:** The graph rises from 0 to 20 m/s during 0–2 s, stays at 20 m/s during 2–6 s, then falls to 0 during 6–10 s.

**Step 2 — Break into pieces:**

$$\text{rising triangle} = \frac{1}{2} \times 2 \times 20 = 20 \text{ m.}$$

$$\text{rectangle} = (6 - 2) \times 20 = 4 \times 20 = 80 \text{ m.}$$

$$\text{falling triangle} = \frac{1}{2} \times (10 - 6) \times 20 = \frac{1}{2} \times 4 \times 20 = 40 \text{ m.}$$

**Step 3 — Add them:**

$$s = 20 + 80 + 40 = 140 \text{ m.}$$

**Why other options are wrong:**

- 200 m treats the whole graph as a  $20 \times 10$  rectangle; 120 m and 100 m drop one of the triangular pieces.



**Final Answer:**  $s = 140 \text{ m} \Rightarrow \boxed{\text{C}}$

**Answer: (C)** [Go Back to Q6](#)

Q7.

### Solution

**Concept — Power:** Power is the rate of doing work,  $P = \frac{W}{t} = \frac{mgh}{t}$ .

**Step 1 — Work done against gravity:**  $W = mgh = 600 \times 10 \times 10 = 60000 \text{ J}$ .

**Step 2 — Power:**

$$P = \frac{60000}{20} = 3000 \text{ W}.$$

**Why other options are wrong:**

- 6000 W forgets to divide by time correctly; 1500 W and 300 W use wrong arithmetic.

**Final Answer:**  $P = 3000 \text{ W} \Rightarrow \boxed{\text{A}}$

**Answer: (A)** [Go Back to Q7](#)

Q8.

### Solution

**Concept — First law of thermodynamics:**  $\Delta U = Q - W$ , where  $Q$  is heat absorbed and  $W$  is work done by the gas.

**Step 1 — Data:**  $Q = +200 \text{ J}$ ,  $W = +80 \text{ J}$ .

**Step 2 — Substitute:**

$$\Delta U = Q - W = 200 - 80 = 120 \text{ J}.$$

**Why other options are wrong:**

- 280 J adds instead of subtracts; 200 J and 80 J ignore one of the terms.

**Final Answer:**  $\Delta U = 120 \text{ J} \Rightarrow \boxed{\text{D}}$

**Answer: (D)** [Go Back to Q8](#)



Q9.

**Solution**

**Concept — Pascal's law (hydraulic lift):** Pressure is transmitted equally, so  $\frac{F_1}{A_1} = \frac{F_2}{A_2}$ .

**Step 1 — Data:**  $F_1 = 20 \text{ N}$ ,  $A_1 = 0.01 \text{ m}^2$ ,  $A_2 = 0.5 \text{ m}^2$ .

**Step 2 — Solve for  $F_2$ :**

$$F_2 = F_1 \times \frac{A_2}{A_1} = 20 \times \frac{0.5}{0.01} = 20 \times 50 = 1000 \text{ N}.$$

**Why other options are wrong:**

- 500 N, 400 N and 2000 N come from using a wrong area ratio.

**Final Answer:**  $F_2 = 1000 \text{ N} \Rightarrow$   B

**Answer: (B)** [Go Back to Q9](#)

Q10.

**Solution**

**Concept — RMS speed and temperature:**  $v_{rms} = \sqrt{\frac{3RT}{M}} \propto \sqrt{T}$ .

**Step 1 — Apply the proportionality:** If  $T \rightarrow 4T$ , then  $v_{rms} \rightarrow \sqrt{4T} = 2\sqrt{T}$ .

**Step 2 — Conclusion:** The rms speed becomes **twice** the original.

**Why other options are wrong:**

- It does not become four times (that needs  $T \rightarrow 16T$ ); it cannot halve or stay unchanged.

**Final Answer:**  $v_{rms}$  becomes twice  $\Rightarrow$   C

**Answer: (C)** [Go Back to Q10](#)



Q11.

**Solution**

**Concept — Heat and specific heat:**  $Q = mc \Delta T$ .

**Step 1 — Data:**  $m = 200 \text{ g}$ ,  $c = 4.2 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$ ,  $\Delta T = 70 - 20 = 50 \text{ }^\circ\text{C}$ .

**Step 2 — Substitute:**

$$Q = 200 \times 4.2 \times 50 = 42000 \text{ J.}$$

**Why other options are wrong:**

- 21000 J uses  $\Delta T = 25$ ; 4200 J and 8400 J drop a factor of the mass or temperature change.

**Final Answer:**  $Q = 42000 \text{ J} \Rightarrow \boxed{\text{A}}$

**Answer: (A)** [Go Back to Q11](#)

Q12.

**Solution**

**Concept — Time period of a simple pendulum:**  $T = 2\pi \sqrt{\frac{L}{g}} \propto \sqrt{L}$ .

**Step 1 — Apply the proportionality:** If  $L \rightarrow 4L$ , then  $T \rightarrow \sqrt{4L} = 2\sqrt{L}$ .

**Step 2 — Conclusion:** The time period becomes **twice** the original.

**Why other options are wrong:**

- It does not become four times (that needs  $L \rightarrow 16L$ ); it cannot halve or stay the same.

**Final Answer:**  $T$  becomes twice  $\Rightarrow \boxed{\text{B}}$

**Answer: (B)** [Go Back to Q12](#)



Q13.

**Solution**

**Concept — Wave equation:** The speed, frequency and wavelength are related by  $v = f\lambda$ , so  $\lambda = \frac{v}{f}$ .

**Step 1 — Data:**  $v = 350$  m/s,  $f = 500$  Hz.

**Step 2 — Substitute:**

$$\lambda = \frac{350}{500} = 0.7 \text{ m.}$$

**Why other options are wrong:**

- 1.4 m, 0.5 m and 2.0 m come from dividing the wrong way or using wrong numbers.

**Final Answer:**  $\lambda = 0.7$  m  $\Rightarrow$   D

**Answer: (D)** [Go Back to Q13](#)

Q14.

**Solution**

**Concept — Energy in SHM:** At displacement  $x$ , PE =  $\frac{1}{2}kx^2$  and KE =  $\frac{1}{2}k(A^2 - x^2)$ .

**Step 1 — Set KE = PE:**

$$\frac{1}{2}k(A^2 - x^2) = \frac{1}{2}kx^2 \Rightarrow A^2 - x^2 = x^2.$$

**Step 2 — Solve:**  $A^2 = 2x^2$ , so  $x = \frac{A}{\sqrt{2}}$ .

**Why other options are wrong:**

- $A/2$  and  $A/4$  do not satisfy the equality; at  $x = A$  all energy is potential.

**Final Answer:**  $x = \frac{A}{\sqrt{2}}$   $\Rightarrow$   C

**Answer: (C)** [Go Back to Q14](#)



Q15.

**Solution**

**Concept — Coulomb's law:**  $F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$ .

**Step 1 — Data:**  $q_1 = 2 \times 10^{-6} \text{ C}$ ,  $q_2 = 3 \times 10^{-6} \text{ C}$ ,  $r = 0.3 \text{ m}$ .

**Step 2 — Substitute:**

$$F = 9 \times 10^9 \times \frac{(2 \times 10^{-6})(3 \times 10^{-6})}{(0.3)^2} = 9 \times 10^9 \times \frac{6 \times 10^{-12}}{0.09}$$

**Step 3 — Compute:**

$$F = 9 \times 10^9 \times 6.67 \times 10^{-11} = 0.6 \text{ N.}$$

**Why other options are wrong:**

- 0.06 N and 6 N misplace a power of ten; 0.3 N halves the result.

**Final Answer:**  $F = 0.6 \text{ N} \Rightarrow \boxed{\text{A}}$

**Answer: (A)** [Go Back to Q15](#)

Q16.

**Solution**

**Concept — Series resistors:** Resistances in series add:  $R_{eq} = R_1 + R_2 + R_3$ , and  $I = \frac{V}{R_{eq}}$ .

**Step 1 — Equivalent resistance:**  $R_{eq} = 2 + 4 + 6 = 12 \Omega$ .

**Step 2 — Current:**

$$I = \frac{V}{R_{eq}} = \frac{12}{12} = 1 \text{ A.}$$

**Why other options are wrong:**

- 3 A and 2 A use a smaller resistance; 0.5 A doubles the resistance.

**Final Answer:**  $I = 1 \text{ A} \Rightarrow \boxed{\text{D}}$

**Answer: (D)** [Go Back to Q16](#)



Q17.

**Solution**

**Concept — Power and resistance:** For a device rated  $P$  at voltage  $V$ ,  $R = \frac{V^2}{P}$ .

**Step 1 — Data:**  $V = 220 \text{ V}$ ,  $P = 60 \text{ W}$ .

**Step 2 — Substitute:**

$$R = \frac{(220)^2}{60} = \frac{48400}{60} \approx 807 \Omega.$$

**Why other options are wrong:**

- $367 \Omega$  uses  $110 \text{ V}$ ;  $220 \Omega$  and  $60 \Omega$  just repeat the given numbers.

**Final Answer:**  $R \approx 807 \Omega \Rightarrow \boxed{\text{B}}$

**Answer: (B)** [Go Back to Q17](#)

Q18.

**Solution**

**Concept — Energy stored in a capacitor:**  $U = \frac{1}{2}CV^2$ .

**Step 1 — Data:**  $C = 4 \times 10^{-6} \text{ F}$ ,  $V = 50 \text{ V}$ .

**Step 2 — Substitute:**

$$U = \frac{1}{2}(4 \times 10^{-6})(50)^2 = \frac{1}{2}(4 \times 10^{-6})(2500) = 5 \times 10^{-3} \text{ J}.$$

**Why other options are wrong:**

- $2 \times 10^{-3} \text{ J}$  forgets to square  $V$ ;  $1 \times 10^{-2} \text{ J}$  and  $1 \times 10^{-3} \text{ J}$  misplace the factor of  $\frac{1}{2}$ .

**Final Answer:**  $U = 5 \times 10^{-3} \text{ J} \Rightarrow \boxed{\text{C}}$

**Answer: (C)** [Go Back to Q18](#)



Q19.

**Solution**

**Concept — Parallel resistors:**  $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$ .

**Step 1 — Substitute:**

$$\frac{1}{R_{eq}} = \frac{1}{6} + \frac{1}{3} = \frac{1}{6} + \frac{2}{6} = \frac{3}{6} = \frac{1}{2}$$

**Step 2 — Invert:**  $R_{eq} = 2 \Omega$ .

**Why other options are wrong:**

- $9 \Omega$  adds them in series;  $4.5 \Omega$  averages them;  $18 \Omega$  multiplies them.

**Final Answer:**  $R_{eq} = 2 \Omega \Rightarrow$   A

**Answer: (A)** [Go Back to Q19](#)

Q20.

**Solution**

**Concept — Electric field of a point charge:**  $E = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2}$ .

**Step 1 — Data:**  $q = 3 \times 10^{-6} \text{ C}$ ,  $r = 0.3 \text{ m}$ .

**Step 2 — Substitute:**

$$E = 9 \times 10^9 \times \frac{3 \times 10^{-6}}{(0.3)^2} = 9 \times 10^9 \times \frac{3 \times 10^{-6}}{0.09}$$

**Step 3 — Compute:**

$$E = 9 \times 10^9 \times 3.33 \times 10^{-5} = 3 \times 10^5 \text{ N/C}$$

**Why other options are wrong:**

- $9 \times 10^4$  and  $9 \times 10^5 \text{ N/C}$  misuse the distance; the value is exactly  $3 \times 10^5 \text{ N/C}$ .

**Final Answer:**  $E = 3 \times 10^5 \text{ N/C} \Rightarrow$   C

**Answer: (C)** [Go Back to Q20](#)



Q21.

**Solution**

**Concept — Magnetic force on a moving charge:**  $F = qvB \sin \theta$ ; for  $\theta = 90^\circ$ ,  $F = qvB$ .

**Step 1 — Data:**  $q = 2 \text{ C}$ ,  $v = 5 \text{ m/s}$ ,  $B = 0.4 \text{ T}$ .

**Step 2 — Substitute:**

$$F = 2 \times 5 \times 0.4 = 4 \text{ N.}$$

**Why other options are wrong:**

- 2 N, 10 N and 0.8 N drop or misuse one of the three factors.

**Final Answer:**  $F = 4 \text{ N} \Rightarrow$   B

Answer: (B) [Go Back to Q21](#)

Q22.

**Solution**

**Concept — Field inside a solenoid:**  $B = \mu_0 n I$ , where  $n$  is the number of turns per metre.

**Step 1 — Data:**  $n = 500 \text{ m}^{-1}$ ,  $I = 4 \text{ A}$ ,  $\mu_0 = 4\pi \times 10^{-7}$ .

**Step 2 — Substitute:**

$$B = (4\pi \times 10^{-7})(500)(4) = 4\pi \times 10^{-7} \times 2000.$$

**Step 3 — Compute:**

$$B = 8000\pi \times 10^{-7} = 2.51 \times 10^{-3} \text{ T.}$$

**Why other options are wrong:**

- $1 \times 10^{-3}$  and  $4 \times 10^{-3} \text{ T}$  use wrong factors;  $2.5 \times 10^{-3}$  drops the factor of  $\pi$  in the rounding.

**Final Answer:**  $B \approx 2.51 \times 10^{-3} \text{ T} \Rightarrow$   C

Answer: (C) [Go Back to Q22](#)



Q23.

**Solution**

**Concept — Faraday's law:** The induced emf is  $\varepsilon = -N \frac{\Delta\Phi}{\Delta t}$ ; its magnitude is  $N \frac{\Delta\Phi}{\Delta t}$ .

**Step 1 — Data:**  $N = 200$ ,  $\Delta\Phi = 0.05 - 0.02 = 0.03$  Wb,  $\Delta t = 0.1$  s.

**Step 2 — Substitute:**

$$|\varepsilon| = 200 \times \frac{0.03}{0.1} = 200 \times 0.3 = 60 \text{ V.}$$

**Why other options are wrong:**

- 6 V and 0.6 V misplace a power of ten; 30 V forgets the number of turns.

**Final Answer:**  $|\varepsilon| = 60 \text{ V} \Rightarrow \boxed{\text{A}}$

**Answer: (A)** [Go Back to Q23](#)

Q24.

**Solution**

**Concept — RMS value of AC:**  $V_{rms} = \frac{V_0}{\sqrt{2}}$ .

**Step 1 — Data:**  $V_0 = 311$  V.

**Step 2 — Substitute:**

$$V_{rms} = \frac{311}{\sqrt{2}} = \frac{311}{1.414} \approx 220 \text{ V.}$$

**Why other options are wrong:**

- 311 V is the peak value; 440 V multiplies instead of divides; 155 V halves the peak.

**Final Answer:**  $V_{rms} \approx 220 \text{ V} \Rightarrow \boxed{\text{D}}$

**Answer: (D)** [Go Back to Q24](#)



Q25.

**Solution**

**Concept — Mirror formula:**  $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ , with the sign convention  $u = -30$  cm,  $f = -20$  cm for a concave mirror.

**Step 1 — Substitute:**

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

**Step 2 — Common denominator:**

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

**Step 3 — Image distance:**  $v = -60$  cm, so the image is 60 cm in front of the mirror (real).

**Why other options are wrong:**

- 30 cm, 12 cm and 20 cm come from sign errors in the mirror formula.

**Final Answer:**  $|v| = 60$  cm  $\Rightarrow$   B

**Answer: (B)** [Go Back to Q25](#)

Q26.

**Solution**

**Concept — Snell's law:**  $n_1 \sin i = n_2 \sin r$ , so  $\sin r = \frac{n_1 \sin i}{n_2}$ .

**Step 1 — Data:**  $n_1 = 1$  (air),  $i = 30^\circ$ ,  $n_2 = 1.5$ ,  $\sin 30^\circ = 0.5$ .

**Step 2 — Substitute:**

$$\sin r = \frac{1 \times 0.5}{1.5} = \frac{0.5}{1.5} = 0.33$$

**Why other options are wrong:**

- 0.75 multiplies by 1.5 instead of dividing; 0.5 ignores the medium; 0.67 uses the wrong ratio.

**Final Answer:**  $\sin r = 0.33 \Rightarrow$   C

**Answer: (C)** [Go Back to Q26](#)



Q27.

**Solution**

**Concept — Fringe width:** In Young's experiment,  $\beta = \frac{\lambda D}{d}$ .

**Step 1 — Data:**  $\lambda = 600 \times 10^{-9} \text{ m}$ ,  $D = 1 \text{ m}$ ,  $d = 1 \times 10^{-3} \text{ m}$ .

**Step 2 — Substitute:**

$$\beta = \frac{(600 \times 10^{-9})(1)}{1 \times 10^{-3}} = 600 \times 10^{-6} = 6 \times 10^{-4} \text{ m} = 0.6 \text{ mm}.$$

**Why other options are wrong:**

- 6 mm and 0.06 mm misplace a power of ten; 1.2 mm doubles the result.

**Final Answer:**  $\beta = 0.6 \text{ mm} \Rightarrow \boxed{\text{A}}$

**Answer: (A)** [Go Back to Q27](#)

Q28.

**Solution**

**Concept — Photon energy:**  $E = \frac{hc}{\lambda}$ ; using  $hc = 1240 \text{ eV nm}$ ,  $E(\text{eV}) = \frac{1240}{\lambda(\text{nm})}$ .

**Step 1 — Data:**  $\lambda = 600 \text{ nm}$ .

**Step 2 — Substitute:**

$$E = \frac{1240}{600} = 2.07 \text{ eV}.$$

**Why other options are wrong:**

- 1.0 eV and 1.5 eV underestimate; 3.1 eV corresponds to about 400 nm.

**Final Answer:**  $E \approx 2.07 \text{ eV} \Rightarrow \boxed{\text{D}}$

**Answer: (D)** [Go Back to Q28](#)



Q29.

**Solution**

**Concept — Radioactive decay:** After  $n$  half-lives, the remaining fraction is  $\left(\frac{1}{2}\right)^n$ .

**Step 1 — Number of half-lives:**  $n = \frac{15}{5} = 3$ .

**Step 2 — Fraction remaining:**

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

**Why other options are wrong:**

- $\frac{1}{4}$  is after 2 half-lives;  $\frac{1}{16}$  after 4;  $\frac{1}{2}$  after 1.

**Final Answer:** Fraction =  $\frac{1}{8} \Rightarrow$   B

**Answer: (B)** [Go Back to Q29](#)

Q30.

**Solution**

**Concept — p-n junction under forward bias:** Forward bias lowers the potential barrier, narrows the depletion region, and allows a large current.

**Explanation:** Under forward bias the external field opposes the built-in field, so the **depletion region narrows** and the diode conducts easily (low resistance).

**Why other options are wrong:**

- The depletion region widening, high resistance and no current all describe reverse bias, not forward bias.

**Final Answer:** Depletion region decreases, current flows  $\Rightarrow$   C

**Answer: (C)** [Go Back to Q30](#)



## Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	C	3	A	4	D	5	B
6	C	7	A	8	D	9	B	10	C
11	A	12	B	13	D	14	C	15	A
16	D	17	B	18	C	19	A	20	C
21	B	22	C	23	A	24	D	25	B
26	C	27	A	28	D	29	B	30	C

