ICSE CLASS 10 EXAMINATION

SAMPLE PAPER 1 · STEP-BY-STEP SOLUTIONS & MARKING SCHEME

PHYSICS

(SCIENCE PAPER 1)

Maximum Marks: 80 · Section A (40) compulsory · Section B: any four of six questions (4 × 10 = 40). Marks for each step are shown in square brackets on the right. Parts added in the solution diagrams are drawn in red. Cartesian sign convention is used for lenses.

SECTION A (40 Marks)

Question 1 — Multiple choice [15 marks, 1 mark each]

No.	Answer	Reason
(i)	**(c)** 90 g	Anticlockwise moment = 60 × (50 − 20) = 1800 gf cm; clockwise moment = m × (70 − 50) = 20 m, so m = 1800 ÷ 20 = 90 g.
(ii)	**(b)** 2 m	K.E. at the start = P.E. at the top: mgh = 40, so h = 40 ÷ (2 × 10) = 2 m.
(iii)	**(b)** 4	M.A. = efficiency × V.R. = 0.80 × 5 = 4.
(iv)	**(b)** 2×10^8 m s^{-1}	$v = c \div \mu = (3 \times 10^8) \div 1.5 = 2 \times 10^8$ m s^{-1}.
(v)	**(c)** 2	$\mu = 1 \div \sin C = 1 \div \sin 30° = 1 \div 0.5 = 2$.
(vi)	**(c)** 20 cm	A real image of the same size is formed when the object is at 2f, i.e. 2 × 10 = 20 cm.
(vii)	**(b)** ultraviolet rays	Ultraviolet rays make the security marks on genuine notes fluoresce.
(viii)	**(b)** 340 m s^{-1}	$v = f\lambda = 500 \times 0.68 = 340$ m s^{-1}.
(ix)	**(c)** Both (A) and (R) are true, and (R) is the correct explanation for (A).	Both are true: the minimum distance for a distinct echo is about 17 m (0.1 s), which a small room does not give; (R) explains (A).
(x)	**(a)** 1 Ω	1/R = 1/2 + 1/3 + 1/6 = (3 + 2 + 1) ÷ 6 = 1, so R = 1 Ω.
(xi)	**(b)** 2 A	Total resistance = 4 + 2 = 6 Ω; I = V ÷ R = 12 ÷ 6 = 2 A.
(xii)	**(b)** live wire	The fuse is placed in the live wire so that the appliance is disconnected from the high potential when the fuse blows.
(xiii)	**(a)** 55 V	$E_s = E_p \times N_s \div N_p = 220 \times 100 \div 400 = 55$ V.
(xiv)	**(c)** 4200 J	$Q = mc\Delta T = 100 \times 4.2 \times 10 = 4200$ J.
(xv)	**(b)** 144	Daughter is $^{234}_{90}$Th: neutrons = 234 − 90 = 144.

Question 2 [10 marks]

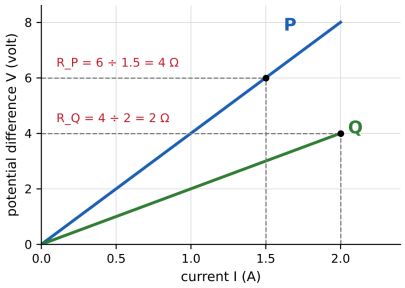
(i) (a) **zero** (the force is perpendicular to the displacement). (b) **+5** (P = 1 ÷ 0.2 m). (c) **increases**. (d) **less** ($E_p I_p = E_s I_s$, so more voltage means less current). (e) **low**. (f) **remains the same** (only Z increases by 1). [6 × 1] **[6]**

(ii) (a) Total internal reflection → **1** (sparkling of a diamond). [1] **[2]**

(b) Scattering of light → **3** (blue colour of the sky). [1]

(iii) (a) **P**: for the same current it has the greater potential difference (greater slope of the V–I graph). [1] **[2]**

(b) $R_Q = V \div I = 4 \div 2 = \mathbf{2\ \Omega}$. [1]

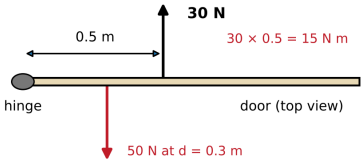


Solution to Q2(iii)

Question 3 [15 marks]

(i) (a) Moment = F × d = 30 × 0.5 = **15 N m**. [1] **[2]**

(b) For balance, 50 × d = 15, so d = **0.3 m**. [1]



Solution to Q3(i)

(ii) (a) W = mgh = 120 × 10 × 10 = **12000 J**. [1] **[2]**

(b) P = W ÷ t = 12000 ÷ 20 = **600 W**. [1]

(iii) (a) V.R. = length ÷ height = 5 ÷ 1 = **5**. [1] **[2]**

(b) M.A. = load ÷ effort = 1000 ÷ 250 = 4; efficiency = M.A. ÷ V.R. × 100 = (4 ÷ 5) × 100 = **80%**. [1]

(iv) (a) Energy = 1 kW × (3 h × 30) = **90 kWh**. [1] **[2]**

(b) Cost = 90 × 7 = **₹ 630**. [1]

(v) (a) **Specific heat capacity** is the heat energy required to raise the temperature of unit mass (1 kg or 1 g) of a substance by 1 °C (1 K). [1] **[2]**

(b) Q = mcΔT = 250 × 2 × (60 − 20) = **20000 J**. [1]

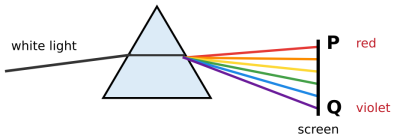
(vi) (a) Mass number: 214 − 210 = 4; atomic number: 84 − 82 = 2, so the particle is an α-particle: **$^{4}_{2}$He**. [1] **[2]**

(b) **γ-radiation**. [1]

(vii) (a) **Dispersion** of light. [1] **[3]**

(b) P is **red** (least deviated) and Q is **violet** (most deviated). [1]

(c) Different colours have different speeds (refractive indices) in glass, so they are refracted through different angles and get separated. [1]



Solution to Q3(vii)

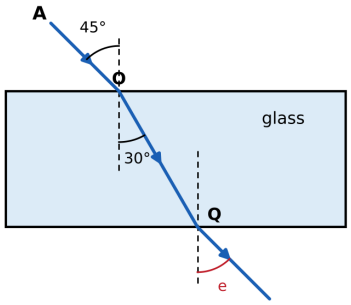
SECTION B (40 Marks) — any four questions

Question 4 [10 marks]

(i) (a) μ = sin i ÷ sin r = sin 45° ÷ sin 30° = 0.707 ÷ 0.5 = **1.41**. [1] **[3]**

(b) v = c ÷ μ = (3 × 10^8) ÷ 1.41 = **2.1 × 10^8 m s^{-1}**. [1]

(c) The faces of a slab are parallel, so the emergent ray is parallel to the incident ray: **e = 45°**. [1]

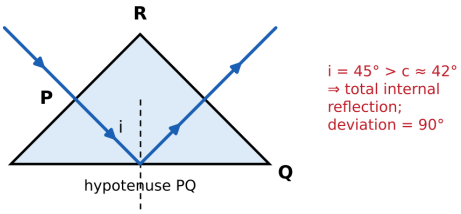


Solution to Q4(i)

(ii) (a) sin C = 1 ÷ μ = 1 ÷ 1.5 = 0.667, so **C ≈ 42°**. [1] **[3]**

(b) The ray meets PQ at an angle of incidence of 45° (the prism is isosceles right-angled), which is greater than C (42°) and the ray moves from denser to rarer medium: **yes, total internal reflection** occurs. [1]

(c) The ray turns through **90°** (it enters along the normal, is reflected at PQ and emerges along the normal from QR). [1]



Solution to Q4(ii)

(iii) Given: h = +4 cm, u = −15 cm, f = +10 cm. **[4]**

(a) 1/v − 1/u = 1/f ⇒ 1/v = 1/10 + 1/(−15) = 1/10 − 1/15 = 1/30, so v = **+30 cm** (on the other side of the lens). [1]

(b) m = v ÷ u = 30 ÷ (−15) = **−2**. [1]

(c) h′ = m × h = −2 × 4 = −8 cm: the image is **8 cm** high (inverted). [1]

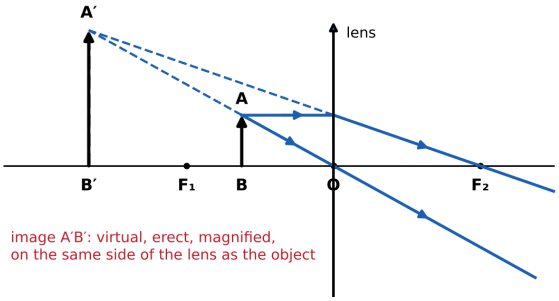
(d) The image is **real, inverted and magnified**. [1]

Question 5 [10 marks]

(i) Ray 1: from the top A of the object, a ray parallel to the principal axis is refracted through the focus F_2 on the other side. [1] **[3]**

Ray 2: a ray from A through the optical centre O passes undeviated. The refracted rays diverge; produced backwards they meet at A′. [1]

Image A′B′ is **virtual, erect, magnified and on the same side as the object**. [1]

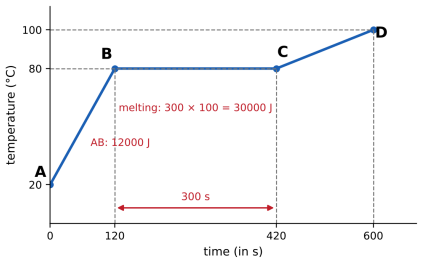


Solution to Q5(i)

(ii) (a) The temperature stays constant at 80 °C during melting: **melting point = 80 °C**. [1] **[3]**

(b) Heat for AB = Pt = 100 × 120 = 12000 J; c = Q ÷ (mΔT) = 12000 ÷ (200 × 60) = **1 J g⁻¹ °C⁻¹**. [1]

(c) Heat for BC = 100 × (420 − 120) = 30000 J; L = Q ÷ m = 30000 ÷ 200 = **150 J g⁻¹**. [1]



Solution to Q5(ii)

(iii) Rise in temperature of water and calorimeter = 30 − 20 = 10 °C. **[4]**

(a) Heat gained by water = 150 × 4.2 × 10 = **6300 J**. [1]

(b) Heat gained by calorimeter = 50 × 0.4 × 10 = **200 J**. [1]

(c) Heat lost by block = heat gained = 6300 + 200 = **6500 J**. [1]

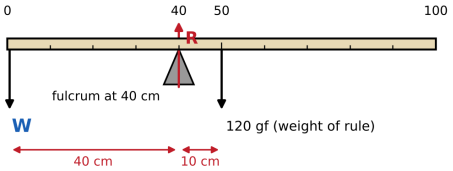
(d) 200 × 0.5 × (t − 30) = 6500, so t − 30 = 65 and **t = 95 °C**. [1]

Question 6 [10 marks]

(i) (a) The **principle of moments**: for equilibrium, the sum of clockwise moments = the sum of anticlockwise moments about the pivot. [1] **[3]**

(b) W × 40 = 120 × (50 − 40) = 120 × 10, so **W = 30 gf**. [1]

(c) Reaction R = W + weight of rule = 30 + 120 = **150 gf** (upward). [1]



Solution to Q6(i)

(ii) (a) P.E. = mgh = 0.5 × 10 × 20 = **100 J**. [1] **[3]**

(b) By the **principle of conservation of energy**, the P.E. lost is gained as K.E., so K.E. just before hitting the ground = **100 J**. [1]

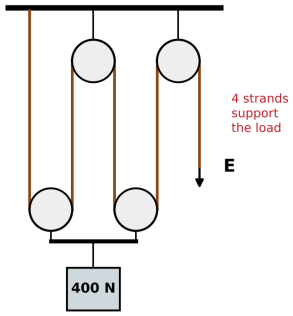
(c) ½ mv² = 100, so v² = 200 ÷ 0.5 = 400 and **v = 20 m s⁻¹**. [1]

(iii) (a) V.R. = number of strands supporting the movable block = **4**. [1] **[4]**

(b) M.A. = load ÷ effort = 400 ÷ 125 = **3.2**. [1]

(c) Efficiency = M.A. ÷ V.R. × 100 = (3.2 ÷ 4) × 100 = **80%**. [1]

(d) Output work = 400 × 0.5 = 200 J; the effort moves 4 × 0.5 = 2 m, so input work = 125 × 2 = 250 J; energy wasted = 250 − 200 = **50 J**. [1]



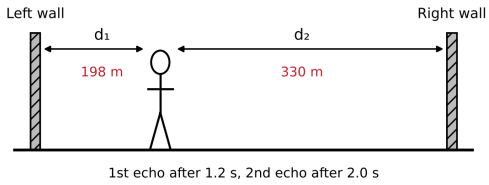
Solution to Q6(iii)

Question 7 [10 marks]

(i) (a) Sound travels $2d_1$ in 1.2 s: $d_1 = (330 \times 1.2) \div 2 =$ **198 m**. [1] **[3]**

(b) $2d_2 = 330 \times 2.0 = 660$ m, so $d_2 =$ **330 m**. [1]

(c) Distance between walls = $d_1 + d_2 = 198 + 330 =$ **528 m**. [1]

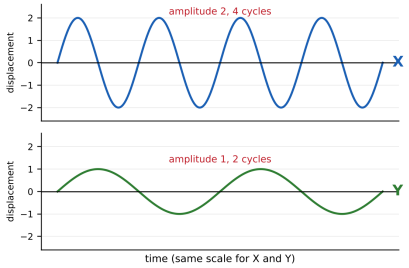


Solution to Q7(i)

(ii) (a) **X** is louder: loudness depends on amplitude, and X has the larger amplitude (2 against 1). [1] **[3]**

(b) **X** has the higher pitch, since it completes more cycles (4 against 2) in the same time, i.e. its frequency is higher. [1]

(c) $f_X = 2 \times f_Y = 2 \times 128 =$ **256 Hz**. [1]



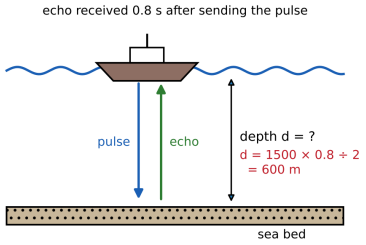
Solution to Q7(ii)

(iii) (a) **Ultrasonic waves** are sound waves of frequency above 20 000 Hz (the upper limit of human hearing). [1] **[4]**

(b) Distance travelled = $1500 \times 0.8 = 1200$ m (to the sea bed and back), so depth = $1200 \div 2 =$ **600 m**. [1]

(c) Ultrasonic waves have a very short wavelength and travel as a narrow beam over long distances without spreading, so the echo can be detected accurately; audible sound spreads out. [1]

(d) Any one: scanning (imaging) of internal organs, breaking kidney stones, cleaning of surgical instruments. [1]



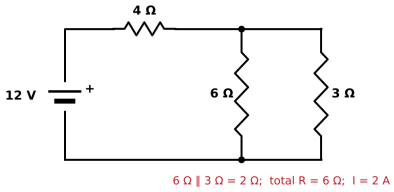
Solution to Q7(iii)

Question 8 [10 marks]

(i) (a) $1/R = 1/6 + 1/3 = 1/2$, so R_p = **2 Ω**. [1] **[3]**

(b) Total R = 4 + 2 = 6 Ω; I = V ÷ R = 12 ÷ 6 = **2 A**. [1]

(c) The p.d. across the parallel part = I × R_p = 2 × 2 = 4 V, which is also the p.d. across the 3 Ω resistor: **4 V**. [1]

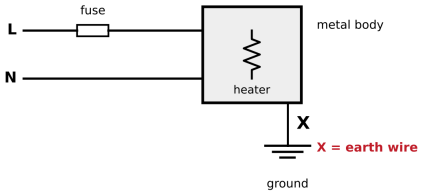


Solution to Q8(i)

(ii) (a) I = P ÷ V = 1650 ÷ 220 = **7.5 A**. [1] **[3]**

(b) The **10 A** fuse: its rating must be just above the normal current (7.5 A); a 5 A fuse would blow in normal use and a 15 A fuse would not protect the circuit well. [1]

(c) The **earth wire**; it provides a low-resistance path for leakage current to the ground, so the body stays at zero potential and the user is protected from shock. [1]



Solution to Q8(ii)

(iii) (a) R = ρl ÷ A ∝ l ÷ r². $R_P : R_Q$ = (L ÷ r²) : (2L ÷ 4r²) = 1 : ½ = **2 : 1**. [1] **[4]**

(b) In parallel the p.d. is the same, so I ∝ 1 ÷ R: $I_P : I_Q$ = **1 : 2**. [1]

(c) In series the current is the same, so power P = I²R ∝ R: $P_P : P_Q$ = **2 : 1**. [1]

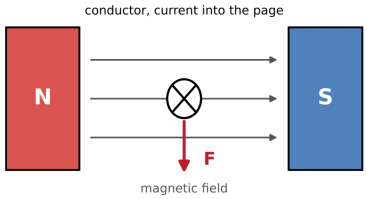
(d) The resistivities are **equal**, since resistivity depends only on the material (and temperature), not on the dimensions. [1]

Question 9 [10 marks]

(i) (a) Field from N to S (left to right), current into the page: the force is **downward** (in the plane of the paper, perpendicular to both). [1] **[3]**

(b) **Fleming's left hand rule** (forefinger – field, central finger – current, thumb – force). [1]

(c) The direction of the force **remains the same**, since reversing both factors reverses the force twice. [1]

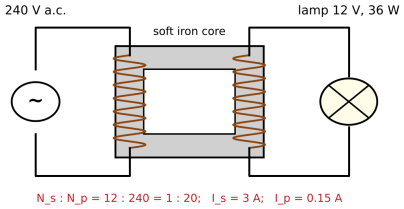


Solution to Q9(i)

(ii) (a) $N_s \div N_p = E_s \div E_p = 12 \div 240 =$ **1 : 20**. [1] **[3]**

(b) $I_s = P \div E_s = 36 \div 12 =$ **3 A**. [1]

(c) For an ideal transformer, input power = output power: $I_p = 36 \div 240 =$ **0.15 A** (= 3 ÷ 20). [1]



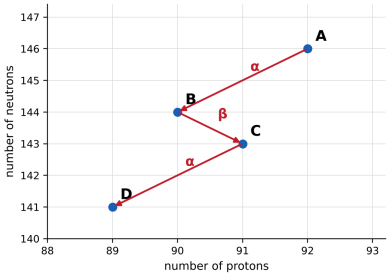
Solution to Q9(ii)

(iii) (a) From A (92, 146) to B (90, 144): Z falls by 2 and N by 2, so mass number falls by 4: an **α-particle**. $^{238}_{92}A \rightarrow {}^{234}_{90}B + {}^{4}_{2}He$. [1] **[4]**

(b) From B (90, 144) to C (91, 143): Z increases by 1 and N decreases by 1 (a neutron changes into a proton): a **β-particle** (electron). [1]

(c) From C (91, 143) to D (89, 141): Z and N each fall by 2: an **α-particle**. [1]

(d) **B and C**: both have mass number 234 but different atomic numbers (90 and 91). [1]



Solution to Q9(iii)

Marks summary	
Section A: Q1 (15) + Q2 (6 + 2 + 2 = 10) + Q3 (2 × 6 + 3 = 15)	**40**
Section B: any four of Q4 – Q9 (3 + 3 + 4 = 10 marks each)	**40**
Total	**80**