2010 Physics

Standard Grade − Credit

Finalised Marking Instructions

Physics – Marking Issues

The current in a resistor is 1·5 amperes when the potential difference across it is 7·5 volts. Calculate the resistance of the resistor.

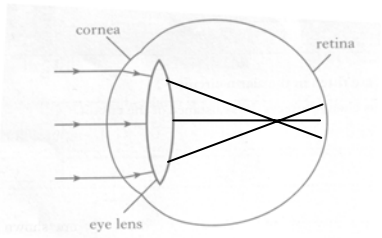
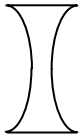
	Answers	**Mark + Comment**	**Issue**
1.	$V=IR$ $7{\cdot}5=1{\cdot}5R$ $R=5{\cdot}0\ \Omega$	(½) (½) (1)	Ideal answer
2.	$5{\cdot}0\ \Omega$	(2) Correct answer	GMI 1
3.	5·0	(1½) Unit missing	GMI 2 (a)
4.	$4{\cdot}0\ \Omega$	(0) No evidence/wrong answer	GMI 1
5.	_____ Ω	(0) No final answer	GMI 1
6.	$R=\frac{V}{I}=\frac{7{\cdot}5}{1{\cdot}5}=4{\cdot}0\,\Omega$	(1½) Arithmetic error	GMI 7
7.	$R=\frac{V}{I}=4{\cdot}0\,\Omega$	(½) Formula only	GMI 4 and 1
8.	$R=\frac{V}{I}=$ _____Ω	(½) Formula only	GMI 4 and 1
9.	$R=\frac{V}{I}=\frac{7{\cdot}5}{1{\cdot}5}=$ _____Ω	(1) Formula + subs/No final answer	GMI 4 and 1
10.	$R=\frac{V}{I}=\frac{7{\cdot}5}{1{\cdot}5}=4{\cdot}0$	(1) Formula + substitution	GMI 2 (a) and 7
11.	$R=\frac{V}{I}=\frac{1{\cdot}5}{7{\cdot}5}=5{\cdot}0\,\Omega$	(½) Formula but wrong substitution	GMI 5
12.	$R=\frac{V}{I}=\frac{75}{1{\cdot}5}=5{\cdot}0\,\Omega$	(½) Formula but wrong substitution	GMI 5
13.	$R=\frac{I}{V}=\frac{7{\cdot}5}{1{\cdot}5}=5{\cdot}0\,\Omega$	(0) Wrong formula	GMI 5
14.	$V=IR\quad 7{\cdot}5=1{\cdot}5\times R\quad R=0{\cdot}2\ \Omega$	(1½) Arithmetic error	GMI 7
15.	$V=IR$ $R=\frac{I}{V}=\frac{1{\cdot}5}{7{\cdot}5}=0{\cdot}2\,\Omega$	(½) Formula only	GMI 20

Part Two: Marking Instructions for each Question

Question			Expected Answer/s	Max Mark	Additional Guidance
1	**a**	**i**	340 m/s (1 or 0)	**1**	Must have correct unit – no (½) marks NOT 'speed of sound' alone
1	**a**	**ii**	$\lambda = \frac{v}{f}$ (½) $= \frac{340}{40000}$ (½) $= 0{\cdot}0085$ m (1)	**2**	Accept value for speed from 1a(i)
1	**b**		$t = \frac{d}{v}$ (½) $= \frac{1{\cdot}7}{340}$ (½) $= 0{\cdot}005$ s (1) (unit not required unless final answer) time taken to return = $2 \times 0{\cdot}01$ = $0{\cdot}01$ s (1)	**3**	Accept value for speed from 1a(i) Final mark is for multiplication by 2. This may occur at end of calculation (to get final time) or at start of calculation (to get 2 times the distance) Max 2 marks if no multiplication by 2.
1	**c**		Decreases OR reduces OR gets smaller OR (gets) less	**1**	NOT '(gets) quicker'
2	**a**		• Radio (signals/waves) have a longer wavelength than television (signals/waves) (1) • Longer wavelengths diffract more (1)	**2**	Must mention both points for full marks If 'radio diffracts more than TV signals' only then (1) max.
2	**b**	**i**	3×10^8 m/s (1 or 0) OR 3 000 000 000 m/s	**1**	Must have correct value and unit – no (½) marks NOT: 'same as speed of light' alone

Question			Expected Answer/s	Max Mark	Additional Guidance
2	**b**	**ii**	(orbits the equator with a) period of 24 hours OR stays above the same point on the Earth's surface OR orbits at 36000 km (above the equator) OR same period as Earth OR same rate of rotation as Earth	**1**	Do not accept: 'Same speed as Earth' OR '(Stays above) same point in space' OR 'Stationary'
3	**a**		$I = \frac{1 \cdot 2}{2}$ $= 0 \cdot 6$ A	**1**	1 mark for final answer deduct (½) if wrong/ missing unit
3	**b**		$R = \frac{V}{I}$ (½) $= \frac{3}{0 \cdot 6}$ (½) $= 5 \cdot 0\ \Omega$ (1)	**2**	Accept value for current from 3(a)
3	**c**		$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$ (½) $= \frac{1}{5} + \frac{1}{5}$ (½) $R_T = 2 \cdot 5\ \Omega$ (1) OR $R = \frac{V}{1}$ (½) $= \frac{3}{1 \cdot 2}$ (½) $R = 2 \cdot 5\ \Omega$ (1) OR $R_T = \frac{R_1 R_2}{R_1 + R_2}$ (½) $= \frac{5 \times 5}{5 + 5}$ (½) $= \frac{25}{10}$ $R_T = 2 \cdot 5 \Omega$ (1)	**2**	Accept calculated value for lamp resistance from 3(b) If wrong equation: $R_T = \frac{1}{R_1} + \frac{1}{R_2}$ then (0) marks Accept imprecise working towards correct answer: $\frac{1}{R_T} = \frac{1}{5} + \frac{1}{5} = \frac{2}{5} = \frac{5}{2} = 2 \cdot 5\Omega$ ↑ accept If final answer $R_T = 2/5\ \Omega$ or $0 \cdot 4\ \Omega$ award (1) mark maximum Accept 5/2 Ω or 2 ½ Ω Accept value for single resistor divided by two

Question			Expected Answer/s	Max Mark	Additional Guidance
3	**d**		$R_T = R_1 + R_2$ (½) $= 2{\cdot}5 + 7{\cdot}5$ (½) $= 10\ \Omega$ (1) OR $R_T = \frac{V_S}{I_T}$ (½) $= \frac{12}{1{\cdot}2}$ (½) $= 10\ \Omega$ (1)	**2**	For this method must be consistent with 3(c)
3	**e**	**i**	(The ammeter reading will) decrease	**1**	Any indication of a reduction of the ammeter reading
3	**e**	**ii**	since the circuit resistance has now increased	**1**	Answer must indicate an **increase** in (total) circuit resistance
4	**a**	**i**	To protect the flex/wire/cable	**1**	**Not** 'to protect appliance'
4	**a**	**ii**	$I = \frac{P}{V}$ (½) $= \frac{2530}{230}$ (½) $= 11{\cdot}0$ A (1) (unit required) no significant figure issue	**2**	No final statement required, but full calculation to show the final current is required
4	**b**	**i**	Motor weighs less/has smaller mass OR field can be controlled/altered OR field is stronger OR can be used on ac or dc OR can be reversed/switched off OR permanent magnets can lose strength	**1**	NOT: 'stronger' by itself 'cheaper' 'easier to replace'

Question			Expected Answer/s	Max Mark	Additional Guidance
4	**b**	**ii**	Motor turns more smoothly OR is more powerful OR greater turning force OR self-starting	**1**	
4	**c**		$E = P \times t$ (½) $E = 1000 \times 60 \times 60$ (½) $= 3\ 600\ 000$ J (1)	**2**	If incorrect conversion of kW into watts or hour into seconds then treat as unit error deduct (½) max
5	**a**		$P = \frac{1}{f}$ (½) $= \frac{1}{0 \cdot 022}$ (½) $= 45$ D (1) rounded	**2**	Accept answers in significant figure range: {50, 45, 45.5, 45.45} Multiple unit error possible; deduct (½) mark maximum unit penalty.
5	**b**	**i**	short sight OR myopia	**1**	
5	**b**	**ii**		**1**	(½) for showing correct refraction direction (½) for showing convergence before retina Ignore rays continued beyond retina **No** dotted line from b(i), rays **must** show convergence before retina because question describes rays from a distant object, and a blurred image.
5	**b**	**iii**	Rays are not focused on retina OR rays are not brought together at back of eye OR rays do not meet/join at retina OR rays are focussing/converging in front of retina OR image is formed before/in front of retina	**1**	Only accept 'rays converge after retina' if this is shown in b(i)
5	**b**	**iv**		**1**	accept  OR 

Question			Expected Answer/s	Max Mark	Additional Guidance
6	**a**	**i**	When an atom gains negative charge OR When an atom loses negative charge OR When an atom gains electrons OR When an atom loses electrons	**1**	
6	**a**	**ii**	Alpha or α OR neutrons OR x-rays OR ultraviolet OR cosmic rays	**1**	
6	**b**		$\frac{24}{8}$ (½) = 3 half lives (½) 6 → 12 → 24 → <u>48</u> (½) for showing doubling process (½) for answer	**2**	Unit not required but deduct (½) if wrong unit given in final answer Doubling process (½) mark is independent of calculation of number of half lives. Candidates who show less/more than three doublings can gain this half mark, but all stages must be numerically doubled.
6	**c**	**i**	sieverts OR Sv OR mSv OR µSv	**1**	Accept upper or lower case abbreviation eg sV or SV or sv

Question			Expected Answer/s	Max Mark	Additional Guidance
6	**c**	**ii**	Type of (absorbing) tissue OR Absorbed dose OR weighting factor OR time OR energy (absorbed) OR nature / type / energy } of radiation OR part of body exposed OR duration of exposure OR mass of material/tissue exposed (not mass alone)	**2**	Any 2 correct (1) mark each Apply ± rule if more than 2 answers given and some are incorrect NOT: 'strength/power of radiation' 'distance' 'size of material/tissue' 'area' 'shielding' 'half life' 'how much' 'amount of'
7	**a**		Sensor resistance = 22 000 Ω (1) (must be value taken from table) $V_2 = \frac{R_2}{R_1 + R_2} V_S$ (½) $= \frac{22000}{88000} \times 5$ (½) $= 1{\cdot}25$ V (1) OR $\frac{V_1}{V_2} = \frac{R_1}{R_2}$ $\frac{5}{V_2} = \frac{88000}{22000}$ (1) $V_2 = 1{\cdot}25\,V$ (1) OR $I = \frac{V}{R}$ $= \frac{5}{88\,000}$ $= 5.68 \times 10^{-5}$ (A) *then* $V = IR$ $= 5.68 \times 10^{5} \times 22\,000$ $= 1.25\,V$	**3**	if wrong value selected from table then (½) max for selecting equation Only accept this method if substitutions are for supply voltage, total resistance and resistance of sensor. (0) marks if relationship stated alone or implied by any other substitution. (½) for attempted use of **two** V = IR equations (½) for all substitutions correct (1) for final answer

<table>
<tr><th colspan="3">Question</th><th>Expected Answer/s</th><th>Max Mark</th><th>Additional Guidance</th></tr>
<tr><td>7</td><td>b</td><td>i</td><td>9</td><td>1</td><td></td></tr>
<tr><td>7</td><td>b</td><td>ii</td><td>$P = \frac{V^2}{R}$ (½)
$V^2 = 0{\cdot}147 \times 120$ (½)
$V = 4{\cdot}2$ V (1)

OR

$P = I^2R$
$0.147 = I^2 \times 120$
$I = 0.035(A)$

then

$V = IR$
$= 0.035 \times 120$
$= 4.2V$</td><td>2</td><td>If no/incorrect conversion of 147 mW then unit error deduct (½)

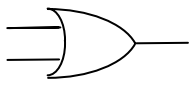
If 147mW not converted to W then V = 133 V
Sig fig range: {130, 133, 132.8, 132.82}

(½) for both formulae

(½) for all substitutions correct

(1) for final answer</td></tr>
<tr><td>8</td><td>a</td><td>i</td><td>Lamp OR LED</td><td>1</td><td>NOT: ‘seven segment display’</td></tr>
<tr><td>8</td><td>a</td><td>ii</td><td><table><tr><th>Seat belt</th><th>Ignition</th><th>P</th><th>Q</th><th>R</th><th>S</th></tr><tr><td>unfastened</td><td>off</td><td>0</td><td>1</td><td>0</td><td>0</td></tr><tr><td>unfastened</td><td>on</td><td>0</td><td>1</td><td>1</td><td>1</td></tr><tr><td>fastened</td><td>off</td><td>1</td><td>0</td><td>0</td><td>0</td></tr><tr><td>fastened</td><td>on</td><td>1</td><td>0</td><td>1</td><td>0</td></tr></table>(1) mark for each correct column</td><td>3</td><td>If column P entries are wrong, can still get marks for column Q and S if entries are consistent with column P.

If column Q entries are wrong, can still get mark for column S if entries are consistent with column Q

No (½) marks</td></tr>
<tr><td>8</td><td>b</td><td></td><td>The driver will continue at constant speed (1) until the seat belt applies an unbalanced force to stop the driver. (1)</td><td>2</td><td>1 mark to indicate driver continues at constant speed
1 mark to indicate decelerating force</td></tr>
<tr><td>8</td><td>c</td><td>i</td><td>OR (gate)</td><td>1</td><td></td></tr>
<tr><td>8</td><td>c</td><td>ii</td><td>  </td><td>1</td><td>No dotted line – must be OR gate drawing</td></tr>
</table>

Question			Expected Answer/s	Max Mark	Additional Guidance
8	**d**		thermistor / thermocouple	**1**	
9	**a**		$v = \frac{d}{t}$ (½) $= \frac{0 \cdot 06}{0 \cdot 075}$ (½) $= 0 \cdot 8$ m/s (1)	**2**	exact answer – no sig fig issue If mm incorrectly or not converted treat as unit error (only penalise once)
9	**b**		$E_K = \frac{1}{2}mv^2$ (½) $= \frac{1}{2} \times 0 \cdot 55 \times 0 \cdot 8^2$ (½) $= 0 \cdot 176$ J (1)	**2**	Accept answers in significant figure range: {0·2, 0·18, 0·176} if wrong sub d =1·2 in part (a) this gives the speed as 16 m/s which gives E_k of 70·4 J
9	**c**		any ***single*** value greater than 0 m/s and **less than** answer given in part 9 (a)	**1**	If no answer given in 9(a) then award zero marks. Do not accept a range of values
10	**a**	**i**	0·6 s only	**1**	Must have unit (1) or (0) no tolerance on graph reading
10	**a**	**ii**	distance = area under graph (½) $= \left(8 \times 0 \cdot 6\right) + \left(\frac{1}{2} \times 8 \times 2 \cdot 2\right)$ (½) = 13·6 m (1)	**2**	If incorrect substitution then (½) max for (implied) formula
10	**b**		$a = \frac{F}{m}$ (½) $= \frac{150}{75}$ (½) $= 2$ m/s^2 (1)	**2**	
11	**a**		I = 60 A (1) Q = It (½) $t = \frac{4500}{60}$ (½) = 75 s (1)	**3**	If any other value for I used, then (½) mark max for equation

Question			Expected Answer/s	Max Mark	Additional Guidance
11	**b**		percentage efficiency = $\frac{\text{useful Po}}{\text{Pi}} \times 100$ (½) Input power = $120 \times \frac{100}{30}$ (½) Input power = 400W (1)	**2**	No sig fig issue
11	**c**		strength of magnet OR number of turns in coil OR relative speed of magnet to coil	**2**	Any 2 correct (1) mark each Not 'size' of magnet If more than two answers and one is incorrect, apply ± rule
12	**a**	**i**	P = IV (½) = 12·5 × 230 (½) = 2875(W) P = $\frac{E}{t}$ (½) E = 2875 × 180 (½) E = 517500 (J) OR E = ItV (1) = 12.5 × 180 × 230 (1) = 517500 (J)	**2**	Must show each (½) mark step to gain full marks Final answer (517500J) or unit not required Candidates can use relationships to work towards correct current, voltage or time, or to establish equivalence of power. Must show relationships and substitutions for each half mark as per expected answer/s If $E = ItV$ used must show both relationship and substitution for full marks Formula cannot be implied
12	**a**	**ii**	c = 4180 (J/kg °C) (1) E = cm Δ T (½) m = 517500/(4180 × 72) (½) m = 1·7 kg (1)	**3**	For any other value for c used from specific heat capacity of materials table then (2) max. Any other value for c then (½) max for equation Accept answers in sig fig range {2, 1.7, 1.72, 1.719}
12	**a**	**iii**	Some heat (energy) is transferred to the surrounding air OR Some heat (energy) is transferred to the kettle parts	**1**	Explanation should indicate that heat is lost from/to … Not: 'because the water is evaporating'

Question			Expected Answer/s	Max Mark	Additional Guidance
12	**b**	**i**	(Temperature) remains constant/same OR (temperature) stays at 100^0C	**1**	Not: 'nothing'
12	**b**	**ii**	l = $22{\cdot}6 \times 10^5$ (J/Kg) (1) E = ml (½) m = $\frac{565000}{22{\cdot}6 \times 10^5}$ (½) m = 0·25 kg (1)	**3**	For any other value for l used from specific latent heat of vaporisation of materials table then (2) max - any other value for l then (½) max for equation
13	**a**		Weight per unit mass OR weight of/per 1 kg OR Force per unit mass	**1**	Not : 'N/kg' alone 'gravity per kg' 'same as 10 m/s^{2}'
13	**b**	**i**	g = $\frac{W}{m}$ (½) g = $\frac{630}{70}$ (½) g 9 N/kg (1)	**2**	
13	**b**	**ii**	Venus	**1**	Only acceptable answer
13	**c**	**i**	a = $\frac{v-u}{t}$ (½) 1·6 = $\frac{(v-0)}{1{\cdot}2}$ (½) v = 1·92 m/s (1)	**2**	
13	**c**	**ii**	1·2s	**1**	Must have unit (1) or (0)
14	**a**	**i**	P Ultraviolet OR uv Q Infrared OR IR OR thermal OR heat rays	**1** **1**	
14	**a**	**ii**	Gamma OR γ	**1**	

Question			Expected Answer/s	Max Mark	Additional Guidance
14	**a**	**iii**	Aerial OR radio telescope OR satellite dish	**1**	Not: 'radio receiver' alone
14	**a**	**iv**	Thermograms/thermographs OR electronic thermometer OR treatment of muscle injury OR sterilization (of equipment) OR tracing / diagnosis of / treatment of } cancer	**1**	Or any acceptable medical use of infrared radiation
14	**b**		*Colour* / *Wavelength* (m): **red** / 7×10^{-7} yellow / **$5{\cdot}9 \times 10^{-7}$** **green** / $5{\cdot}5 \times 10^{-7}$ **blue** / $4{\cdot}5 \times 10^{-7}$	**2**	(½) each correct entry (shown in bold)
14	**c**	**i**	687 < period < 10 760 (days)	**1**	A single value required Unit (days) not required but if wrong unit given then unit penalty deduct (½)
14	**c**	**ii**	$v = 3 \times 10^8$ (m/s) (1) $t = \frac{d}{v}$ (½) $= \frac{1430 \times 10^9}{3 \times 10^8}$ (½) $= 4767$ s (1)	**3**	For any other value for c used from speed of light in materials table then (2) marks max Any other value for c then (½) max for equation (if stated or implied) Accept answers in significant figure range: {5000,4800,4770,4767}

[END OF MARKING INSTRUCTIONS]