2014 Physics

Intermediate 2

Finalised Marking Instructions

Part One: General Marking Principles for: Physics Intermediate 2

This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this Paper. These principles must be read in conjunction with the specific Marking Instructions for each question.

(a) Marks for each candidate response must always be assigned in line with these general marking principles and the specific Marking Instructions for the relevant question. If a specific candidate response does not seem to be covered by either the principles or detailed Marking Instructions, and you are uncertain how to assess it, you must seek guidance from your Team Leader/Principal Assessor.

(b) Marking should always be positive ie, marks should be awarded for what is correct and not deducted for errors or omissions.

GENERAL MARKING ADVICE: Physics Intermediate 2

The marking schemes are written to assist in determining the "minimal acceptable answer" rather than listing every possible correct and incorrect answer. The following notes are offered to support Markers in making judgements on candidates' evidence, and apply to marking both end of unit assessments and course assessments.

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.	$5{\cdot}0$	(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.	$V = IR$ $7{\cdot}5 = 1{\cdot}5 \times R$ $R = 0{\cdot}2\ \Omega$	(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

2014 Physics Intermediate 2

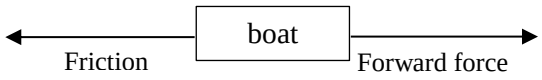
Marking scheme

Section A

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

Part Two: Marking Instructions for each Question

Section B

Question			Sample Answers and Mark Allocation	Notes	Inner Margin	Outer Margin
21.	**(a)**	**(i)**	a = (v – u) / t **(½)** = (4·8 – 0) / 25 **(½)** = 0·192 m/s^2 **(1)**	0·2 m/s^2 0·19 m/s^2	**2**	
	(a)	**(ii)**	Constant speed/steady velocity	accept zero acceleration same speed − 0	**1**	
	(a)	**(iii)**	 **(½ each)**	Opposite forces. Names of forces must be attempted to gain marks for force arrows Incorrect labels − ½ each Arrows must be attached (− ½ each if not)	**2**	
	(b)	**(i)**	distance = a.u.g **(½)** = (½ × 25 × 4·8) + (4·8 × 425) + (½ × 60 × 4·8) **(½)** = 2244 m **(1)**	2000m 2200 m 2240 m } acceptable	**2**	
		(ii)	v = total distance / time **OR** = total a.u.g. / time **(½)** = 2244 / 510 **(½)** = 4·4 m/s **(1)**	consistent with (b) (i)	**2**	**9**

Question			Sample Answers and Mark Allocation	Notes	Inner Margin	Outer Margin
22.	**(a)**		$F_{un} = 500 - 15$ $= 485$ (N) **(1)** --- $F_{un} = m \times a$ **(½)** $a = 485 / 0{\cdot}20$ **(½)** $= 2425$ m/s^2 **(1)**	Attempt at subtraction shown but incorrectly done **(− ½)** --- If subtraction not attempted ½ max for equation 2400 m/s^2 2430 m/s^2	**3**	
	(b)		$v = u + at$ **(½)** $0 = u + (-3600 \times 0{\cdot}012)$ **(½)** $0 = u - 43{\cdot}2$ $u = 43{\cdot}2$ m/s **(1)**	$a = (v - u)/t$ watch for wrong sub (eg u = 0)	**2**	
	(c)		(The second arrow will take a) <u>shorter</u> (time to reach the target) **(1)** greater acceleration. **(1)** **OR** greater velocity/speed.	no attempt at explanation = zero marks	**2**	**7**
23.	**(a)**		The <u>spacecraft</u> (or equivalent) pushes the exhaust <u>gases</u> (backward). The <u>gases</u> push the <u>spacecraft</u> (or equivalent) (forward.)	Air not acceptable	**1**	
	(b)	**(i)**	momentum before = momentum after **(½)** $(5800 \times 0{\cdot}2) + 0 = (5800 + 8700)\ v$ **(½)** $1160 = 14500\ v$ $v = 0{\cdot}08$ m/s **(1)**	accept 0·1 m/s	**2**	
		(ii)	$E_k = ½\ mv^2$ **(½)** $= ½ \times 14500 \times 0{\cdot}08^2$ **(½)** $E_k = 46{\cdot}4$ J **(1)**	consistent with (b) (i) <u>Stop marking if velocity not squared</u>.	**2**	
	(c)		$E_h = cm\Delta T$ **(½)** $1{\cdot}25 \times 10^9 = 931 \times c \times 1300$ **(½)** $c = 1032{\cdot}8$ (J/ kg ºC) **(1)** --- Heat shield is made from silica. **(1)**	Must attempt a calculation for any marks. 1033 (J/ kg ºC) Wrong unit − ½	**3**	**8**

Question			Sample Answers and Mark Allocation	Notes	Inner Margin	Outer Margin
24.	**(a)**		Electrical **(½)** ⟶ light + heat **(½)**	Must have transformation for any marks. do not accept electric or electricity	**1**	
	(b)	**(i)**	R = V/I **(½)** R = 3/0·4 **(½)** R = 7·5 Ω **(1)**		**2**	
		(ii)	(Resistance) increases **(1)** Gradient of graph increases/graph gets steeper **(1)** **OR** by calculation	There must be an attempt at justification for first mark eg $R = \frac{V}{I}$ $= \frac{6}{0 \cdot 46} \quad = 13\Omega$	**2**	
	(c)	**(i)**	correct symbols; LED, resistor, voltage supply **(½ each)** LED connected correctly **(½)**	variable resistor OK cell symbol ok	**2**	
		(ii)	f = v/λ **(½)** f = $3 \times 10^8 / 6 \times 10^{-7}$ **(½)** f = 5×10^{14} Hz **(1)**		**2**	
		(iii)	Any suitable – heater, motor, (loud)speaker, relay, etc.	"Switch" on its own not acceptable.	**1**	**10**

Question			Sample Answers and Mark Allocation	Notes	Inner Margin	Outer Margin
25.	**(a)**	**(i)**	$P_{gain} = P_o / P_i$ **(½)** $P_{gain} = 100/0{\cdot}02$ **(½)** $P_{gain} = 5000$ **(1)**	do not accept voltage gain formula (0) − ½ if unit given	**2**	
		(ii)	$P = V^2/R$ **(½)** $100 = V^2/9$ **(½)** $V = 30V$ **(1)**	accept use of $P = I^2 R$ & $V = IR$ **OR** $P = I^2 R$ & $P = IV$ Both eqns needed for 1st ½ mark.	**2**	
	(b)		$1/R_T = 1/R_1 + 1/R_2$ **(½)** $1/R_T = 1/9 + 1/6$ **(½)** $R_T = 3{\cdot}6\ \Omega$ **(1)**	Do not accept incorrect or early rounding	**2**	
	(c)		440 Hz	Minus ½ for no unit or incorrect unit	**1**	
	(d)	**(i)**	stronger magnetic field /magnet **OR** more <u>turns</u> (in the coil) **OR** faster movement of <u>string</u> / string pulled further /larger vibration.	do not accept movement of coil or magnetic field	**1**	
		(ii)	The flow of electrons constantly changes direction.	Idea of repetition needed.	**1**	
		(iii)	The string <u>changes direction</u> (in the magnetic field.)	Accept any implication of change of direction eg vibrate, back and forth etc…	**1**	**10**

Question			Sample Answers and Mark Allocation	Notes	Inner Margin	Outer Margin
26.	**(a)**	**(i)**	$R_1/R_2 = V_1/V_2$ **(½)** $R_1/1050 = 2{\cdot}0/3{\cdot}0$ **(½)** $R_1 = 700\ \Omega$ **(1)**	Accept V = IR $3 = I \times 1050$ $I = 2{\cdot}857 \times 10^{-3}$ (A) V = IR $2 = 2{\cdot}857 \times 10^{-3} \times R$ $R = 700\ \Omega$ (½) mark for ohm's law (½) mark for <u>both</u> substitutions (1) mark for final answer and units	**2**	
		(ii)	80 ºC* * consistent with (a) part (i)	unit required +/− half box tolerance	**1**	
	(b)	**(i)**	MOSFET	do not accept transistor do accept MOSFET transistor not MOSPHET.	**1**	
		(ii)	(As $R_{thermistor}$ increases,) $V_{thermistor}$ increases. **(1)** (When $V_{thermistor} = 2{\cdot}0$ V or V reaches switching voltage,) MOSFET turns on. **(1)** Relay activates (and completes heater circuit.) **(1)**	No arrows, no "up".	**3**	
		(iii)	(Temperature would be) lower **(1)** Resistance of thermistor must be greater than 700 Ω to maintain 2·0 V or switching voltage **(1)**	There must be an attempt at explanation for first mark.	**2**	**9**

Question			Sample Answers and Mark Allocation	Notes	Inner Margin	Outer Margin
27.	**(a)**	**(i)**	Total internal reflection	accept T. I. R.	**1**	
		(ii)	$v = 2 \times 10^8$ m/s **(1)** $t = d/v$ **(½)** $t = 1{\cdot}6 \times 10^3 / 2 \times 10^8$ **(½)** $t = 8 \times 10^{-6}$ s **(1)**	If wrong speed used (**must be from speed of light data**) then 2 marks maximum.	**3**	
	(b)	**(i)**	$\lambda = v/f$ **(½)** $\lambda = 3 \times 10^8 / 1200 \times 10^6$ **(½)** $\lambda = 0{\cdot}25$ m **(1)**	If wrong v used ½ mark maximum	**2**	
		(ii)	Same (time)		**1**	**7**
28.	**(a)**		$P = 1/f$ **(½)** $P = 1/0{\cdot}8$ **(½)** $P = 1{\cdot}25$ D **(1)**		**2**	
	(b)		Focal lengths should be approximately symmetrical − P.J. 2 real rays drawn from object **(½ each)** 2 rays projected back **(½)** labelled upright image shown **(½)**		**2**	**4**

Question			Sample Answers and Mark Allocation	Notes	Inner Margin	Outer Margin
29.	**(a)**	**(i)**	$D = E / m$ **(½)** $= 7{\cdot}2 \times 10^{-3} / 80$ **(½)** $= 9 \times 10^{-5}$ Gy **(1)**	accept J/kg	**2**	
		(ii)	$H = D \times w_R$ **(½)** $= 9 \times 10^{-5} \times 1$ **(½)** $= 9 \times 10^{-5}$ Sv **(1)** (= 90 μSv)	consistent with (a) (i)	**2**	
	(b)		(Photographic film will) fog / darken (when exposed to radiation).	accept blackens not "changes colour" or "goes cloudy"	**1**	
	(c)		When an <u>atom</u> gains / loses (orbiting) <u>electrons</u>.		**1**	**6**

Question			Sample Answers and Mark Allocation	Notes	Inner Margin	Outer Margin
30.	**(a)**		Slows down/stops (the chain reaction) **(1)** The (boron control) rods <u>absorb</u> neutrons **(1)**	an explanation must be attempted to get the first mark	**2**	
	(b)		$P = E/t$ **(½)** $= 2{\cdot}4 \times 10^{9} / 60$ **(½)** $= 4{\cdot}0 \times 10^{7}$ W **(1)** **(**= 40 MW)	Accept J/s	**2**	
	(c)		% Efficiency = $P_{out} / P_{in} \times 100$ **(½)** $36 = P_{out} / 4{\cdot}0 \times 10^{7} \times 100$ **(½)** $P_{out} = 1{\cdot}44 \times 10^{7}$ W **(1)** (P_{out} = 14·4 MW)	consistent with (b)	**2**	
	(d)	**(i)**	1954 to 2014 = 60 years = 2 half-lives **(1)** Double final activity twice to get initial activity = 16×10^{12} Bq **(1)** **OR** 16×10^{12} Bq ⟵ 8×10^{12} ⟵ 4×10^{12} 1954 2014 **(2)**		**2**	
		(ii)	$A = N / t$ **(½)** $4 \times 10^{12} = N / (5 \times 60)$ **(½)** $N = 4 \times 10^{12} \times 300$ $N = 1{\cdot}2 \times 10^{15}$ (nuclei) **(1)**		**2**	**10**

[END OF MARKING INSTRUCTIONS]