2011 Physics

Standard Grade − Credit

Marking Instructions

Part One: General Marking Principles for Physics Standard Grade – Credit

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. You can do this by posting a question on the Marking Team forum or by e-mailing/phoning the emarker Helpline.

(b) Guidance for using marking instructions for Standard Grade Physics Credit level.

The Physics **General Marking Instructions** (GMI) provides guidance on all marking issues.
http://www.sqa.org.uk/files_ccc/Physics_General_Marking_Instructions.pdf

When marking Standard Grade Physics, there are common issues which arise when considering candidates' answers.

There is often a range of acceptable answers which would sensibly answer a particular question. However, it is often difficult to anticipate all correct or partially correct responses to questions.

The Principal Assessor and Team Leaders study a large sample of candidates' scripts and use the responses to refine the Marking Instructions (MIs) to include guidance on how to interpret different responses.

The answers given in the MIs represent ideal answers.
Additional acceptable answers are also given in the MIs to offer guidance to assist interpreting candidates' answers.
Also, advice on answers which are NOT acceptable or only attract partial marks may also be given in the MIs for some questions.

Markers are reminded that marks for each candidate response must always be assigned in accordance with these general marking principles and the specific Marking Instructions for the relevant question.

Common issues with candidates' responses:

Spelling:

The incorrect spelling of technical terms should be ignored and candidates should be awarded the relevant mark. If answers can be interpreted and understood without any doubt as to the meaning, then the answer should be marked according to the MIs.
However, care should be taken to ensure that the incorrect spelling does not make the response ambiguous, leading to possible 'wrong physics'.
One notable exception is for questions requiring the response 'reflection' or the response 'refraction'. The spelling of these two words is similar, but the words have totally different meanings. If the spelling (or handwriting) in an answer makes it difficult for you to interpret a candidate's intention, then do not award the mark.

Units:

For ***non-numerical*** answers which require a unit to be ***stated*** in an answer, the incorrect spelling of the unit is not usually penalised (if the unit can be clearly identified) eg:

'What is the correct unit for the activity of a radioactive source?' Answer: 'Becquerels'.
The answer: 'beckerels' would be acceptable.
Examples of other common mis-spellings: Seeverts, decibelles, Diopiters.
Also for ***non-numerical*** answers, do not penalise upper/lower casing when the abbreviated version is given eg DB, sV, hZ, bq.

However, for ***numerical answers,*** care must be taken to ensure the unit has the correct prefix. eg for an answer t = 0·005 seconds, t = 5 ms is acceptable but NOT t = 5 Ms.

Some common units often attract wrong abbreviations in answers to numerical questions. When the abbreviation can be confused with a different unit then this would attract a unit penalty eg sec or secs as an abbreviation for seconds is NOT acceptable.

Common units and abbreviations:	
Acceptable unit/Abbreviation	*NOT acceptable version*
second, s	sec, secs
ampere, amp, amps, A	
metres per second, m/s, ms^{-1},	mps, m/s^{-1}
metres per second per second, m/s/s, m/s^2 , ms^{-2}	mpsps, m/s^{-2}

Standard form:
Candidates may fail to express an answer in standard form correctly.
For an answer t = 400 000 s, then $t = 4 \times 10^5$ s would be correct but $t = 4^5$ s would be treated as an arithmetic error (deduct (½)).

Relationship (equation) selection:

No marks should be awarded if a 'magic triangle' eg 

was the only statement in a candidate's response.

The correct relationship must be stated eg $R = \frac{V}{I}$ to gain (½) mark.

'Dotted line.' : - - - - - - - - - - - - - - -

A dotted line immediately above an answer in the MIs indicates that the answer requires an answer (or value) calculated or stated in a previous part of the question to be used.
If the candidate's answer in the first part of the question is wrong, this wrong answer may be used by the candidate in the subsequent question. If the subsequent answer is correctly completed, then full marks may be awarded.

PART (c)

Part (c) below sets out how to apportion marks to answers requiring calculations.
These are the '**standard two marker**' type of questions.

Unless a numerical question specifically requires evidence of working to be shown, full marks should be given for a ***correct*** answer to a numerical question even if the steps are not shown explicitly. The individual marks shown in **part (c)** are for use when marking partially correct answers.

Markers who are new to marking Standard Grade Physics should study these issues closely, since the guidance illustrates common faults in candidates' answers to the 'standard two marker' type of question. Items 1-15 below illustrate how to apportion marks accordingly. Experienced markers should also re-acquaint themselves with these examples before marking.

For some questions requiring numerical calculations, there may be alternative methods (eg alternative relationships) which would lead to a correct answer.
These alternative methods of reaching the answer and how to apportion marks are also included in the specific MIs for these questions.

Sometimes, a question requires a calculation which does not fit into the 'standard two marker' type of response. Full guidance on how to apportion marks will be given in the MIs for that specific question.

PART (c)

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

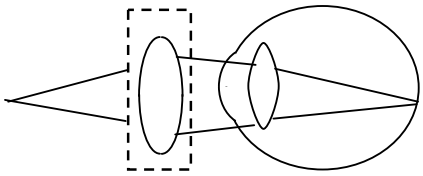
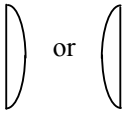
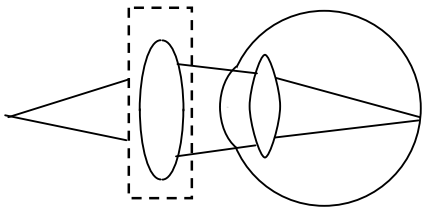
Question			Expected Answer/s	Max Mark	Additional Guidance
1	a	i	3×10^8 m/s OR 3 00 000 000 m/s	1	Must have correct value and unit – no (½) marks (1 or 0) NOT: 'same as speed of light' alone
1	a	ii	$d = vt$ (½) $= 3 \cdot 0 \times 10^8 \times 0 \cdot 068$ (½) $= 20400000$ m (1)	2	Must use value for speed from (a) OR correct value for speed of radio signals If $v = 340$, then $d = 23 \cdot 12$ m
1	b		$v = f\lambda$ (½) $3 \cdot 0 \times 10^8 = 2100 \times 10^6 \times \lambda$ (½) $\lambda = \frac{3 \cdot 0 \times 10^8}{2100 \times 10^6}$ $= 0 \cdot 14$ m (1)	2	Must use value for speed from (a) OR correct value for speed of radio signals Sig. fig range: 0·1, 0·14, 0·143, 0·1429 If $v = 340$, then $\lambda = 1 \cdot 62 \times 10^{-7}$m
1	c	A	It gets louder/increases (½) Signal has a larger amplitude (½)	1	Independent (½) marks for questions A and B Accept: "volume increases" NOT: "it changes" Accept: "waves/signal get taller" NOT: bigger/higher
		B	It/pitch gets higher/increases (½) Waves are closer together OR more waves are being produced in a certain time (½) OR Waves on graph are more frequent	1	Accept "bigger" frequency including "frequency doubled" Accept answers in terms of wavelength changes for the description

Question			Expected Answer/s	Max Mark	Additional Guidance
2	**a**	**i**	White	**1**	
2	**a**	**ii**	Magenta	**1**	Only acceptable answer
2	**b**	**i**	(Light travels through the glass fibre.) Rays of *light* are (1) (totally internally) *reflected* (inside the fibre) OR: "TIR" (1)	**2**	No marks for answers in terms of electric current through the optical fibre If mention of wire/tube/pipe apply +/- rule and award 1 mark for reflection NOT: "bouncing" in place of "reflecting" Accept sketch showing: (Total internal) reflection (1) Light ray labelled (1)
2	**b**	**ii**	Carry more information OR better signal quality	**1**	• less/no (electrical) interference • cheaper • larger bandwidth/capacity • less amplifiers needed etc • less repeaters required • less signal loss • lighter • more secure (or similar) • less energy/power/loss NOT 'faster' alone Accept faster ONLY if qualified by rate of data transfer NOT: • 'less recharging' • 'more efficient' • '**no** signal loss'

Question			Expected Answer/s	Max Mark	Additional Guidance
3	a		$I = \frac{P}{V}$ (½) $= \frac{60}{230}$ (½) $= 0{\cdot}26$ A (1)	2	Sig. fig. Range: 0·3, 0·26, 0·261
3	b	i	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$ (½) $\frac{1}{R_T} = \frac{1}{46} + \frac{1}{92}$ (½) $R_T = 30{\cdot}67\ \Omega$ (1)	2	OR $R_T = \frac{R_1 R_2}{R_1 + R_2}$ (½) $= \frac{46 \times 92}{46 + 92}$ (½) $R_T = 30{\cdot}67\ \Omega$ (1) If wrong equation used eg $R_T = \frac{1}{R_1} + \frac{1}{R_2}$ *then zero marks* Accept *imprecise* working towards a final answer $\frac{1}{R_T} = \frac{1}{46} + \frac{1}{92} = 30{\cdot}67\Omega$ ↑ *accept* Sig. fig. Range: 30, 31, 30·7, 30·67 If answer left as 30 ⅔ then – ½ (sig fig error) If intermediate rounding of 1/46 and 1/92 then deduct ½ for arith error.
3	b	ii	$P = \frac{V^2}{R}$ (½) $= \frac{230^2}{30{\cdot}67}$ (½) $= 1725$ W (1) Or calculate individual power of each heating element and add together	2	Must use value for R_T from 3(b)(i) or fresh start with **correct** value. Alternative solution: $I = \frac{V}{R}$ $= \frac{230}{30{\cdot}67}$ $= 7{\cdot}5$ (A) THEN $P = IV$ $= 7{\cdot}5 \times 230$ $= 1725$ W (1) OR $P = I^2R$ $= 7{\cdot}5^2 \times 30{\cdot}67$ $= 1725$ W If $R = 138\ \Omega$ from b(i) then $P = 383$W Sig figs depend on candidates answer to (b) part (i) Award (½) for <u>both</u> formulae ie $I = \frac{V}{R}$ <u>and</u> $P = IV$ OR $I = \frac{V}{R}$ <u>and</u> $P = I^2R$ Award (½) mark for all substitutions correct Award (1) mark for final answer

Question			Expected Answer/s	Max Mark	Additional Guidance
3	**b**	**iii**	S3 (only) (1) Greatest value of resistance/ lowest current/lowest power (1)	**2**	S3 without explanation: (1) mark Accept: 'heating element with greatest resistance has lowest power output/rating "because it has the biggest/largest resistance" DO NOT accept "bigger resistor" Can only get second mark if S3 selected.
4	**a**		To switch off all circuits OR To isolate the consumer unit fuses and domestic circuits from the mains supply	**1**	Accept: • To turn/switch off **all** circuits/electrical appliances • To switch off: electricity supply OR power OR current • To isolate mains • So that circuits are not live when switched off • 'would still be live if switch was in neutral' DO NOT accept: • 'because live is dangerous' • 'live wire carries electricity' • Current would still flow through wires even when switch is off" • Not any reference to 'electricity flowing' • "To switch off the mains" • To "shut down" or "cut (off)"
4	**b**	**i**	<table><tr><th>Circuit</th><th>Value of fuse</th></tr><tr><td>Lighting Circuit</td><td>5(A)</td></tr><tr><td>Cooker</td><td>45A (given)</td></tr><tr><td>Ring Circuit</td><td>30(A)</td></tr></table>	**1**	(1) for both correct, Deduct (½) if wrong unit given
4	**b**	**ii**	The lighting circuit uses thinner cable	**1**	Accept: • Lighting circuit uses 5 A cable and ring circuit uses 15 A cable • Cost • Cheaper for lighting circuit • Ring circuit is 'looped parallel circuit' • Two paths (for current) in a ring circuit • Different thickness DO NOT accept: • Higher power in ring circuit • Larger wire in ring circuit • 'Parallel'

Question			Expected Answer/s	Max Mark	Additional Guidance
4	**c**		Two routes for current to flow/less (half) current in each branch OR Thinner cable/cheaper	**1**	Accept: • Easier to add more sockets • Less heating • Less voltage drop DO NOT accept: • Safer (unless qualified by "less current") • Less cable • Any comparison with series circuit • Less current per ring • All sockets get 230 V
4	**d**		Reusable/faster response time/ easily reset	**1**	Accept: • Easier to tell if on or off • 'Trips' at a smaller overload • Fuse needs to be replaced • Switches off "immediately" DO NOT accept: • Cheaper • Safer

Question			Expected Answer/s	Max Mark	Additional Guidance
5	a		Convex (or biconvex or converging)	1	
5	b	i	Not a standard 2 marker From graph, $t = ½ \times \begin{pmatrix}\text{back edge return}\\ \text{time} - \text{front edge}\\ \text{return time}\end{pmatrix}$ (½) $t = ½ \times \left(13\times10^{-6} - 8\times10^{-6}\right)$ (½) $= 2\cdot5\times10^{-6}\,\text{s}$ (1)	2	If wrong values extracted from graph then treat as wrong substitution But can still get (½) mark maximum for showing halving of total time. If answer for t = 5μs is left as final answer then (1½) mark max. Deduct (½) if wrong/missing unit.
5	b	ii	$d = vt$ (½) $= 1500 \times 2\cdot5\times10^{-6}$ (½) $= 0\cdot00375$ m (1)	2	Must use value for t indicated in answer in (b) (i) or fresh start with **correct** value. otherwise (½) mark maximum for (implied) relationship Accept 0·004, 0·0038, 0·00375 **If answer to (b)(ii) is 5μs then *d*=0·0075m**
5	c	i		1	Accept:  or Lens shape only required. (1 mark) Accept lens shape drawn outwith dotted box
5	c	ii		2	**No dotted line from 5(c)(i)** (1) mark for showing some convergence after first lens by both rays (ignore path of rays inside both lenses) (1) mark for showing two rays converging on retina Must show convergence **even** if wrong lens drawn inside dotted box

Question			Expected Answer/s	Max Mark	Additional Guidance
5	**c**	**iii**	$P = \frac{1}{f}$ (½) $1 \cdot 4 = \frac{1}{f}$ (½) $f = 0 \cdot 71$ m (1)	**2**	Sig. fig. range for *f*: 0·7, 0·71. 0·714, 0·7143
6	**a**	**i**	Diagram 2 (represents ionised atom) (1). An electron has been removed (from the atom) (1).	**2**	For second mark must explain that: Electron has been removed OR Fewer electrons **than protons**
6	**a**	**ii**	Alpha (accept symbol α)	**1**	
6	**b**		Use forceps/don't point at eyes/ wear gloves etc	**1**	Accept: • Wash hands • Do not eat • Wear protective clothing • Use shielding • Return to container as soon as demo is finished Or other *suitable* alternative
6	**c**	**i**	Instrument sterilisation/treatment of cancer	**1**	
6	**c**	**ii**	Beta (radiation) (accept symbol β)	**1**	
6 **6**	**c** **c**	**iii** **iii**	A the same as B Equivalent dose takes into account type of radiation OR Both have equivalent dose = 2 mSv	**1** **1**	Circle <u>or</u> any clear indication of intended answer

Question			Expected Answer/s	Max Mark	Additional Guidance
7	a		$V_1 = \frac{R_1}{R_1 + R_2} \times V_S$ (½) $= \frac{4000}{4000 + 60000} \times 12$ (½) $= 0{\cdot}75$ V (1)		Alternatives: $I = \frac{V}{R}$ $= \frac{12}{64000}$ $= 1{\cdot}875 \times 10^{-4}$ (A) THEN $V = IR$ $= 1{\cdot}875 \times 10^{-4} \times 4000$ $= 0{\cdot}75$ V Award (½) for <u>both</u> formulae ie $I = \frac{V}{R}$ <u>and</u> $V = IR$ Award (½) mark for all substitutions correct Award (1) mark for final answer OR $\frac{V_1}{V_2} = \frac{R_1}{R_2}$ $\frac{12}{V_2} = \frac{64000}{4000}$ (1) $V_2 = 0{\cdot}75$ V (1) Only accept this method if the substitutions are for: the supply voltage, the **total** resistance, and the resistance of the LDR Award zero marks if this relationship is stated alone or implied by any other substitutions eg $\frac{12}{V_2} = \frac{60000}{4000}$
7	b		Transistor (switch)	1	Ignore any reference to pnp or npn NOT: • Phototransistor • MOSFET transistor • Switch alone
7	c		R of LDR increases (½) V across LDR increases (above 0·7V) (½) Transistor switches ON (½) Relay coil is energised (which closes the relay switch and activates the motor) (½)	2	Must clearly identify: • the resistance of LDR increasing • the voltage across LDR increasing • transistor on • relay coil operates/is switched on/ activated/magnetised 4 independent (½) marks.

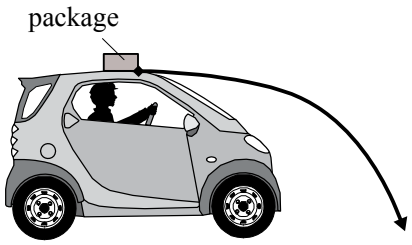
Question			Expected Answer/s	Max Mark	Additional Guidance
8	**a**	**i**	<table><tr><th>P</th><th>Q</th><th>R</th><th>S</th></tr><tr><td>0</td><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td></tr></table> 1 for each correct column	**2**	If column R entries are wrong can still get (1) mark for column S if its entries are consistent with columns R and Q. No (½) marks
8	**b**	**i**	AND (gate)	**1**	
8	**b**	**ii**	When one of the inputs (to gate X) is logic 0/OFF/ LOW (½) The output (from gate X) is logic 0/OFF/LOW (½)	**1**	NO dotted line from part (b) (i) Look for an answer indicating the function of AND gate in two parts: • When one input is zero (master switch input) • The output is zero (regardless of other input). DO NOT accept "alarm is off" (½) mark for each part Do NOT accept answers in terms of both inputs = 1
8	**b**	**iii**	(Loud)speaker OR buzzer OR Siren OR bell	**1**	

Question			Expected Answer/s	Max Mark	Additional Guidance
9	a	i	It is accelerating OR Speeding up (NOT 'going down the flume')	1	DO NOT accept "goes faster"
9	a	ii	distance = area under graph (½) $= \frac{1}{2} \times 7 \cdot 5 \times 5 + 20 \times 5$ (½) $= 18 \cdot 75 + 100$ $= 118 \cdot 75$ m (1)	2	(0) marks for d = vt (½) mark if there is an incorrect substitution Can award (½) for implied relationship if addition of areas is attempted No significant figure penalty (exact answer)
9	a	iii	$a = \frac{v-u}{t}$ (½) $= \frac{15-5}{5}$ (½) $= 2$ m/s^2 (1)	2	
9	b		Clear indication of measurement of time for log to pass a point (1) Clear indication of what distance is to be measured (1) Use $v = \frac{d}{t}$ to calculate (instantaneous) speed (1)	3	No need to mention devices used, but if light gate mentioned then timer must be attached to it. These points may appear in any order.

Question			Expected Answer/s	Max Mark	Additional Guidance
10	**a**	**i**	$W = mg$ (½) $= 35 \times 10^{-3} \times 10$ (½) $= 0 \cdot 35\,\text{N}$ (1)	**2**	Accept answers using g = 9·8 or 9·81 N/kg
10	**b**	**i**	4·0 m/s	**1**	Accept 'same' (1) or (0): units required
10	**b**	**ii**	Answer must relate to: (Newton's 1st law:) no unbalanced force (so speed is unchanged)	**1**	Accept: • No frictional force • No force to slow it (puck) down • No unbalanced force Not: • Forces are balanced
10	**c**	**i**	$E_K = \frac{1}{2} mv^2$ (½) $= 0 \cdot 5 \times 35 \times 10^{-3} \times 8 \cdot 0^2$ (½) $= 1 \cdot 12$ J (1)	**2**	If no squaring of *v* then incorrect substitution
10	**c**	**ii**	$Fd = \frac{1}{2} mv^2$ (1) for conservation of energy (may be implied) $5 \cdot 0 \times d = 1 \cdot 12$ (½) for relationship Fd $d = \frac{1 \cdot 12}{5 \cdot 0}$ (½) for substitutions $= 0 \cdot 224$ m (1)	**3**	Must use answer for E_K from (c)(i) or fresh start with **correct** value.

Question			Expected Answer/s		Max Mark	Additional Guidance
11	**a**		$c = 4180\,(\text{J/Kg °C})$	(1)	**3**	(1) data mark for correct selection of **c** from 'Specific heat capacity of materials' table. If **any other value from this table** is used, then lose data mark but can still get (2) marks max if rest of calculation is correctly executed using this value. If any value of ***c*** used **not from this table** (including 4200) then only (½) max possible for correct selection of relationship. No s.f. issue (exact answer)
			$E = mc\Delta T$ $= 4180 \times 1{\cdot}6 \times 80$ $= 535040$ J	(½) (½) (1)		
11	**b**	**i**	$l_v = 22{\cdot}6 \times 10^5$ (J/Kg)	(1)	**3**	(1) data mark for correct selection of $\boldsymbol{l_v}$ from 'Specific latent heat of vaporisation of materials' table. If **any other value from this table** is used, then lose data mark but can still get (2) marks max if rest of calculation is correctly executed using this value. If any value of $\boldsymbol{l_v}$ used **not from this table** then only (½) max possible for correct selection of relationship. No sig. fig. issue (exact answer)
			$E = ml$ $= 0{\cdot}9 \times 22{\cdot}6 \times 10^5$ $= 2\,034\,000$ J	(½) (½) (1)		
11	**b**	**ii**	$t = \frac{E}{P}$ $= \frac{2\,034\,000}{2000}$ $= 1017$ s	(½) (½) (1)	**2**	must use answer for *E* from (b) (i) or fresh start with **correct** value. 16.95 minutes 16 minutes 57 seconds Accept mins No sig. fig. issue (exact answer)

Question			Expected Answer/s	Max Mark	Additional Guidance
12	**a**		$E_P = mgh$ (½) $= 25 \times 10 \times 1 \cdot 2$ (½) $= 300$ J (1)	**2**	Accept $g = 9 \cdot 81$ or $9 \cdot 8$
12	**b**	**i**	$P_{out} = \frac{E}{t}$ (½) $= \frac{300}{60}$ (½) $= 5\,(\text{W})$ (½) Efficiency $= \frac{P_{out}}{P_{in}} \times 100$ (½) $0 \cdot 4 = \frac{5}{P_{in}}$ (½) $P_{in} = 12 \cdot 5\,(\text{W})$ (½)	**3**	Must use answer for E in 12(a) or fresh start with **correct** value. No unit required in final answer but if incorrect unit given then deduct (½) mark. if $P_{out} = \frac{E}{t} = \frac{300}{1} = 300\,\text{W}$ Then treat as a unit error and continue if rest of calculation is correct deduct unit penalty at end (750W) Can work out efficiency by calculating energy input then calculate power afterwards
12	**b**	**ii**	A statement about energy loss is required: eg "Heat (energy) is lost/produced" "Sound (energy) is lost/produced" energy is lost through vibrations Friction between the water and the inside wall of the plastic tube (NOT "friction" alone) (1) mark each	**2**	If more than two answers given then apply +/- rule to any wrong answers. DO NOT accept "Heat" and/or "sound" alone

Question			Expected Answer/s	Max Mark	Additional Guidance
13	**a**	**i**		**1**	(1) mark or zero – no (½) marks. Sketch should show a reasonable **curve** from the package (to ground level). Straight line – zero marks.
13	**a**	**ii**	It moves with constant speed in the horizontal direction (1) while accelerating due to the force of gravity in the vertical direction (1)	**2**	Answer should be based on the following two points: • Statement relating to horizontal motion, eg 'package moves forward', or 'package continues at a constant speed' (1) • Statement relating to vertical motion eg 'package falls towards the road/Earth', or 'force of gravity acts/pulls downwards' (1) **Not** an answer referring to 'gravity' alone. No (½) marks
13	**b**		$g = 10\,(\text{m/s}^2)$ (1) $a = \frac{v-u}{t}$ (½) $10 = \frac{v\,(-0)}{0\cdot55}$ (½) $v = 5\cdot5\,\text{m/s}$ (1) If incorrect relationship stated (eg $a = v/t$, $v = at$ *or* $v = gt$) stop marking and award (0) marks but can still get (1) for data. Candidates who start with $v = 0{\cdot}55 \times 10$ have not shown an incorrect relationship so should not be penalised eg $v = 0{\cdot}55 \times 10$ (½) for implied formula, (1½) for substitution & data mark $v = 5{\cdot}5$ m/s (1)	**3**	(1) data mark for correct selection of ***g*** from 'Gravitational field strengths' table. OR accept $g = 9{\cdot}8$, $9{\cdot}81$

Question			Expected Answer/s	Max Mark	Additional Guidance
14	**a**	**i**	P ultraviolet (accept uv/UV) Q infrared (accept ir/IR/heat (rays)) R microwaves	**2**	All correct (2) marks Two correct (1) mark One correct (½) mark
14	**a**	**ii**	TV and Radio	**1**	Both required (no ½ marks)
14	**b**		Cadmium and Mercury	**2**	(1) mark for each correct answer. If more than 2 answers are given then apply +/- rule
15	**a**	**i**	If A exerts a force on B, B exerts an equal but opposite force on A. To every action (force) there is an equal and opposite reaction (force)	**1**	Must show a good attempt at stating Law
15	**a**	**ii**	Engine/exhaust gases pushed down (A on B); gases push rocket up (B on A)	**1**	Must refer to engine/exhaust gases
15	**b**		$F_{UN} = ma$ (½) $8200000 = 2 \cdot 05 \times 10^6 \times a$ (½) $a = 4\ m/s^2$ (1)	**2**	

[END OF MARKING INSTRUCTIONS]