National
Qualifications
2014

2014 Physics

National 5

Finalised Marking Instructions

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General Marking Principles for National 5 Physics

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 detailed marking instructions, which identify the key features required in candidate responses.

(a) Marks for each candidate response must always be assigned in line with these General Marking Principles and the Detailed Marking Instructions for this assessment.

(b) Marking should always be positive. This means that, for each candidate response, marks are accumulated for the demonstration of relevant skills, knowledge and understanding: they are not deducted from a maximum on the basis of errors or omissions.

(c) 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.

When marking National 5 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 <u>always</u> be assigned in accordance with general marking principles and the specific Marking Instructions for the relevant question.

(d) There are **no half marks** awarded.

(e) Mark should be awarded for non-standard symbols where the symbols are defined and the relationship is correct, or where the substitution shows that the relationship used is correct. This must be clear and unambiguous.

(f) Rounding to an expected number of significant figures, the mark can be awarded for answers which have up to two figures more or one figure less than the number in the data with the fewest significant figures.

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', 'refraction' or 'diffraction'. The spelling of these 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.

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 <u>t = 0·005 seconds</u>, t = 5 ms is acceptable but NOT t = 5 Ms.

It should be noted that, in any part of a question, multiple unit errors or conversion errors/omissions should only be penalised once.

Eg when calculating speed from distance and time, and answer required to be in $m\,s^{-1}$.

If d = 4 km $\quad v = \frac{d}{t}$ (1)

t = 2 minutes

$= \frac{400}{2}$ (1)

$= 200$ (0)

Although the candidate has made three unit errors (not correctly converted distance or time and has omitted the final unit) only the final mark would not be awarded.

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, $m\,s^{-1}$	mps, m/s^{-1}
metres per second per second, m/s/s, m/s^2, $m\,s^{-2}$	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 x 10^5 s would be correct but t = 4^5 s would be treated as an arithmetic error and the final mark would not be awarded.

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 V = IR or R = $\frac{V}{I}$ etc. to gain (1) mark.

Where a wrong answer to a part of a question is carried forward

- within that part of the question (eg (a)(i) and (a)(ii))
- to the next part of the question (eg (a) and (b))

this should incur no further penalty, provided that it is used correctly.

Where a question requires a Data value and the candidate has selected the wrong value, then either the candidate's wrong value may be used OR the correct data value in the subsequent answer and the response could gain full marks if correctly completed.

Example:

(a) What is the speed of microwaves?
Candidate's answer: 340 m s^{-1} This answer would attract zero marks

(b) What distance would be travelled by these microwaves in 0·34 seconds?
Candidate may use either the value given in part (a) OR the correct value for the speed of microwaves and could gain full marks if correctly completed.

The 'Additional Guidance' column of the MIs would indicate the comment 'or consistent with Q (previous answer)' to indicate that a wrong answer may be carried forward.

Marking from Image Issues:

When marking candidates' scripts on screen, it is important to start by checking the 'full response view' in case answers are continued elsewhere outside the answer boxes or spaces provided and to identify unreadable responses.

Also, for each candidate, the end of the script (up to the very last page) should be checked for any answers completed at the end. Candidates may not indicate that an answer is continued at the end of the script.

If an answer or part of an answer is unreadable, the marker should then click the "!" button *to raise an exception*:

This process is illustrated by:

SQA Academy, My Courses, e-marking 2012, Topic 4, Section 7 – Communications.
Or Scoris Assessor Guide, page 76-80.

Candidates are advised in the 'Your Exams' booklet to cross out any rough work when they have made a final copy. However, crossed-out work must be marked if the candidate has not made a second attempt to answer the question. When a second attempt has been made, or started, the crossed-out working should be ignored.

The examples below set out how to apportion marks to answers requiring calculations. These are the **'standard three 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 below are for use when marking partially correct answers.

Markers who are new to marking SQA Physics exams should study these issues closely, since the guidance illustrates common faults in candidates' answers to the 'standard three 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 three marker' type of response. Full guidance on how to apportion marks will be given in the MIs for that specific question.

Question:
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. (3 marks)

	Candidate answer	**Mark + Comment**
1.	$V = IR$ $7{\cdot}5 = 1{\cdot}5R$ $R = 5{\cdot}0\Omega$	1 mark, formula 1 mark, substitution 1 mark, correct answer
2.	$5{\cdot}0\Omega$	3 marks: correct answer
3.	$5{\cdot}0$	2 marks: unit missing
4.	$4{\cdot}0\Omega$	0 marks: no evidence, wrong answer
5.	$\_\_\ \Omega$	0 marks: no working or final answer
6.	$R = \frac{V}{I} = \frac{7{\cdot}5}{1{\cdot}5} = 4{\cdot}0\Omega$	2 marks: arithmetic error
7.	$R = \frac{V}{I} = 4{\cdot}0$	1 mark: formula only
8.	$R = \frac{V}{I} = \_\_\ \Omega$	1 mark: formula only

9. $R = \frac{V}{I} = \frac{7{\cdot}5}{1{\cdot}5} = \_\_\ \Omega$ — 2 marks: formula & subs, no final answer

10. $R = \frac{V}{I} = \frac{7{\cdot}5}{1{\cdot}5} = 4{\cdot}0$ — 2 marks: formula & subs, wrong answer

11. $R = \frac{V}{I} = \frac{1{\cdot}5}{7{\cdot}5} = 5{\cdot}0\ \Omega$ — 1 mark: formula but wrong substitution

12. $R = \frac{V}{I} = \frac{75}{1.5} = 5{\cdot}0\ \Omega$ — 1 mark: formula but wrong substitution

13. $R = \frac{I}{V} = \frac{7.5}{1.5} = 5{\cdot}0\ \Omega$ — 0 marks: wrong formula

14. $V = IR$
$7{\cdot}5 = 1{\cdot}5 \times R$
$R = 0{\cdot}2\ \Omega$ — 2 marks: formula & subs, arithmetic error

15. $V = IR$
$R = \frac{I}{V} = \frac{1{\cdot}5}{7{\cdot}5} = 0{\cdot}2\ \Omega$ — 1 mark: formula only wrong rearrangement of symbols

Detailed Marking Instructions for each question

Section 1

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

Section 2

Question			Answer	Max Mark	Additional Guidance
1.	(a)		$P = \frac{V^2}{R}$ (1) $= \frac{12 \cdot 0^2}{100}$ (1) $= 1 \cdot 44$ W (1)	3	Accept 1, 1·4, 1·44 Do not accept: 1·40 Alternative methods: $I = \frac{V}{R}$ $= \frac{12 \cdot 0}{100}$ $= 0 \cdot 12$ (A) $P = IV$ $= 0 \cdot 12 \times 12$ $= 1 \cdot 44$ W OR $P = I^2 R$ $= 0 \cdot 12^2 \times 100$ $= 1 \cdot 44$ W (1) mark for both formulae (1) mark for both substitutions (1) mark for final answer and unit

Question			Answer	Max Mark	Additional Guidance
	(b)	(i)	$\frac{1}{R_T}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$ (1) $\frac{1}{R_T}=\frac{1}{100}+\frac{1}{50}+\frac{1}{50}$ (1) $\frac{1}{R_T}=\frac{1}{20}$ $R_T=20\Omega$ (1)	3	If wrong equation used eg $R_T=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$ then zero marks Accept *imprecise* working towards a final answer $\frac{1}{R_T}=\frac{1}{100}+\frac{1}{50}+\frac{1}{50}=20\ \Omega$ ↑ accept Can be answered by applying product over sum method twice. Accept: $\frac{1}{R_T}=\frac{1}{100}+\frac{1}{25}$

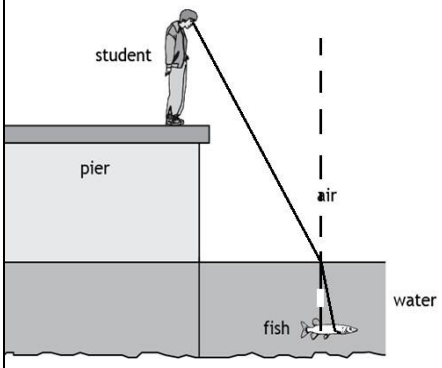
Question			Answer	Max Mark	Additional Guidance
		(ii)	**Effect:** The other lamp: • remains lit • stays on • is the same brightness • gets brighter • is not affected (1) **Justification:** The current still has a path through the other lamp. (1) OR The current in the other lamp is the same (only acceptable if other lamp stays same brightness) (1) OR The current in the other lamp is greater (only acceptable if other lamp gets brighter) (1) OR It has the same voltage / 12 V (across it) (1) OR The lamps are connected in parallel (1)	**2**	First mark can only be awarded if a justification is attempted Effect correct + entire justification correct (2) Effect correct + justification incorrect (1) Effect correct + no justification (0) Incorrect effect regardless of justification (0) If the effect is not stated (0) regardless of justification Do not accept: Other lamp gets dimmer

Question			Answer	Max Mark	Additional Guidance
2.	(a)	(i)	$V_2 = V_S - V_1 = 3{\cdot}0$ (V) $I = \frac{V_2}{R}$ $= \frac{3{\cdot}0}{1050}$ $= (2{\cdot}857 \times 10^{-3}$ A) $R_1 = \frac{V_1}{I}$ $= \frac{2{\cdot}0}{2{\cdot}857 \times 10^{-3}}$ $= 700\ \Omega$	**4**	(1) mark for 3·0 (V) If no attempt at subtraction is seen then MAX (1) mark for equation If subtraction is incorrect treat as arithmetic error. (1) mark for Ohm's Law (even if only seen once) (1) mark for both substitutions (1) mark for final answer including units Allow correct intermediate rounding of the current but check calculation of final answer s.f. range: 1-4 Alternative methods: 1 mark for 3·0 V (1) If no attempt at subtraction is seen then MAX (1) mark for equation If subtraction is incorrect treat as arithmetic error. $R_1/R_2 = V_1/V_2$ (1) $R_1/1050 = 2{\cdot}0/3{\cdot}0$ (1) $R_1 = 700\ \Omega$ (1) OR $V_2 = \left(\frac{R_{th}}{R_V + R_{th}}\right) \times V_S$ (1) $2{\cdot}0 = \left(\frac{R_{th}}{1050 + R_{th}}\right) \times 5{\cdot}0$ (2) $R_{th} = 700\ \Omega$ (1)

Question			Answer	Max Mark	Additional Guidance
		(ii)	80 °C	**1**	Or answer consistent with 2(a)(i) Unit required +/- half box tolerance
	(b)	(i)	(As R_{th} increases,) V_{th} increases (1) (When V_{th} = 2·0 V or V reaches switching voltage,) MOSFET/transistor turns **on** (1) Relay switches **on** (the heater). (1)	**3**	(3) independent marks Look for: • voltage across thermistor increases • MOSFET/transistor switches **on** / activates • Relay switches **on** / activates / switch closes
		(ii)	Temperature decreases (1) Resistance of **thermistor** must be greater / increase (1) to switch **on** MOSFET / transistor (1)	**3**	First mark can only be awarded if a justification is attempted Effect correct + justification correct (3) Effect correct + justification partially correct (2) Effect correct + justification incorrect (1) Effect correct + no justification (0) Incorrect or no effect stated regardless of justification (0)

Question			Answer	Max Mark	Additional Guidance
3.	(a)		Must start with the correct formula or (0) marks $E = Pt$ (1) $E = 15 \times 10 \times 60$ (1) $E = 9000$ J	**2**	Final answer of 9000 J must be shown otherwise a maximum of (1) mark can be awarded. Alternative method: $E = Pt$ (1) $9000 = P \times 10 \times 60$ (1) $P = 15$ W This is the same as the power of the heater used. For the alternative method, if the final statement is not included a maximum of (1) mark can be awarded.
	(b)	(i)	X (1)	**1**	
		(ii)	$E = cm\Delta T$ (1) $9000 = c \times 1{\cdot}0 \times 10$ (1) $c = 900$ J kg^{-1} °C^{-1} (1)	**3**	Or consistent with material selected in (b)(i) sig fig range: 1-3 only For block Y: $c = 129$ J kg^{-1} °C^{-1} For block Z: $c = 474$ J kg^{-1} °C^{-1}
	(c)	(i)	Insulating the (metal) block OR Switch heater on for shorter time	**1**	Accept any suitable suggestion
		(ii)	Increase / greater (for insulating) OR Decrease / lower (for shorter time)	**1**	Answer **must** be consistent with (c)(i) If candidate has not made a suitable suggestion in (c)(i) they cannot access the mark in (c)(ii) i.e. if (0) marks awarded for (c)(i) then award (0) marks for (c)(ii).

Question			Answer	Max Mark	Additional Guidance
4.	(a)		f = *N° of waves/time* $= \frac{4}{20}$ $= 0{\cdot}2(\text{Hz})$ (1) $v = f\lambda$ (1) $= 0{\cdot}2 \times 12$ (1) $= 2{\cdot}4\ \text{m s}^{-1}$ (1)	4	Alternative methods: $d = 12 \times 4 = 48\ (\text{m})$ (1) $v = \frac{d}{t}$ (1) $= \frac{48}{20}$ (1) $= 2{\cdot}4\ \text{m s}^{-1}$ (1) OR $\text{time for 1 wave} = \frac{20}{4}$ $= 5\ (\text{s})$ (1) $v = \frac{d}{t}$ (1) $= \frac{12}{5}$ (1) $= 2{\cdot}4\ \text{m s}^{-1}$ (1) If arithmetic error in calculation of frequency, distance or time for one wave, then MAX (3) marks. If no attempt made at calculation of frequency, distance or time for one wave, then MAX (1) mark for equation.

Question			Answer	Max Mark	Additional Guidance
	(b)		 (1) mark for ray changing direction at water/air boundary (1) mark for angle in water less than angle in air. Angle of incidence in water should be less than the angle of refraction in air. (1) mark for correct normal (must be placed at the point where a ray meets the water/air boundary)	**3**	Ignore arrows and any labelled angles. Lines should be passably straight. If the normal is not represented as a dotted line it must be labelled.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Max Mark</th><th>Additional Guidance</th></tr>
<tr><td>5.</td><td>(a)</td><td></td><td>UV index = (total effect of UV radiation x elevation above sea level adjustment x cloud adjustment) ÷ 25

UV index = (280 x 1·12 x 0·31) ÷ 25 (1)

= 3·89

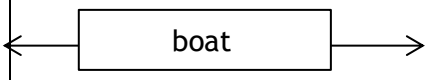
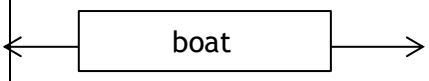
= 4 (1)</td><td>2</td><td>1 mark for substitution
1 mark for final rounded correct answer</td></tr>
<tr><td></td><td>(b)</td><td></td><td><table><tr><td></td><td>UVA</td><td>UVB</td><td>UVC</td></tr><tr><td>Type of sunscreen that absorbs most of this radiation</td><td>P</td><td>Q</td><td>R</td></tr><tr><td>Type of sunscreen that absorbs least of this radiation</td><td>R</td><td>R</td><td>P</td></tr></table></td><td>2</td><td>1 mark for each correct row</td></tr>
<tr><td></td><td>(c)</td><td></td><td>Detecting counterfeit bank notes, setting dental fillings, etc</td><td>1</td><td>Any sensible suggestion
Apply +/- rule</td></tr>
</table>

			Answer	Max Mark	Additional Guidance
6.	(a)		The time taken for the activity / corrected count rate (of a radioactive source) to half.	**1**	Do not accept: Time for radiation / radioactivity / count rate to half.
	(b)	(i)	Measure the count in a set time interval (1) Repeat at (regular) intervals (1) Measure background (count) and subtract (1)	**3**	(3) independent marks. Description must refer to the apparatus shown. If candidate response makes reference to using a rate meter then MAX (2) marks.
	(b)	(ii)	(Half-life =) 10 minutes (1)	**1**	Unit required (accept mins) +/- half box tolerance
		(iii)	88 ⟶ 44 ⟶ 22 ⟶ 11 ⟶ 5·5 (1) mark for evidence of halving Count rate = 5·5 counts per minute (1)	**2**	Or answer consistent with 6(b)(ii) Accept 5 or 6 counts per minute Accept calculation based on one halving of 11 counts per minute Unit required (accept c.p.m.) Alternative method: Accept calculation using division by 2^4 (equivalent to halving).

Question			Answer	Max Mark	Additional Guidance
7.			Demonstrates no understanding 0 marks Demonstrates limited understanding 1 marks Demonstrates reasonable understanding 2 marks Demonstrates good understanding 3 marks This is an open-ended question. **1 mark:** The student has demonstrated a limited understanding of the physics involved. The student has made some statement(s) which is/are relevant to the situation, showing that at least a little of the physics within the problem is understood. **2 marks**: The student has demonstrated a reasonable understanding of the physics involved. The student makes some statement(s) which is/are relevant to the situation, showing that the problem is understood. **3 marks:** The maximum available mark would be awarded to a student who has demonstrated a good understanding of the physics involved. The student shows a good comprehension of the physics of the situation and has provided a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. This does not mean the answer has to be what might be termed an "excellent" answer or a "complete" one.	**3**	Open-ended question: a variety of physics arguments can be used to answer this question. Marks are awarded on the basis of whether the answer overall demonstrates "no", "limited", "reasonable" or "good" understanding.

Question			Answer	Max Mark	Additional Guidance
8.	(a)	(i)	$D = \frac{E}{m}$ (1) $= \frac{7 \cdot 2 \times 10^{-3}}{80 \cdot 0}$ (1) $= 9 \cdot 0 \times 10^{-5}$ Gy (1)	**3**	
		(ii)	$H = Dw_R$ (1) $= 9 \cdot 0 \times 10^{-5} \times 1$ (1) $= 9 \cdot 0 \times 10^{-5}$ Sv (1)	**3**	Or answer consistent with 8(a)(i) If wrong radiation weighting factor selected then (1) MAX for correct equation.
	(b)		When an **atom** gains / loses / gains or loses electrons.	**1**	Ignore additional information.

Question			Answer	Max Mark	Additional Guidance
9.			Demonstrates no understanding 0 marks Demonstrates limited understanding 1 marks Demonstrates reasonable understanding 2 marks Demonstrates good understanding 3 marks This is an open-ended question. **1 mark:** The student has demonstrated a limited understanding of the physics involved. The student has made some statement(s) which is/are relevant to the situation, showing that at least a little of the physics within the problem is understood. **2 marks**: The student has demonstrated a reasonable understanding of the physics involved. The student makes some statement(s) which is/are relevant to the situation, showing that the problem is understood. **3 marks:** The maximum available mark would be awarded to a student who has demonstrated a good understanding of the physics involved. The student shows a good comprehension of the physics of the situation and has provided a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. This does not mean the answer has to be what might be termed an "excellent" answer or a "complete" one.	**3**	Open-ended question: a variety of physics arguments can be used to answer this question. Marks are awarded on the basis of whether the answer overall demonstrates "no", "limited", "reasonable" or "good" understanding.

Question			Answer	Max Mark	Additional Guidance
10.	(a)	(i)	$a = \frac{v - u}{t}$ (1) $= \frac{4 \cdot 8 - 0}{25}$ (1) $= 0 \cdot 19 \text{ m s}^{-2}$ (1)	**3**	Do not accept: $a = \frac{v}{t}$ s.f. range: 0·19, 0·192, 0·2
		(ii)	constant speed OR constant velocity	**1**	Do not accept: • terminal speed/velocity • "constant" alone • steady speed/velocity
		(iii)	 friction forward force OR  forward force friction	**2**	1 mark for each correctly labelled force and direction For forward force there are other acceptable answers such as thrust, push(ing) (force), etc For friction also accept water resistance, drag. Do not accept: • resistance on its own • air resistance alone • air friction alone Ignore vertical forces.

Question			Answer	Max Mark	Additional Guidance
	(b)	(i)	distance = area under graph (1) $=\left(\frac{1}{2}\times 25\times 4\cdot 8\right)+\left(4\cdot 8\times 425\right)$ $+\left(\frac{1}{2}\times 60\times 4\cdot 8\right)$ (1) (= 60 + 2040 + 144) $=2244$ m (1)	**3**	If wrong substitution then (1) MAX for (implied) equation. Any attempt to use s = vt (or d = vt) applied to the **whole** graph (eg 4·8×510) is wrong physics (0) marks. If s = vt (or d = vt) is used correctly for each section of the graph and the results added to give the correct total distance then full marks can be awarded. Ignore incorrect intermediate units eg m^2 s.f. range: 2000 m 2200 m 2240 m 2244 m
		(ii)	*v = total distance/time* (1) = 2244/510 (1) = 4·4 m s^{-1} (1)	**3**	or consistent with (b)(i)

Question			Answer	Max Mark	Additional Guidance
11.	(a)		To check that the maximum take-off weight is not exceeded.	**1**	An indication that the total weight is less than the maximum take-off weight.
	(b)		19 625 N (1)	1	Unit required
	(c)		$d = vt$ (1) $201\,000 = 67 \times t$ (1) $t = 3000$ s (1)	**3**	Accept: 50 minutes / mins

Question			Answer	Max Mark	Additional Guidance
12.	(a)		$W = mg$ (1) $= 0{\cdot}94 \times 9{\cdot}8$ (1) $= 9{\cdot}2$ N (1)	**3**	Do not accept 10 or 9·81 for g s.f. range: 9 N, 9·2 N, 9·21 N, 9·212 N Do not accept 9·0 N
	(b)		**Method 1** $A = 3 \times \left(2{\cdot}0 \times 10^{-4}\right)$ $= 6{\cdot}0 \times 10^{-4}$ (m^2) (1) $p = \frac{F}{A}$ (1) $= \frac{9{\cdot}2}{6{\cdot}0 \times 10^{-4}}$ (1) $= 1{\cdot}5 \times 10^{4}$ Pa (1) **Method 2** $p = \frac{F}{A}$ (1) $= \frac{9{\cdot}2}{2{\cdot}0 \times 10^{-4}}$ (1) $= 4{\cdot}6 \times 10^{4}$ (Pa) (1) (If this line is the candidate's final answer, unit required.) total $p = \frac{4{\cdot}6 \times 10^{4}}{3}$ $= 1{\cdot}5 \times 10^{4}$ Pa (1) **Method 3…** Alternative – take 1/3 of weight and use this for *F* in *p* = *F*/*A*	**4**	or consistent with (a) Each method requires to multiply or divide by 3. This can appear at any stage in the candidate response, but if this does not appear then MAX (3) marks. s.f. range: 1-4 if 9·2 used, 20 000, 15 000, 15 300, 15 330 s.f. range: 1-4 if 9·21 used, 20 000, 15 000, 15 400, 15 350 s.f. range: 1-4 if 9·212 used, 20 000, 15 000, 15 400, 15 350

Question			Answer	Max Mark	Additional Guidance
	(c)		Rocket / bottle pushes down on water, water pushes up on rocket / bottle	**1**	
	(d)		F_{un} = upthrust − weight = 370 − 9·2 = 360·8 (N) (1) $a = \frac{F}{m}$ (1) $= \frac{360 \cdot 8}{0 \cdot 94}$ (1) $= 380 \text{ m s}^{-2}$ (1)	**4**	or consistent with (a) If arithmetic error in calculation of F_{un}, then MAX (3) marks. If no attempt made at calculation of F_{un}, then MAX (1) mark for equation. s.f. range for 9·2, 9·21, 9·212: (400, 380, 384, 383·8)
	(e)		• more water will increase weight/mass (1) • unbalanced force decreases (1) • acceleration is less (1)	**2**	Any two from three. Do not accept: • heavier

[END OF MARKING INSTRUCTIONS]