N5 National Qualifications 2017

2017 Physics

National 5

Finalised Marking Instructions

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.

When marking National 5 Physics, there are some 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 general marking principles and the specific marking instructions for the relevant question.

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

(e) Marks 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. (Note: the use of a recurrence dot, eg $0\cdot\dot{6}$, would imply an infinite number of significant figures and would therefore not be acceptable)

Common issues with candidate 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'.
Notable exceptions are for questions requiring the response 'reflection', 'refraction' or 'diffraction' and also 'fission' or 'fusion'. 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 t = 0·005 seconds, 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 $v = \frac{d}{t}$ (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, a	
metres per second, m/s, m s^{-1}	mps, m/s^{-1}
metres per second per second, m/s^2, m s^{-2}	m/s/s, mpsps, m/s^{-2}

Standard form:
Candidates may fail to express an answer in standard form correctly.
For an answer $\underline{t = 400\ 000\ s}$, 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 candidates' response.

The correct relationship must be stated eg $V = IR$ or $R = \frac{V}{I}$, to gain (1) mark.

Incorrect answer carried forward:

Where an incorrect 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 part...' to indicate that an incorrect answer may be carried forward.

Standard Three Marker:

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 (e.g. 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 A when the potential difference across it is 7·5 V. Calculate the resistance of the resistor. (3 marks)

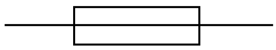
	Candidate answer	**Mark + Comment**
1.	$V = IR$ $7{\cdot}5 = 1{\cdot}5 \times R$ $R = 5{\cdot}0\,\Omega$	1 mark, relationship 1 mark, substitution 1 mark, correct answer
2.	$5{\cdot}0\,\Omega$	3 marks: correct answer
3.	$5{\cdot}0$	2 marks: unit missing
4.	$4{\cdot}0\,\Omega$	0 marks: no evidence, wrong answer
5.	$\_\_\,\Omega$	0 marks: no working or final answer
6.	$R = \frac{V}{I} = \frac{7\cdot5}{1\cdot5} = 4\cdot0\ \Omega$	2 marks: arithmetic error
7.	$R = \frac{V}{I} = 4\cdot0\ \Omega$	1 mark: relationship only
8.	$R = \frac{V}{I} = \_\_\,\Omega$	1 mark: relationship only
9.	$R = \frac{V}{I} = \frac{7\cdot5}{1\cdot5} = \_\_\,\Omega$	2 marks: relationship & subs, no final answer
10.	$R = \frac{V}{I} = \frac{7\cdot5}{1\cdot5} = 4\cdot0$	2 marks: relationship & subs, wrong answer
11.	$R = \frac{V}{I} = \frac{1\cdot5}{7\cdot5} = 5\cdot0\ \Omega$	1 mark: relationship but wrong substitution
12.	$R = \frac{V}{I} = \frac{75}{1\cdot5} = 5\cdot0\ \Omega$	1 mark: relationship but wrong substitution
13.	$R = \frac{I}{V} = \frac{7\cdot5}{1\cdot5} = 5\cdot0\ \Omega$	0 marks: wrong relationship
14.	$V = IR$ $7{\cdot}5 = 1{\cdot}5 \times R$ $R = 0{\cdot}2\,\Omega$	2 marks: relationship & subs, arithmetic error
15.	$V = IR$ $R = \frac{I}{V} = \frac{1\cdot5}{7\cdot5} = 0\cdot2\ \Omega$	1 mark: relationship only wrong rearrangement of symbols

Detailed marking instructions for each question

Section 1

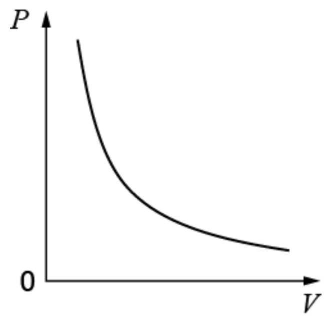
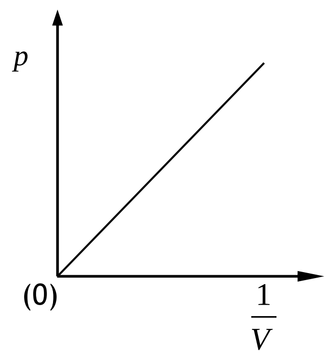
Question	Answer	Mark
1.	A	**1**
2.	D	**1**
3.	A	**1**
4.	E	**1**
5.	B	**1**
6.	D	**1**
7.	B	**1**
8.	E	**1**
9.	C	**1**
10.	C	**1**
11.	B	**1**
12.	A	**1**
13.	B	**1**
14.	C	**1**
15.	C	**1**
16.	E	**1**
17.	D	**1**
18.	B	**1**
19.	B	**1**
20.	D	**1**

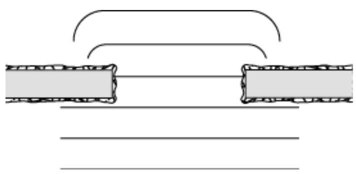
Section 2

Question			Answer	Max mark	Additional guidance
1.	(a)	(i)		**1**	
		(ii)	stops too large a current OR prevents wiring overheating OR protect wiring (from damage)	**1**	
		(iii)	3 A (fuse required) (1) $P = IV$ (1) $290 = I \times 230$ (1) $I = 1{\cdot}3(\text{A})$ (1)	**4**	Mark for selection of 3A fuse is independent. Accept 13 A fuse if consistent with arithmetic error in calculation of current. Can be done by calculating the maximum power rating for a 3A fuse: 3 A (fuse required) (1) $P = IV$ (1) $= 3 \times 230$ (1) $= 690(\text{W})$ (1)
	(b)		direction of electron (flow) (continually) changing back and forth/to and fro	**1**	Must answer in terms of electrons/charges (NOT current alone). Must indicate repeated changing of direction. Can be represented by a diagram indicating movement of electrons in both directions

Question			Answer	Max mark	Additional guidance
2.	(a)	(i)	$R_T = 40{\cdot}0\ (\Omega)$ (1) $V = IR$ (1) $12{\cdot}0 = I \times 40{\cdot}0$ $(I = 0{\cdot}300\ A)$ $V = IR$ $= 0{\cdot}300 \times 25{\cdot}0$ (1) for both subs $= 7{\cdot}50\ V$ (1)	**4**	(1) for total resistance 40(·0) (1) for use of $V=IR$ (even if only stated once) (1) for both substitutions (1) for final answer and unit Accept 2-5 sig fig: 7·5 V 7·500 V 7·5000 V **Method 2:** $V_2 = \left(\frac{R_2}{R_1 + R_2}\right)V_S$ (1) $= \left(\frac{25\cdot0}{25\cdot0 + 15\cdot0}\right) \times 12\cdot0$ (1) + (1) $= 7\cdot50\,V$ (1)
		(ii)	$P = \frac{V^2}{R}$ (1) $= \frac{7\cdot50^2}{25\cdot0}$ (1) $= 2\cdot25$ W (1)	**3**	or consistent with (a)(i) for values of current and/or voltage Accept 2-5 sig fig: 2·3 W 2·250 W 2·2500 W **Method 2:** $P = I\,V$ (1) $= 0\cdot300 \times 7\cdot50$ (1) $= 2\cdot25$ W (1) **Method 3:** $P = I^2R$ (1) $= 0\cdot300^2 \times 25\cdot0$ (1) $= 2\cdot25$ W (1)

Question			Answer	Max mark	Additional guidance
2.	(b)	(i)	$\frac{1}{R_T}=\frac{1}{R_1}+\frac{1}{R_2}$ (1) $=\frac{1}{15 \cdot 0}+\frac{1}{35 \cdot 0}$ (1) $R_T = 10 \cdot 5\ \Omega$ (1)	**3**	Accept 2-5 sig fig: 11 Ω 10·50 Ω 10·500 Ω
		(ii)	(power dissipated is) greater/increased/higher (1) (combined/parallel/total) resistance less (1) voltage across motor is greater/increased OR current (in motor) is greater/increased (1)	**3**	Effect must be correct otherwise (0 marks) Do not accept: 'motor resistance is less' for second mark The effect can be established and/or justified by appropriate calculation(s). If this is done then effect must be correct for any marks to be awarded – award: (1) for correct calculation of total resistance (1) for correct voltage across motor or current in motor (1) for correct power or statement that power is greater

Question			Answer	Max mark	Additional guidance
3.	(a)		$p_1 V_1 = p_2 V_2$ (1) $1{\cdot}0\times10^5\times4{\cdot}0\times10^{-4} = p_2\times1{\cdot}6\times10^{-4}$ (1) $p_2 = 2{\cdot}5\times10^5$ Pa (1)	**3**	Accept 1-4 sig fig: 3×10^5 Pa $2{\cdot}50\times10^5$ Pa $2{\cdot}500\times10^5$ Pa
	(b)		(individual) particles collide with container/walls more frequently (than before) (1) (overall) force (on walls) is greater (1) pressure increases (1)	**3**	Independent marks.
	(c)		axes labelled p and V (1) correct shape (curved) (1) 	**2**	Axes may be transposed Accept for (2 marks) graph of p against $1/V$ (or V against $1/p$) labelled with a straight line through the origin, but origin does not need to be labelled eg 

Question			Answer	Max mark	Additional guidance
4.	(a)	(i)	$T = \frac{1}{f}$ (1) $2 \cdot 5 = \frac{1}{f}$ (1) $f = 0 \cdot 40$ Hz (1)	**3**	Accept: $f = \frac{N}{t}$ Accept 1-4 sig fig: 0·4 Hz 0·400 Hz 0·4000 Hz
		(ii)	measure the time for more waves to pass OR count the number of waves in a longer period of time OR repeat (the measurement) <u>and</u> average	**1**	Do not accept answers relating to precision eg a stopclock with more decimal places.
	(b)		$v = f\lambda$ (1) $v = 0 \cdot 40 \times 8 \cdot 0$ (1) $v = 3 \cdot 2$ m s^{-1} (1)	**3**	Or consistent with (a)(i) Accept 1-4 sig fig: 3 m s^{-1} 3·20 ms^{-1} 3·200 ms^{-1} **Method 2:** $d = vt$ (1) $8 \cdot 0 = v \times 2 \cdot 5$ (1) $v = 3 \cdot 2$ m s^{-1} (1)
	(c)		diffraction of waves into 'shadow' regions behind walls (1) straight sections in middle and consistent wavelengths before and after gap (1) 	**2**	
	(d)		<u>energy</u> decreases/lost	**1**	Accept: description of <u>energy</u> being spread over greater area.

Question			Answer	Max mark	Additional guidance
5.			Demonstrates no understanding 0 marks Demonstrates limited understanding 1 mark 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
6.	(a)		background count (rate)	**1**	
	(b)	(i)	4·4 mm	**1**	Accept answers in the range: 4·3 mm - 4·5 mm
		(ii)	Evidence of establishing 3 half-value thicknesses (1) (3 × 4·4) 13·2 mm (1)	**2**	Or consistent with (b)(i) Accept: 13 mm
		(iii)	greater	**1**	
	(c)		$\dot{H} = \frac{H}{t}$ (1) $2 \cdot 5 \times 10^{-6} = \frac{20 \times 10^{-3}}{t}$ (1) $t = 8000$ (h) (1)	**3**	

Question			Answer	Max mark	Additional guidance
7.	(a)		80 000 (nuclei) decay(s) per unit time	**1**	Accept: 'per second' in place of 'per unit time'
	(b)	(i)	neutrons can go on to cause further (fission) reactions/split more (uranium) nuclei (1) causing a chain reaction/this process repeats (1)	**2**	Independent marks.
		(ii)	$(E) = 3\cdot0\times10^{21}\times3\cdot2\times10^{-11}$ (1) $= (9\cdot6\times10^{10}\text{ J})$ $P=\frac{E}{t}$ (1) $=\frac{9\cdot6\times10^{10}}{60}$ (1) $=1\cdot6\times10^{9}\text{ W}$ (1)	**4**	**Method 2:** $A=\frac{N}{t}$ (1) $=\frac{3\cdot0\times10^{21}}{60}$ (1) $=(5\times10^{19}\text{ Bq})$ $P=5\times10^{19}\times3\cdot2\times10^{-11}$ (1) $=1\cdot6\times10^{9}\text{ W}$ (1) Calculation of power of one decay over a minute then multiplication by number of decays per minute is wrong physics MAX (1) for relationship
	(c)		any suitable use (eg treating cancer/tracers/ sterilisation/smoke detectors/ measuring thickness of paper)	**1**	Must be a use of nuclear radiation

Question			Answer	Max mark	Additional guidance
8.	(a)		0 (m)	**1**	Ignore any mention of direction.
	(b)	(i)	d = *area under graph* (1) $= (0\cdot5\times1\times3)$ $+(0\cdot5\times3\times24)+(3\times3)$ (1) $= 46\cdot5\text{ m}$ (1)	**3**	If incorrect substitution then MAX (1) for (implied) relationship. Any attempt to use $d=\bar{v}t$ (or $s=\bar{v}t$) applied to first 4 s is wrong physics, award (0 marks). If $d=\bar{v}t$ (or $s=\bar{v}t$) is used for each section of the graph and the results added to give the correct total distance then full marks can be awarded. Accept 1-3 sig fig: 50 m 47 m
		(ii)	$a=\frac{v-u}{t}$ (1) $a=\frac{27-3}{3\cdot0}$ (1) $a=8\text{ m s}^{-2}$ (1)	**3**	Accept: $a=\frac{\Delta v}{t}$ $v=u+at$ Do not accept a response starting with: $a=\frac{v}{t}$ OR $v=at$ Accept 1-3 sig fig: $8\cdot0\text{ m s}^{-2}$ $8\cdot00\text{ m s}^{-2}$
	(c)		$d=\bar{v}t$ (1) $4\times380=\bar{v}\times 79$ (1) $\bar{v}=19\text{ m s}^{-1}$ (1)	**3**	Bar not required above *v* Accept: calculation of average time for one lap then division of distance of one lap by this time. Accept 1-4 sig fig: 20 m s^{-1} $19\cdot2\text{ m s}^{-1}$ $19\cdot24\text{ m s}^{-1}$

Question			Answer	Max mark	Additional guidance
9.	(a)		(The forces are) equal (in size) <u>and</u> opposite (in direction).	**1**	Accept: '(The forces are) balanced'
	(b)		$W = mg$ (1) $1176 = m \times 9 \cdot 8$ (1) $m = 120$ kg (1)	**3**	Use of $F=ma$ is wrong physics - award (0 marks)
	(c)		$F = 1344 - 1176 = 168$ (N) (1) $F = ma$ (1) $168 = 120 \times a$ (1) $a = 1 \cdot 4$ m s^{-2} (1)	**4**	Or consistent with (b) Accept 1-4 sig fig: 1 m s^{-2} 1·40 m s^{-2} 1·400 m s^{-2}

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Max mark</th><th>Additional guidance</th></tr>
<tr><td>10.</td><td></td><td></td><td>Demonstrates no understanding 0 marks
Demonstrates limited understanding 1 mark
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.</td><td>3</td><td>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.</td></tr>
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Question			Answer	Max mark	Additional guidance
11.	(a)		Q	**1**	
	(b)		equal (to) (1) vertical/downward <u>acceleration</u> is the same (1)	**2**	Effect must be correct otherwise (0 marks)
	(c)		$E_w = Fd$ (1) $5500 = F \times 25$ (1) $F = 220\text{ N}$ (1)	**3**	Accept 1-4 sig fig: 200 N 220·0 N
12.	(a)	(i)	$3{\cdot}0 \times 10^8\text{ m s}^{-1}$	**1**	Accept: $3 \times 10^8\text{ m s}^{-1}$ $300\,000\,000\text{ m s}^{-1}$
		(ii)	$d = vt$ (1) $d = 3{\cdot}0 \times 10^8$ $\times (7{\cdot}8 \times 365{\cdot}25 \times 24 \times 60 \times 60)$ (1) $d = 7{\cdot}4 \times 10^{16}\text{ (m)}$ (1)	**3**	Accept 1-4 sig fig: 7×10^{16} (m) $7{\cdot}38 \times 10^{16}$ (m) $7{\cdot}384 \times 10^{16}$ (m) Also accept, if using 365 days: $7{\cdot}379 \times 10^{16}$ (m)
	(b)	(i)	photographic film	**1**	Accept: 'charge coupled device'/'CCD' 'photodiode' 'phototransistor' 'retina (of the eye)' 'LDR'
		(ii)	equal (to)	**1**	Accept equivalent statement (eg 'same')

[END OF MARKING INSTRUCTIONS]