Markscheme

November 2018

Physics

On-screen examination

14 pages

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The following are the annotations available to use when marking responses.

Annotation	Explanation
	Correct point, place at the point in the response where it is clear that the candidate deserves the mark. For use in analytically marked questions only.
	Omission, incomplete
CON	Contradiction
	Valid part (to be used when more than one element is required to gain the mark)
	Error carried forward
	Dynamic annotation, it can be expanded to surround work
	Horizontal wavy line that can be expanded
	Highlight tool that can be expanded to mark an area of a response

Annotation	Explanation
	Not good enough
	The candidate has given a response but it is not worthy of any marks
	Text box used for additional marking comments
	Seen; must be stamped on all blank response areas and on duplicate pages of concatenated responses
	Vertical wavy line that can be expanded
	Words to that effect
	Award 1, 2, 3, 4 marks. For use in holistically marked questions only

Markscheme instructions

1 Mark positively. Give candidates credit for what they have achieved and what is correct. Do not deduct marks for incorrect responses.

2 Follow the markscheme provided and award only whole marks.

3 Each marking point appears on a separate line.

4 The maximum mark for each subpart is indicated in the "Total" column.

5 Where a mark is awarded a tick should be placed in the text at the precise point where it is clear the candidate deserves the mark.

6 Each marking point in a question part should be awarded separately unless there is an instruction to the contrary in the Notes column.

7 A question subpart may have more marking points than the total allows. This will be indicated by the word "**max**" in the Answer column. Further guidance may be given in the Notes column.

8 Additional instructions on how to interpret the markscheme are in bold italic text in the Answer column.

9 Alternative wording may be indicated in the Answer column by a slash (/). Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.

10 Alternative answers are indicated in the Answer column by "***or***". Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.

11 If two related points are required to award a mark, this is indicated by "***and***" in the answer column.

12 Words in brackets ( ) in the Answer column are not necessary to gain the mark.

13 Words that are <u>underlined</u> are essential for the mark.

14 In some questions a reverse argument is also acceptable. This is indicated by the abbreviation *ORA* (or reverse argument) in the Notes column. Candidates should not be rewarded for reverse arguments unless *ORA* is given in the Notes column.

15 If the candidate's response has the same meaning or is clearly equivalent to the expected answer the mark should be awarded. In some questions this is emphasized by the abbreviation *WTTE* (words to that effect) in the Notes column.

16 When incorrect answers are used correctly in subsequent question parts the follow through rule applies. Award the mark and add *ECF* (error carried forward) to the candidate response.

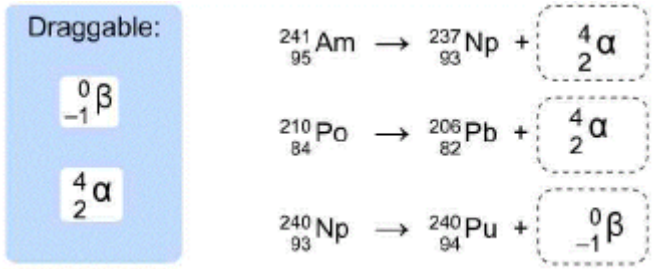
17 The order of marking points does not have to be the same as in the Answer column unless stated otherwise.

18 Marks should not be awarded where there is a contradiction in an answer. Add *CON* to the candidate response at the point where the contradiction is made.

19 Do not penalize candidates for errors in units or significant figures unless there is specific guidance in the Notes column.

20 Questions with higher mark allocations will generally be assessed using a level response method using task specific clarifications developed with reference to the criteria level descriptors. A candidate's work should be reviewed to determine holistically the mark for each row of the holistic grid and a mark awarded for each row.

Question		Answers	Notes	Total	Criterion
1	a	speed of sound=330 ms^{-1} ***and*** speed of light = 300 000 000 ms^{-1}		**1**	A
	b	time between lightning and thunder use speed = distance / time to find distance using speed of sound in air	 *Accept velocity, displacement* *Can be implied, award separately*	**3**	A
	c	moving with constant / unchanging speed ***or*** it is not accelerating ***any additional point, for example*** • moving towards ***and*** then away from student • it passes at a distance of 1 km • it passes overhead		**2**	A
	d	values from graph to give 12 (km hr^{-1})	*Seen or implied* *Ignore incorrect unit if present*	**2**	A
2	a	electrons are transferred from the small upward moving crystals to the water drops		**1**	A
	b	R=500 000/20 000 R=25 correct unit Ω	*Seen or implied*	**3**	A
	c	$\Delta Q = I \Delta t$ $\Delta Q = 0.6$ (C)	*Seen or implied from* *20 000 x 30 x 10^{-6}* *Award 1 mark for 600000 (ºC)*	**2**	A
	d	metal is a better conductor / has a lower resistance than buildings current/charge from lightning will flow through the conductor current/charge passes to earth (without passing through building)		**3**	A

3	**a**	***All three correct*** 		**1**	A
	b	atomic number = 107 mass number = 270 bohrium ***or*** Bh	*Award all marks independently*	**3**	A
	c	high energy ***or*** high frequency ***or*** short wavelength electromagnetic waves ***or*** radiation ***or*** photon	*Do **not** accept particle*	**2**	A
	d	Carbon-14 after 10 000 years the change in abundance will be noticeable ***or*** the half-life is appropriate to the situation it exists in nature	*WTTE*	**3**	A

4	**a**	Image Object **Independent variable** / **Dependent variable** / **Control variables** Text/MCQ/Mini-Cloze Object ☐ ☐ ☒ Drop height ☒ ☐ ☐ Internal air pressure ☐ ☒ ☐ Bounce height ☐ ☐ ☒ Size of ball ☐ ☐ ☒ Bouncing surface ☐ ☐ ☒ Material of the ball ***Independent:*** only internal air pressure chosen ***Dependent:*** only bounce height chosen Two control variables correct All control variables correct		**4**	B
	b	Text/MCQ/Mini-Cloze Object Measurements each 10 kPa; 3 repetitions at each pressure ***comment for reliability, for example [max 1]:*** • allows a mean to be calculated • reduces experimental uncertainty sufficient data ***or*** data across the full range		**3**	B

	c	***Safety factor linked to the question is stated, for example [max 1]:*** • use a safe method to drop from height • avoid bouncing into the face • avoid over pressurizing the ball ***Justification, for example [max 1]:*** • to avoid falling injury • to avoid injury • the ball might explode	*Consider both response boxes when awarding marks for this question part*	**2**	B
	d	83±0.5 kPa	*Notes award 1 mark 12.5 PSI if unit is also present* *Do not accept kpa for the unit mark*	**2**	D
	e	line must go through all of the data points		**1**	C
	f	0.63 – 0.65 (m)		**1**	C
	g	*y* intercept corresponds to bounce height approx. 0.40 m ball is deflated when its pressure is 0 kPa so in reality it will not bounce at all		**3**	C
	h	if the relationship was proportional, the line would go through the origin of the graph the line does not go through the origin – it is not proportional		**2**	C

<table>
<tr><td>5</td><td>a</td><td>Identification of incorrect step in the method from this list <u>only</u> [max 2]
• ruler not used correctly – eg at an angle, not placed on the floor
• different ball used
• bounce height measured incorrectly
• ball is dropped at a different angle or height

Effect of the error on the measurement [max 2]
• the measurement of bounce height will be inconsistent

Improvement linked with the step identified [max 2]
• hold the ruler vertically
• place the ruler on the floor
• use the same ball for all repeats</td><td>WTTE
Consider all three responses for each step when awarding marks</td><td>6</td><td>C
C</td></tr>
<tr><td></td><td>b</td><td>evidence of method of conversion to m

0.51(33)</td><td>No ECF from first marking point, ignore sig fig errors</td><td>2</td><td>C</td></tr>
<tr><td></td><td>c</td><td>Table Object
<table><tr><th>Height +/-0.01m</th><th>Bounce height +/-0.01m</th></tr><tr><td>1.0</td><td>0.18</td></tr><tr><td>1.4</td><td>0.40</td></tr><tr><td>1.8</td><td>0.51</td></tr><tr><td>2.2</td><td>0.63</td></tr><tr><td>3.0</td><td>0.82</td></tr><tr><td>3.4</td><td>0.89</td></tr><tr><td></td><td></td></tr></table>
both initial height and bounce height table headers correct

table headers include units that agree with the data and no units in the columns

correct values recorded

values recorded in order of increasing or decreasing initial height

values have been recorded to a consistent number of decimal places</td><td>Accept either vertical or horizontal tables

Data must be in consistent units</td><td>5</td><td>C</td></tr>
</table>

	d	data point plotted correctly (0.51, 1.8) *X* axis: drop height/m ***and*** *Y* axis: bounce height/m	*ECF part b* *Accept incorrect use of brackets, metres* *There must be a clear difference in the two types of height measured. Do not accept height alone*	**2**	C

<table>
<tr><td>6</td><td>a</td><td>Dependent variable:
height of the bounce

Control variables [max 2]:
accept any two reasonable, relevant control variables that would affect the outcome of the experiment</td><td>Accept any specifically named bounce, (first bounce etc) and alternative, appropriate methods</td><td>3</td><td>B</td></tr>
<tr><td></td><td>b</td><td colspan="4"><table>
<tr><th></th><th>1 mark</th><th>2 marks</th><th>3 marks</th><th>4 marks</th></tr>
<tr><td>Hypothesis</td><td>RQ is suggested</td><td>Prediction linking IV and DV</td><td>Testable hypothesis linking IV and DV with incomplete scientific reasoning</td><td></td></tr>
<tr><td>Method / Equipment</td><td>Specific equipment for measuring the temperature of the ball</td><td>Specific equipment for measuring the temperature of the ball and precise measurement of dependent variable, eg video camera, stopwatch</td><td></td><td></td></tr>
<tr><td>Method / manipulation</td><td>Attempt at a method but detail is insufficient to follow</td><td>Method described and could easily be followed by another student</td><td>Complete method that would allow for precise data is described and could easily be followed</td><td></td></tr>
<tr><td>Data</td><td>Method implies a range of values</td><td>Method includes at least 5 values of DV or at least 3 trials/repeats</td><td>Method includes at least 5 values of DV and at least 3 trials/repeats</td><td>Method includes at least 5 values of DV with 3 trials/repeats and plans to calculate average</td></tr>
<tr><td>Safety</td><td>Reasonable safety consideration</td><td>Reasonable safety consideration with justification linked to a named hazard</td><td></td><td></td></tr>
</table></td><td>14</td><td>B</td></tr>
</table>

7	**a**	wind		**1**	A
	b	both global temperature ***and*** the amount of CO_2 increases use of values from the graph for both temperature and CO_2		**2**	D
	c	increased use of fossil fuels because of industrialization	*WTTE*	**2**	D
	d	***Any two reasonable consequences of increasing temperature, for example [max 2]*** • as the temperature rises, the polar ice sheets melt • changing environmental conditions reduce plant growth ***Any two correctly linked impacts, for example [max 2]*** • rising ocean levels • desertification		**4**	D
	e	***One type of technology, for example [max 1]*** • wind power • carbon capture • electric vehicles ***A strength of using this technology to reduce CO_2, for example [max 1]*** • no fossil fuels are burnt • existing technology can be used • converts wind energy to electrical energy • CO_2 is stored underground • electric vehicles do not produce CO_2 ***A limitation of using this technology, for example [max 1]*** • visual impact, noisy • unknown impact of long-term storage • electric vehicles use new technology that is still being developed ***An additional point, either a strength or limitation [max 1]***	*Accept any reasonable specific technology*	**4**	D

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	1	**2**	**3**	**4**
Health and well-being	A simple comment on a health or well-being impact for one of the methods	A health or well-being impact for both methods ***or*** a linked explanation for how one method impacts health	A health or well-being impact for ***both*** methods with a linked explanation for how the method impacts health for ***either*** method	A health or well-being impact for ***both*** methods with a linked explanation for how the method impacts health for ***both*** methods
Economic or social impacts	A simple comment on an economic or social impact for ***one*** of the methods	An economic or social impact for ***both*** methods	An economic or social impact for ***both*** methods with a linked explanation for ***either*** method	An economic or social impact with a linked explanation for ***both*** methods
Comparison	Comparison of health impacts for each method ***or*** Comparison of economic impacts for each method	Comparison of health impacts for each method ***and*** Comparison of economic impacts for each method		
Final recommendation	Recommendation of one method over another supported with justification (may be seen above)			

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