Markscheme

May 2022

Physics

On-screen examination

19 pages

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. Do not deduct marks for spelling errors.

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 (or words to that effect)* in the Notes column.

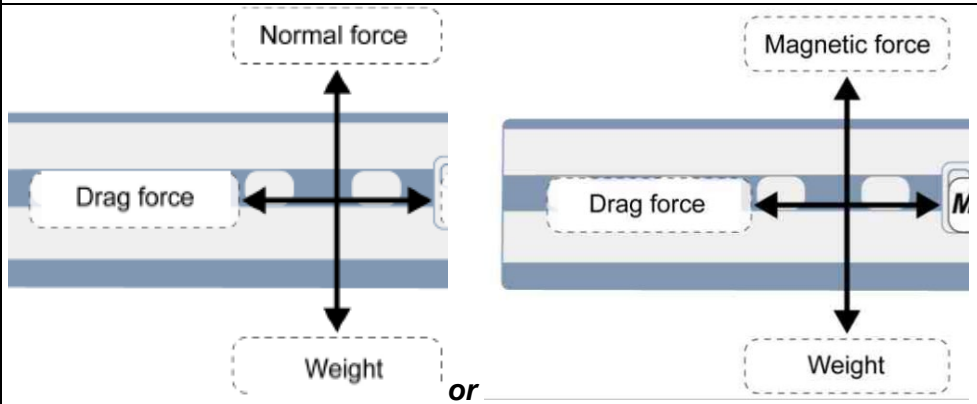
16 When incorrect answers are used correctly in subsequent question parts the follow through rule applies. Award the mark and add ECF (error carried forward) to the candidate response.

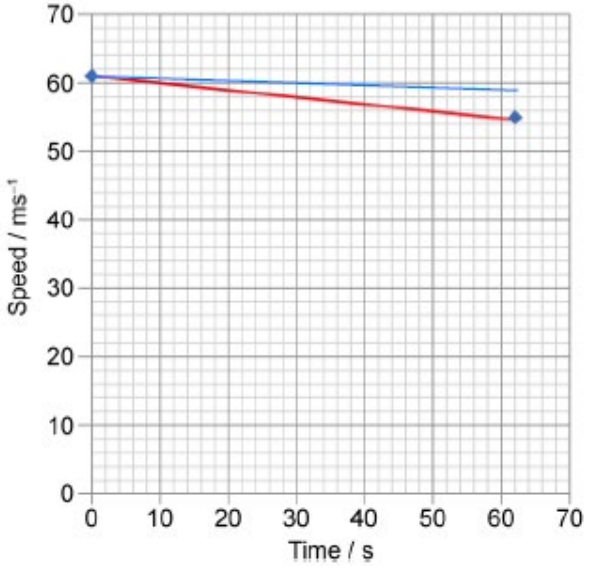
17 The order of marking points does not have to be the same as in the Answer column unless stated otherwise.

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.

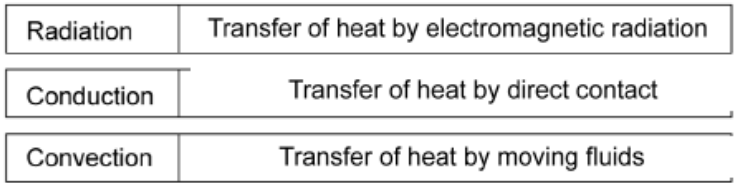
19 Do not penalize candidates for errors in units or significant figures unless there is specific guidance in the Notes column.

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.

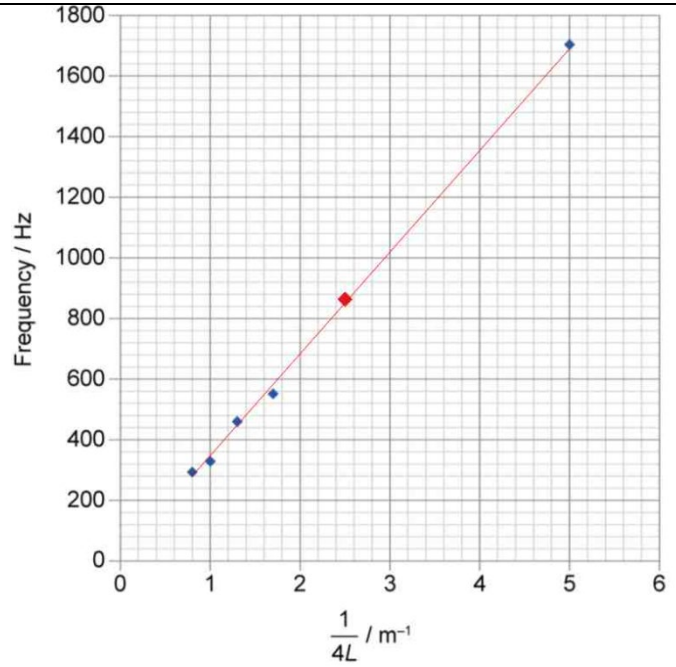
Question		Answers	Notes	Total	Crit
1	a	newtons		1	A
	b	 ***or*** 2 correct All correct	*Accept magnetic force or normal force for vertical component*	2	A
	c	Less than The drag force ***or*** air resistance is reduced The forces are balanced ***or*** resultant force is zero (at constant speed)	*WTTE* *WTTE*	3	A
	d	Evidence of speed x time **or** area calculation Use of 2 data points from graph to calculate area of trapezium ***or*** average speed 3600 or 3596 (m)	*Seen or implied (eg 61x62)* *Accept answers in the range 3534 to 3627(m) for 3 marks. Rounding not required*	3	A

	e	 *y* intercept is the same Always above original line	*Candidate's line has no end markers* *Allow approximately the same starting point, ignore end point* *Do **not** accept positive gradient (showing acceleration)*	**2**	A

2	**a**	Power ***and*** equal to	*Both required*	**1**	A
	b	Evidence of use of transformer equation ***or*** power in = power out 12 000 (V)	*Seen or implied* *Award 2 marks for correct answer* *Accept 651V for 2 marks if the number of turns from the diagram is used to calculate the primary voltage*	**2**	A
	c	Use of P=IV Power supplied (98% efficiency) 14112 (W)	*Seen or implied* *Accept correct answer rounded to 2sf or more in W or kW for 2 marks*	**2**	A
	d	***Accept any points from the list [max 2]*** • By increasing the voltage, the current is reduced • Energy is wasted as heat in the wires • (Increasing voltage or decreasing current) reduces energy wasted (as heat) • R is fixed value (property of wire) • more energy or power is supplied to the destination	*ORA*	**2**	A

3	**a**	 All correct		**1**	A
	b	D		**1**	A
	c	Condensation	*Accept "it condenses"*	**1**	A
	d	Condensation occurs on cold surfaces ***or*** Salt water is only cold at the top of the cup		**1**	A
	e	***Any two points from the list, [max 2]*** • salt water is more dense (than pure water) • melted cold water remains near surface • convection of salt water does not occur ***or*** less convection in saltwater than in pure water ***Conclusion:*** (so) heat is transferred less quickly (in the salt water)	*WTTE for all points* *WTTE* *Do **not** award the final mark unless the first and second marks are awarded*	**3**	A
	f	***First marking point:*** Melted cold water would be distributed ***or*** Stirring would increase (heat transfer by) convection ***Second marking point:*** Melting time for the ice in salt water would decrease ***or*** Melt time would be the same for both ice cubes or Melt time would be less for both cubes	*WTTE* *WTTE*	**2**	B

4	**a**	How does the length of a tube affect the <u>frequency</u> of the sound produced?	*WTTE*	**1**	B
	b	At least three of one material only, no other material included At least three of one diameter only 5 lengths of 2.5 cm diameter wood only	 *Award third mark only if first 2 marks awarded*	**3**	B
	c	IV is length ***or*** wood is the only material with five different lengths Material ***and*** diameter should be controlled	*Accept description of length as IV* *WTTE*	**2**	B
	d	Two data points taken from the graph Correct calculation using pair of points ***or*** double IV and halve DV ***or*** comparing products of x and y values So hypothesis supported	 *Award 1 mark only if the candidate identifies the fact that as length increases, frequency decreases but performs no calculation or processing to confirm if this is inverse proportionality* *WTTE* *Do **not** award the third mark unless marking points one and two are awarded*	**3**	C
	e	4L value = 0.4 ***and*** 1/4L value 2.5	*Values must be to 1 d.p.*	**1**	C

	f	 Data point plotted correctly (2.5, 860) Line of best fit has roughly equal distribution of data points above and below line (judge by eye)	*Award the mark if the point is plotted within the correct square i.e.* (2.5±0.1, 860±20)	**2**	C
	g	Image Object $\frac{1}{v}$ v $\frac{1}{4L}$ $\frac{v}{4L}$ Text/MCQ/Mini-Cloze Object ○ ◉ ○ ○		**1**	C

	h	Calculation seen and points separated by more than 1000Hz in y Correct value 343±10 m s^{-1}	*Consistent with their LOBF in part g* *Accept m/s or Hz m* *Award unit mark separately*	**3**	C

<table>
<tr><td rowspan="4">5</td><td>a</td><td>W=mg

3 (N)</td><td>Seen or implied</td><td>2</td><td>C</td></tr>
<tr><td>b</td><td>Accept any two variables from the list, [max 2]
• Length of wire
• Thickness or diameter
• Material or type of wire or density of wire
• Force of the pluck or strum of the string</td><td>WTTE</td><td>2</td><td>C</td></tr>
<tr><td>c</td><td>Table Object
<table><tr><th>tension (N)</th><th>frequency (Hz)</th></tr><tr><td>4.9</td><td>180</td></tr><tr><td>14.7</td><td>280</td></tr><tr><td>24.5</td><td>460</td></tr><tr><td>39.3</td><td>509</td></tr><tr><td>49.0</td><td>588</td></tr></table>
Column headers: Tension and Frequency

Units for both quantities in headers only

39.28 correctly rounded to 39.3 (N) to give consistent dps

Results in order</td><td>Accept tables arranged in columns or rows

Accept results in ascending or descending order</td><td>4</td><td>C</td></tr>
<tr><td>d</td><td>Accept any relevant suggestion for example, [max 1]
• increased range of data
• repeat measurements
• values of the IV in between the values already used
• regular intervals of the IV

Accept any correctly linked justification for example, [max 1]
• pattern in data will be more clearly visible
• reduce the effect of random errors on the line of best fit
• line of best fit would be more accurate/reliable</td><td></td><td>2</td><td>C</td></tr>
</table>

	e	***Accept any reasonable IV, for example [max 1]*** • length • thickness ***or*** diameter • material • temperature ***Accept any two reasonable CV, for example [max 2]*** • length • thickness or diameter • material • temperature • tension	*Award 0 marks for this question if tension is selected as IV* *Do not award CV mark if it is the same as the IV*	**3**	B
	f	***If, then:*** linking their IV with frequency ***Because:*** Attempt at explanation linked to their IV and frequency	*Does not have to be correct for the first marking point* *Award 0 marks if the hypothesis relates tension and frequency*	**2**	B

6	**a**	***Accept any reasonable suggestion, for example [max 1]*** • increased reliability • reference to background noise • to identify anomalies	*Do **not** accept "to take an average", Do **not** accept "to improve accuracy/validity" without clarification* *WTTE*	**1**	C
	b	113 113	*Do **not** accept answers with additional decimal places e.g. 113.3*	**2**	C
	c	105 (dB)		**1**	C

<table>
<tr>
<td>6</td>
<td>d</td>
<td>
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Variables</td><td>sound intensity level as dependent variable or number of layers/thickness of cardboard as independent variable</td><td>sound intensity level as dependent variable and number of layers/thickness of cardboard as independent variable</td><td>IV and DV correct and one control variable stated and justified or IV and DV correct and two control variables stated</td><td>independent, dependent variable and two control variables are stated and justified</td></tr>
<tr><td>Hypothesis</td><td>attempt at a hypothesis linked to either sound intensity level or number of layers/thickness of cardboard</td><td>testable hypothesis linking sound intensity level and number of layers/thickness of cardboard</td><td>hypothesis links sound intensity level and number of layers/thickness of cardboard, is testable and with an attempted explanation referencing relevant scientific knowledge</td><td></td></tr>
<tr><td>Method</td><td>attempt at a method linked to either sound intensity level or number of layers/thickness of cardboard</td><td>attempt at method linked to sound intensity level and number of layers/thickness of cardboard but insufficient detail to be followed by another student and not likely to give relevant data</td><td>method linked to sound intensity level and number of layers/thickness of cardboard described and could easily be followed by another student and will produce relevant data</td><td></td></tr>
<tr><td>Data collection</td><td>reference to different increments or trials</td><td>at least five different numbers of cardboard layers/thicknesses or three trials</td><td>at least five different numbers of cardboard layers/thicknesses and three trials</td><td></td></tr>
</table>
</td>
<td>13</td>
<td>B</td>
</tr>
</table>

7	**a**	Mars seems to go backwards ***or*** changes direction If Earth was the centre, Mars would orbit in a circular path/ellipse around Earth **or** Mars would seem to follow a straight-path or an arc ***or*** reference to changing distance between Earth and Mars	*WTTE* *WTTE*	**2**	D
	b	Calculation of time in s: $4x10^{11}/3x10^{8}$ = 1330(s) ***or*** use of ratio to give 1330(s), 1333(s), 1333.3(s) Conversion and rounding 22 (minutes)	*Accept any correct value of time in s rounded or unrounded for first mark* *Award two marks for correct answer alone*	**2**	A D
	c	***Accept any two points from the list [max 2]*** • the launch date is calculated to give the shortest journey time • the launch date gives the shortest distance to travel • in order to minimise fuel • in order to minimise communication time • the launch date is calculated to reach a specific landing spot on Mars	*WTTE for all*	**2**	D

8

	1	**2**	**3**	**4**
Technical (planning the journey)	One technical challenge is stated	One technical challenge is stated with a partial explanation ***or*** Two technical challenges stated	Two technical challenges stated with a scientific explanation for at least one	Two technical challenges stated with a scientific explanation for both
Economic advantages and disadvantages (for the government of a country)	One economic advantage ***or*** disadvantage is stated	One economic advantage ***and*** disadvantage is stated ***or*** Two advantages or disadvantages are stated	One economic advantage ***and*** one disadvantage are stated with further discussion for one	One economic advantage ***and*** one disadvantage are stated with further discussion for both
Political implications	One political implication is stated	One political implication is stated with further discussion ***or*** two political implications are stated	Two political implications are stated and further discussion for one	
Concluding appraisal	A simple conclusion	A concluding appraisal with reference to issues raised		

13

D

9		***Effect of low temperature, for example [max 1]*** • too cold for humans to live • too cold for humans to grow food ***Correctly linked suggestion to overcome the effect of low temp [max 1]*** • reference to minimising heat transfer through insulation of housing/clothing ***Effect of radiation, for example [max 1]*** • (exposure to) too much radiation is harmful to health ***or*** can cause cancer ***Correctly linked suggestion to overcome effect of UV radiation [max 1]*** • reference to a method of absorbing or reflecting the radiation ***Effect of low gravity, for example [max 1]*** • reference to health problems caused by low gravity eg poor circulation, muscle wasting, bone density • difficulties in moving around compared to Earth ***Correctly linked suggestion to overcome effect of low gravity [max 1]*** • need to exercise to build muscle mass or maintain bone density • wear a weighted suit	*Do **not** accept constant heating without mention of insulation as a solution* *Accept responses suggesting the use of rotation to simulate gravity if this is clearly expressed.*	**6**	D