Markscheme

November 2020

Physics

On-screen examination

12 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
	Test 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.

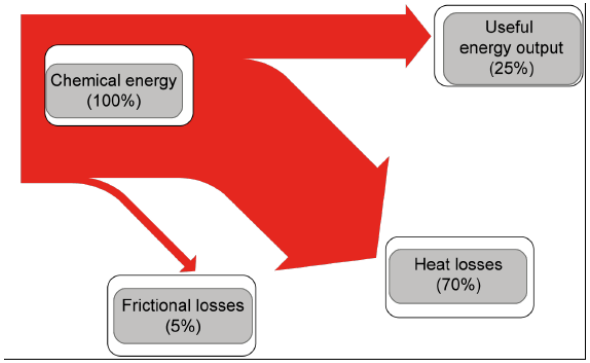
16 When incorrect answers are used correctly in subsequent question parts the follow through rule applies. Award the mark and add *ECF* (error carried forward) to the candidate response.

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	Crit
1	a	C		1	A
	b	hollow fibres help to trap air air is a poor conductor / good insulator ***or*** heat cannot be lost through convection	*WTTE*	2	A
	c	white fur ***and*** reduces (heat lost through infra-red) radiation large <u>surface area</u> ***and*** increases (heat lost through) conduction ***or*** convection ***or*** radiation		2	A
	d	Heat is required for evaporation or evaporation removes heat high energy particles (in the liquid) escape the surface leaving lower <u>energy</u> particles behind	*Accept fast moving for high energy*	3	A
2	a	 two correct all correct		2	A

	b	gain in height = 1440(m) gain in energy = mgh (= 880 x 10 x 1440) = 12 672 000 (J) or 12.672 (MJ) J ***or*** MJ ***or*** joule ***or*** mega joule	 *Seen or implied, ECF* *Accept any correctly rounded value* *Accept Nm* *Do not accept j, unit must match number given*	**4**	A D
	c	power = energy / time taken 16117 ***or*** 0.016117 ***or*** 16.117 W / Js^{-1} ***or*** MW ***or*** kW	*Seen or implied* *Accept correctly rounded values to 2 or 3 sig figs* *Unit to be consistent with value in second marking point. Do not accept MJs^{-1} or kJs^{-1}*	**3**	A
3	a	Table Object Object / Emits or reflects light Star – Emits Moon – Reflects Planet – Reflects Satellite – Reflects three correct – one mark all four correct - two marks		**2**	A
	b	orbital period of 1 day / 24 hours	*WTTE*	**1**	A
	c	weather forecasting ***or*** communications ***or*** television relay ***or*** navigation ***or*** GPS	*WTTE* *Accept military intelligence* *Do not accept reference to mobile phone use as this is given in the question*	**1**	A
	d	conversion of km to m 0.24 s	*Seen or implied* *Award two marks max for 0.12s*	**3**	A

<table>
<tr><td></td><td>e</td><td>in the past galaxies would be closer together

which is evidence for the big bang model or a description of the big bang model</td><td>WTTE</td><td>2</td><td>A</td></tr>
<tr><td>4</td><td>a</td><td>How does the current flowing through the coil affect the strength of the electromagnet / magnetic field?</td><td>WTTE</td><td>1</td><td>B</td></tr>
<tr><td></td><td>b</td><td>Table Object
<table><tr><th>Quantity</th><th>Independent</th><th>Dependent</th><th>Control</th></tr><tr><td>Current</td><td>☒</td><td>☐</td><td>☐</td></tr><tr><td>Diameter of the iron rod</td><td>☐</td><td>☐</td><td>☒</td></tr><tr><td>Number of turns</td><td>☐</td><td>☐</td><td>☒</td></tr><tr><td>Total length taken up by the turns</td><td>☐</td><td>☐</td><td>☒</td></tr><tr><td>Total weight of paper clips supported by the electromagnet</td><td>☐</td><td>☒</td><td>☐</td></tr><tr><td>Size of the paper clips</td><td>☐</td><td>☐</td><td>☒</td></tr></table>
Independent: only current chosen

Dependent: only total weight of paperclips chosen

Control variables:
two control variables correct

all control variables correct</td><td></td><td>4</td><td>B</td></tr>
<tr><td></td><td>c</td><td>If: the current increases

Then:
the weight of the papers clips supported will increase
or
the strength of the electromagnet will increase

Because: the electromagnetic field is stronger</td><td>Do not award the second mark and third marks unless the first is given</td><td>3</td><td>B</td></tr>
<tr><td></td><td>d</td><td>D

to measure size of the current

or

B

to weigh (the total mass of) the paper clips</td><td></td><td>2</td><td>B</td></tr>
<tr><td></td><td>e</td><td>B

greatest range</td><td></td><td>2</td><td>B</td></tr>
</table>

<table>
<tr>
<td>5</td>
<td>a</td>
<td>
Table Object
<table>
<tr><th>Length of coil/ cm</th><th>Number of paperclips picked up</th></tr>
<tr><td>1.0</td><td>6</td></tr>
<tr><td>2.0</td><td>3</td></tr>
<tr><td>3.0</td><td>2</td></tr>
<tr><td>4.0</td><td>1</td></tr>
<tr><td>5.0</td><td>1</td></tr>
<tr><td>6.0</td><td>1</td></tr>
</table>

Raw data table
header and units

data recorded correctly

data recorded in ascending or descending numerical order
</td>
<td>Accept weight of paperclips / g, turns cm^{-1}

Ignore additional information or processed</td>
<td>3</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>
Table Object
<table>
<tr><th>Turns per centimetre/ cm^{-1}</th><th>Weight of paperclips picked up/N</th></tr>
<tr><td>6.0</td><td>1.2</td></tr>
<tr><td>3.0</td><td>0.6</td></tr>
<tr><td>2.0</td><td>0.4</td></tr>
<tr><td>1.5</td><td>0.2</td></tr>
<tr><td>1.2</td><td>0.2</td></tr>
<tr><td>1.0</td><td>0.2</td></tr>
</table>

Processed data table
Terms per centimetre (no units needed) and weight / N

correct number of turns per centimetre recorded for all data

correct total weight of paper clips recorded for all data

complete set of data and all data recorded to 1 dp
</td>
<td>unit needed for weight

Do not accept spacing</td>
<td>4</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>this would lead to more accurate data

(because) small pins produce a more precise measure of weight supported</td>
<td></td>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>Graph has straight line

(which goes) through the origin

(indicating that) the relationship is proportional</td>
<td></td>
<td>4</td>
<td>C</td>
</tr>
</table>

<table>
<tr><td></td><td></td><td>Any reasonable further point, for example [max 1]
• (if) current is a control variable
• equation suggests that relationship between magnetic force and turns per centimetre is directly proportional
• each increase of 1 turn cm^{-1} allows an additional 0.25(N) to be supported</td><td></td><td></td><td></td></tr>
<tr><td></td><td>e</td><td>shape: (the line of would be straight and so) no change

gradient: would be different (as it represents a different quantity)</td><td>

Accept gradient would be constant</td><td>2</td><td>C</td></tr>
<tr><td>6</td><td>a</td><td><table><tr><th></th><th>Diameter / mm</th><th>$\frac{1}{\text{diameter}}$ / mm^{-1}</th><th>Height of water / mm</th></tr><tr><td>A</td><td>0.8</td><td>1.25</td><td>37.0</td></tr><tr><td>B</td><td>1.6</td><td>0.63</td><td>19.0</td></tr><tr><td>C</td><td>2.5</td><td>0.40</td><td>12.0</td></tr><tr><td>D</td><td>3.2</td><td>0.31</td><td>9.0</td></tr><tr><td>E</td><td>4.0</td><td>0.25</td><td>7.0</td></tr></table>Height = 12±0.5 and diameter = 2.5±0.5

0.4 accept value in range 0.3-0.5</td><td>Ignore sig fig errors

ECF</td><td>2</td><td>C</td></tr>
<tr><td></td><td>b</td><td>point plotted

line of best fit added

x- axis: inverse / 1 / diameter and y-axis: height (of liquid)

Units: mm^{-1} and mm</td><td>ECF from part a

Approximately equal distribution of points above and below the line

Do not award a mark for diameter alone</td><td>4</td><td>C</td></tr>
<tr><td></td><td>c</td><td>two points from line of best fit Δy ≥ 20

evidence of gradient calculation

final value = 30±5</td><td>

Ignore any unit if present</td><td>3</td><td>C</td></tr>
</table>

<table>
<tr><td></td><td>d</td><td>height is inversely proportional to diameter

(so) for a tree of this height, the diameter of the capillary tubes (inside the tree) would have be extremely small (for capillary action alone)</td><td></td><td>2</td><td>A</td></tr>
<tr><td>7</td><td></td><td>
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Research question (RQ)</td><td>simple research question</td><td></td><td></td><td></td></tr>
<tr><td>Variables (V)</td><td>some variables implied</td><td>IV or DV and one CV identified</td><td>IV and DV and one CV identified</td><td></td></tr>
<tr><td>Equipment (E)</td><td>equipment suggested but not relevant</td><td>equipment to measure IV or DV</td><td>equipment to measure IV and DV</td><td></td></tr>
<tr><td>Method (M)</td><td>attempt at method, insufficient detail and not likely to give relevant data</td><td>method described, could be followed, will produce relevant data</td><td></td><td></td></tr>
<tr><td>Data (D)</td><td>refer to different increments or trials</td><td>at least five increments or three trials</td><td>at least five increments and three trials</td><td>at least five increments, three trials and plans to calculate mean</td></tr>
</table>
</td><td></td><td>13</td><td>B</td></tr>
<tr><td>8</td><td>a</td><td>iron</td><td></td><td>1</td><td>A</td></tr>
<tr><td></td><td>b</td><td>Key:
 

one correct

all three correct</td><td></td><td>2</td><td>D</td></tr>
<tr><td></td><td>c</td><td>Accept any two reasonable points, for example [max 2]
• less noise
• less energy wasted
• less wear and tear / maintenance for train or track</td><td></td><td>2</td><td>D</td></tr>
</table>

<table>
<tr><td></td><td></td><td>• speed can be higher than conventional trains
• less affected by weather</td><td></td><td></td><td></td></tr>
<tr><td></td><td>d</td><td>increase in number of passengers will increase weight or there will be an increased load

this will decrease the distance between the magnets

(hence) the size of the repelling force will increase</td><td></td><td>3</td><td>D</td></tr>
<tr><td>9</td><td></td><td>
<table>
<tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Economic advantages and disadvantages compared to driving</td><td>an economic advantage or disadvantage is implied</td><td>an economic advantage or disadvantage is compared to driving</td><td>an economic advantage and disadvantage are compared to driving</td><td>an economic advantage and disadvantage and an additional advantage or disadvantage are compared to driving</td></tr>
<tr><td>Environmental advantages and disadvantages</td><td>an environmental advantage or disadvantage is implied</td><td>an environmental advantage or disadvantage is compared to driving</td><td>an environmental advantage and disadvantage are compared to driving</td><td>an environmental advantage and disadvantage and an additional advantage or disadvantage are compared to driving</td></tr>
<tr><td>Comfort</td><td>a comfort advantage or disadvantage is implied</td><td>a comfort advantage or disadvantage is compared to driving</td><td>a comfort advantage and disadvantage are compared to driving</td><td></td></tr>
<tr><td>Safety</td><td>a simple statement about safety</td><td>a comparative statement about safety using data from the table</td><td></td><td></td></tr>
<tr><td>Concluding appraisal</td><td>a concluding statement</td><td>a concluding appraisal</td><td></td><td></td></tr>
</table>
</td><td>15</td><td>D</td></tr>
</table>