Markscheme

May 2017

Physics

On-screen examination

14 pages

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

Annotation	Explanation	Shortcut	Annotation	Explanation	Shortcut
	Correct point, place at the point in the response where it is clear that the candidate deserves the mark	Alt+1		No benefit of the doubt	Alt+4
AEr	Arithmetic error		NEX	No explanation given	
	Benefit of the doubt	Alt+3		Not good enough	
	Omission, incomplete	Alt+7		Not worthy of any marks	
CON	Contradiction	Alt+6	NWS	No working shown	
	Valid part (to be used when more than one element is required to gain the mark)			Test box used for additional marking comments	
	Error carried forward	Alt+8		Unclear	Alt+2
	Dynamic annotation, it can be expanded to surround work			Seen; must be stamped on all blank response areas	Alt+9
	Horizontal wavy line that can be expanded			Vertical wavy line that can be expanded	
	Highlight tool that can be expanded to mark an area of a response			Words to that effect	
	Not answered the question				

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.

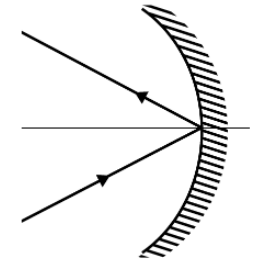
19 Do not penalize candidates for errors in units or significant figures unless there is specific guidance in the Notes column.

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. Candidate's work should be marked using a best fit approach. A candidate's response should be reviewed to determine holistically the band in which the response falls. Once this has been determined, each bullet point within that band should be assessed to see if the candidate has met the requirements of the statement. Where those requirements are met, marks should be awarded, starting from the lowest available mark for that band.

Once this process has been completed if the highest (or lowest) mark available for that band has been determined, the examiner must check the band above (or below) to ensure that the initially correct determination of the band was correctly allocated. For example, there may be sufficient detail in the candidate's response to award the lowest mark of the band above.

NB. Marks are distributed unevenly across the mark bands as candidates have to include much more detail in their responses to access the highest mark bands.

Question		Answers	Notes	Marks	Criterion
1	a	***any one correct scores one mark*** ***all three correct scores two marks*** • equal to • greater than • less than		**2**	A
	b	less than 3200 (°C) ***or*** < 3200 (°C)	*Do **not** accept 3200 (°C) alone*	**1**	A
	c	white		**1**	A
2	a	white light ***or*** sunlight is a mixture of different colours ***or*** frequencies ***or*** wavelengths light of different colour/frequency/wavelength is <u>refracted</u> by different amounts ***or*** light of different colour/frequency/wavelength <u>slows down</u> by different amounts	*Do **not** accept "light" alone* *Do **not** reward a repeat of the question*	**2**	A
	b	he had discovered <u>infra-red</u> waves ***or*** light ***any additional point from the following list*** • a reference to the discovery that the EM spectrum extended beyond visible light • the light ***or*** waves were invisible but were detected due to their heating effect • the light ***or*** waves were invisible but were detected due to the temperature change	*WTTE*	**2**	A
	c	the colour ***and*** surface of the bulb both affect the temperature rise the temperature rise is caused by the absorption of (infra-red) radiation as <u>black matt</u> surfaces absorb best, these experience the highest temperature rise	 *Accept transfer of heat from wave to the bulb is caused by absorption of radiation* *ORA*	**3**	C

3	**a**	 A. ◉		**1**	A
	b	Angle of both reflected rays from curved mirror are approximately correct Rays reflected from secondary mirror towards the lens are approximately correct Correct direction of arrows	*Award 1 mark if one ray is completely correct* *Award the 3rd marking point **only** if points 1 and 2 are also awarded*	**3**	A
	c	the stars appear to move across the sky as the Earth is rotating/spinning on its axis	*WTTE* *Do **not** accept "orbit" in place of "axis"*	**2**	A
	d	Polaris is in line with the axis of rotation of the Earth		**1**	A
	e	from a distance the three stars cannot be seen as distinct with the naked eye (since) new technology (eg telescopes) has been developed it has become possible to see the separate stars		**2**	A
	f	(time in 1 year = 365 × 24 × 60 × 60 =) 31536000s $\text{distance} = \text{speed} \times \text{time} = 9.5 \times 10^{15}\,(\text{m})$ Any calculated answer expressed in standard form ***and*** to 2 or 3 sig fig 9.5 x 10^{15} ***or*** 9.46 x 10^{15} (m)	*Seen or implied* *ECF from marking point 1* *Units not essential*	**3**	A D
	g	$323 \times 9.5 \times 10^{15} = 3.1 \times 10^{18}\,(\text{m})$	*Allow ECF from part 3f*	**1**	A

4	**a**	planets are opaque ***or*** eclipse ***or*** would block some of the light this means that there would be a reduction in the brightness that was measured		**2**	A
	b	planets are non-luminous objects so they cannot be seen directly they can only be detected if they are illuminated by the light from a star ***or*** if they block the light from a star	*WTTE*	**2**	A
	c	it would be too hot the water would evaporate ***or*** become vapour ***or*** boil away	*WTTE*	**2**	A
	d	the hotter the star, the further away the habitable zone (because) the energy received by the planet is related to distance ***or*** (because) the surface temperature of the planet is related to distance		**2**	B

5	**a**	gravitational energy to kinetic energy		**1**	A
	b	GPE = mgh ***or*** GPE = 0.25 x 10 x 0.6 1.5 (J) J	 *Accept Nm **or** joules* *Do **not** accept j*	**3**	A
	c	how does the height of the ramp affect the distance travelled by the block?	*ORA*	**1**	B
	d	***Any simple prediction, for example*** • as the ramp gets higher the block travels further ***Explanation contains relevant scientific knowledge*** • (because) the block has a greater gravitational potential ***or*** kinetic energy ***Quantitative element to prediction, for example*** • as the height doubles, the distance travelled doubles • as the height doubles, the gravitational potential energy also doubles • as the height doubles the kinetic energy will also double	*ECF from part 5c*	**3**	B
	e	***Correct independent variable:*** height ***Dependent variable:*** distance travelled ***Two relevant control variables, for example (2 max)*** • material of sliding block • same distance slid down the ramp • mass ***or*** weight	*ECF from part 5c* *Do **not** accept temperature, colour **or** gravitational field strength*	**4**	B
	f	a ruler/measuring tape	*ECF from part 5c*	**1**	B
	g	at low heights the ramp will not be steep enough for the block to slide force of friction will be too high (for the force of) gravity to overcome it	 *WTTE*	**2**	B

	h	distance travelled at height 0.60 m ***and*** distance travelled at height at 0.35 m at least three values planned in between data values evenly spaced at least two trials		**4**	B
	i	as the ramp gets higher the wooden block slides further there is a linear relationship between the variables	*Do **not** accept proportional*	**2**	C
	j	Accept any number in the range: 0.29 – 0.31 (m)	*Units not essential for this mark*	**1**	C
	k	it is the minimum height of the ramp at which the block will travel in the flat section ***or*** beyond the ramp ***Brief explanation, for example*** • all of the energy of the falling block will be lost • frictional ***or*** retarding forces are too high • ramp has to be high enough for the block to overcome friction		**2**	C
	l	the method produced sufficient data for a conclusion to be drawn ***or*** the method allowed for a suitable graph to be drawn	*WTTE*	**1**	C

6	**a**	***Any relevant question using a suitable alternative independent variable, for example (1 max)*** • surface material of sliding object • mass of sliding object • angle of ramp • length of ramp.	*Change in the dependent variable should not be rewarded* *Accept weight* *Do **not** accept speed*	**1**	B
	b	Any simple prediction linking the independent variable from part a with distance travelled Quantitative element to prediction Attempt at a scientific explanation	*ECF for independent variable from 6a*	**3**	B
	c	Any reasonable independent variable (1 max) Any reasonable control variable that can be measured (2 max)	*ECF from part 6a* *Do **not** accept height*	**3**	B
	d	Plans to use different conditions of the independent variable ***Any one from the following list (1 max)*** • Specifies at least 5 different conditions of independent variable • Specifies multiple trials • specifies relevant equipment	*ECF from part 6a*	**2**	B

7	**a**	measurement of 6.28 or 6.13 (m) recorded stopping distance of 6.11 (m) correctly calculated unit of m included	*Accept answers correctly expressed in cm*	**3**	C D
	b	both radius ***and*** stopping distance table headers correct table headers include units that agree with the data only table headers include units values recorded in order of increasing or decreasing radius values have been recorded to a consistent number of decimal places	*Accept either vertical or horizontal tables*	**5**	C
	c	data collected is continuous (scatter graph) allows us to draw a line of best fit ***or*** (scatter graph) allows us to determine the relationship between the two variables		**2**	C
	d	as the radius increases the stopping distance decreases (but) this relationship is not linear/proportional	*Award 2 marks for "there is an inverse square relationship"*	**2**	C
	e	stopping distance is inversely proportional to radius squared ***or*** stopping distance is directly proportional to $1/R^2$		**1**	C
	f	larger radius of sail increases drag/air resistance (because) there are more collisions with air particles relating area to R^2 (seen or implied)		**3**	C
	g	stopping distance decreases as area (or radius) increases (however) the results show that stopping distance is inversely proportional to radius squared (not radius)	*Do **not** accept "the hypothesis is supported" without qualifier*	**2**	C
	h	accept any reasonable extension eg change shape of sail		**1**	C
	i	prediction justification justification supported by scientific evidence		**3**	B

<table>
<tr><td>8</td><td>a</td><td>steel</td><td></td><td>1</td><td>C</td></tr>
<tr><td></td><td>b</td><td>Any relevant point, for example
• too soft
• less rigid
• not able to support high forces during competition</td><td></td><td>1</td><td>D</td></tr>
<tr><td></td><td>c</td><td>compares the density of material X to carbon fibre or to bone

suggestion of how this could affect the function of the prosthesis

compares the E or stiffness or Young’s modulus of material X to carbon fibre or to bone

suggestion of how this could affect the function of the prosthesis

A concluding comment, for example
• a leg is more complicated than the bone alone
• muscles are also important
• a recommendation suggesting which of the two materials would be better for performance in sport</td><td>ORA</td><td>5</td><td>D</td></tr>
<tr><td>9</td><td></td><td><table>
<tr><td>• an attempt to make an ethical or a social statement on prosthetic limbs</td><td>1</td></tr>
<tr><td>• an ethical statement on prosthetic limbs
• a social statement on prosthetic limbs
• either statement is linked to fairness of the competition or inclusion</td><td>2-4</td></tr>
<tr><td>• ethical statement is relevant to the fairness of the competition
• social statement is relevant linked to inclusion
• an evaluative statement</td><td>5-7</td></tr>
<tr><td>• ethical statement is relevant to the fairness of the competition and justified
• social statement is relevant linked to inclusion and justified
• evaluative statement is justified with scientific reasoning
• a concluding appraisal linking all the issues discussed previously</td><td>8-11</td></tr>
</table></td><td></td><td>11</td><td>D</td></tr>
</table>

10	**a**	50 000 Nm^{-2} ***or*** N/m^2 ***or*** Pa ***or*** pascal(s)		**2**	A D
	b	pressure is inversely proportional to area ***Contact with the ground*** contact area between the prosthesis and the ground is as large as that of a natural foot pressure on the ground allows the elephant to walk without the artificial foot sinking into the ground ***Contact with the limb*** area of contact between the prosthesis and the elephant's skin is maximized the elephant's skin feels less <u>pressure</u> making the limb comfortable	*WTTE* *used correctly in either response box* *Accept "leg" for "foot"*	**5**	D
	c	***Any advantage, for example*** • Allows movement ***Justification of advantage, for example*** • Able to find food over a wider area ***Any disadvantage, for example*** • Never as good as original limb ***Justification of disadvantage, for example*** • Prosthetic limb/attachment might need maintenance, this would not be possible in its natural habitat ***Any additional advantage or disadvantage <u>and</u> justification, for example*** • Male elephants fight and the prosthetic limb would not be sturdy enough ***A simple evaluative statement*** ***The evaluative statement is justified***		**7**	D