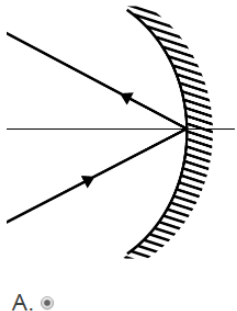


Question		Answers	Notes	Marks	Criterion
1	a	<p>any one correct scores one mark</p> <p>all three correct scores two marks</p> <ul style="list-style-type: none"> • equal to • greater than • less than 		2	A
	b	less than 3200 (°C) or < 3200 (°C)	<i>Do not accept 3200 (°C) alone</i>	1	A
	c	white		1	A
2	a	<p>white light or sunlight is a mixture of different colours or frequencies or wavelengths</p> <p>light of different colour/frequency/wavelength is <u>refracted</u> by different amounts</p> <p>or</p> <p>light of different colour/frequency/wavelength <u>slows down</u> by different amounts</p>	<p><i>Do not accept "light" alone</i></p> <p><i>Do not reward a repeat of the question</i></p>	2	A
	b	<p>he had discovered <u>infra-red</u> waves or light</p> <p>any additional point from the following list</p> <ul style="list-style-type: none"> • 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	<p>the colour and surface of the bulb both affect the temperature rise</p> <p>the temperature rise is caused by the absorption of (infra-red) radiation</p> <p>as <u>black matt</u> surfaces absorb best, these experience the highest temperature rise</p>	<p><i>Accept transfer of heat from wave to the bulb is caused by absorption of radiation</i></p> <p>ORA</p>	3	C

3	a	 <p>A. ●</p>		1	A
	b	<p>Angle of both reflected rays from curved mirror are approximately correct</p> <p>Rays reflected from secondary mirror towards the lens are approximately correct</p> <p>Correct direction of arrows</p>	<p><i>Award 1 mark if one ray is completely correct</i></p> <p><i>Award the 3rd marking point only if points 1 and 2 are also awarded</i></p>	3	A
	c	<p>the stars appear to move across the sky</p> <p>as the Earth is rotating/spinning on its axis</p>	<p><i>WTTE</i></p> <p><i>Do not accept "orbit" in place of "axis"</i></p>	2	A
	d	Polaris is in line with the axis of rotation of the Earth		1	A
	e	<p>from a distance the three stars cannot be seen as distinct with the naked eye</p> <p>(since) new technology (eg telescopes) has been developed it has become possible to see the separate stars</p>		2	A
	f	<p>(time in 1 year = $365 \times 24 \times 60 \times 60 =$) 31536000s</p> <p>distance = speed \times time = 9.5×10^{15} (m)</p> <p>Any calculated answer expressed in standard form and to 2 or 3 sig fig 9.5×10^{15} or 9.46×10^{15} (m)</p>	<p><i>Seen or implied</i></p> <p><i>ECF from marking point 1</i> <i>Units not essential</i></p>	3	A D
	g	$323 \times 9.5 \times 10^{15} = 3.1 \times 10^{18}$ (m)	<i>Allow ECF from part 3f</i>	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	<i>Accept Nm or joules Do not accept j</i>	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 <ul style="list-style-type: none"> as the ramp gets higher the block travels further Explanation contains relevant scientific knowledge <ul style="list-style-type: none"> (because) the block has a greater gravitational potential or kinetic energy Quantitative element to prediction, for example <ul style="list-style-type: none"> 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) <ul style="list-style-type: none"> material of sliding block same distance slid down the ramp mass or weight 	ECF from part 5c <i>Do not accept temperature, colour or gravitational field strength</i>	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

	<p>h distance travelled at height 0.60 m and distance travelled at height at 0.35 m</p> <p>at least three values planned in between</p> <p>data values evenly spaced</p> <p>at least two trials</p>		4	B
	<p>i as the ramp gets higher the wooden block slides further</p> <p>there is a linear relationship between the variables</p>	<i>Do not accept proportional</i>	2	C
	<p>j Accept any number in the range: 0.29 – 0.31 (m)</p>	<i>Units not essential for this mark</i>	1	C
	<p>k it is the minimum height of the ramp at which the block will travel in the flat section or beyond the ramp</p> <p>Brief explanation, for example</p> <ul style="list-style-type: none"> • 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
	<p>l the method produced sufficient data for a conclusion to be drawn</p> <p>or</p> <p>the method allowed for a suitable graph to be drawn</p>	<i>WTTE</i>	1	C

6	a	<p>Any relevant question using a suitable alternative independent variable, for example (1 max)</p> <ul style="list-style-type: none"> • surface material of sliding object • mass of sliding object • angle of ramp • length of ramp. 	<p><i>Change in the dependent variable should not be rewarded</i></p> <p><i>Accept weight</i> <i>Do not accept speed</i></p>	1	B
	b	<p>Any simple prediction linking the independent variable from part a with distance travelled</p> <p>Quantitative element to prediction</p> <p>Attempt at a scientific explanation</p>	<p><i>ECF for independent variable from 6a</i></p>	3	B
	c	<p>Any reasonable independent variable (1 max)</p> <p>Any reasonable control variable that can be measured (2 max)</p>	<p><i>ECF from part 6a</i> <i>Do not accept height</i></p>	3	B
	d	<p>Plans to use different conditions of the independent variable</p> <p>Any one from the following list (1 max)</p> <ul style="list-style-type: none"> • Specifies at least 5 different conditions of independent variable • Specifies multiple trials • specifies relevant equipment 	<p><i>ECF from part 6a</i></p>	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	<i>Accept answers correctly expressed in cm</i>	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	<i>Accept either vertical or horizontal tables</i>	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	<i>Award 2 marks for "there is an inverse square relationship"</i>	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)	<i>Do not accept "the hypothesis is supported" without qualifier</i>	2	C
	h	accept any reasonable extension eg change shape of sail		1	C
	i	prediction justification justification supported by scientific evidence		3	B

8	a	steel		1	C								
	b	<p>Any relevant point, for example</p> <ul style="list-style-type: none"> • too soft • less rigid • not able to support high forces during competition 		1	D								
	c	<p>compares the density of material X to carbon fibre or to bone</p> <p>suggestion of how this could affect the function of the prosthesis</p> <p>compares the E or stiffness or Young's modulus of material X to carbon fibre or to bone</p> <p>suggestion of how this could affect the function of the prosthesis</p> <p>A concluding comment, for example</p> <ul style="list-style-type: none"> • 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 	ORA	5	D								
9		<table border="1"> <tr> <td> <ul style="list-style-type: none"> • an attempt to make an ethical or a social statement on prosthetic limbs </td> <td>1</td> </tr> <tr> <td> <ul style="list-style-type: none"> • 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> <ul style="list-style-type: none"> • 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> <ul style="list-style-type: none"> • 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>	<ul style="list-style-type: none"> • an attempt to make an ethical or a social statement on prosthetic limbs 	1	<ul style="list-style-type: none"> • an ethical statement on prosthetic limbs • a social statement on prosthetic limbs • either statement is linked to fairness of the competition or inclusion 	2-4	<ul style="list-style-type: none"> • ethical statement is relevant to the fairness of the competition • social statement is relevant linked to inclusion • an evaluative statement 	5-7	<ul style="list-style-type: none"> • 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 	8-11		11	D
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10	a	50 000 Nm ⁻² or N/m ² or Pa or pascal(s)		2	A D
	b	<p>pressure is inversely proportional to area</p> <p>Contact with the ground contact area between the prosthesis and the ground is as large as that of a natural foot</p> <p>pressure on the ground allows the elephant to walk without the artificial foot sinking into the ground</p> <p>Contact with the limb area of contact between the prosthesis and the elephant's skin is maximized</p> <p>the elephant's skin feels less <u>pressure</u> making the limb comfortable</p>	<p><i>WTTE</i> <i>used correctly in either response box</i></p> <p><i>Accept "leg" for "foot"</i></p>	5	D
	c	<p>Any advantage, for example</p> <ul style="list-style-type: none"> • Allows movement <p>Justification of advantage, for example</p> <ul style="list-style-type: none"> • Able to find food over a wider area <p>Any disadvantage, for example</p> <ul style="list-style-type: none"> • Never as good as original limb <p>Justification of disadvantage, for example</p> <ul style="list-style-type: none"> • Prosthetic limb/attachment might need maintenance, this would not be possible in its natural habitat <p>Any additional advantage or disadvantage <u>and</u> justification, for example</p> <ul style="list-style-type: none"> • Male elephants fight and the prosthetic limb would not be sturdy enough <p>A simple evaluative statement</p> <p>The evaluative statement is justified</p>		7	D