



MARKSCHEME

MAY 2016

MYP PHYSICS

ON-SCREEN EXAMINATION

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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 underlined 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.

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. Examiners should consider every statement in the holistic grid and identify the most appropriate mark band corresponding to the Candidate's response. Once the mark band is identified, the final mark is determined using a best fit approach.

Question		Answers	Notes	Total	Criteria
1	a	two rows correct all correct		2	A
	b	Venus – Neptune – Jupiter one correct all correct		2	A
	c	they are further from the sun/star	ORA	1	A
2	a	Mercury = 3.7 (ms ⁻²) Mars = 3.8 (ms ⁻²) ms ⁻²	<i>Maximum 2 if more than two significant figures are recorded.</i> <i>Accept m/s²</i>	3	A
	b	a reference to the relationship between <i>g</i> and density or a reference to the relationship between <i>r</i> and density (So) Mars must have a much lower density	<i>Accept mass per unit volume in place of density</i>	2	A
	c	E _p = mgh – correct equation selected 3600(J) / 3.6(kJ) unit correct as J or kJ as appropriate	<i>Seen or implied by correct substitution</i> <i>Award 1 mark only for 3600(J)/3.6 (kJ) if no working is shown</i> <i>accept Nm or kNm</i>	3	A
	d	as <i>g</i> on Ganymede is smaller, GPE would be smaller as all GPE becomes KE probe would have less KE as all other quantities are the same, velocity must be smaller	<i>Or reverse argument</i>	3	A

	<p>or as g on Ganymede is smaller, acceleration is lower there are no other forces acting lower acceleration leads to lower final/terminal velocity</p>	<p><i>Or reverse argument</i></p>		
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3	a	<p>Equipment and reason, for example</p> <ul style="list-style-type: none"> • equipment: stop watch/timing device • this equipment is needed in order to measure the time it takes for the parachute to fall <p>or</p> <ul style="list-style-type: none"> • equipment: metre rule or device to measure length • this is needed to measure the height fallen by the parachute <p>or</p> <ul style="list-style-type: none"> • equipment: data logger with sensor to measure velocity • this is needed to measure the speed of the parachute <p>or</p> <ul style="list-style-type: none"> • equipment: metre rule or device to measure length • this is needed to measure the area of the parachute 	<p><i>Accept answer that describes the equipment needed to make the parachute (cloth or mass) only where correct explanation is given</i></p>	2	B
	b	<p>statement of prediction that links area and terminal velocity eg terminal velocity decreases as area increases</p> <p>area increases so will air resistance/drag force</p> <p>(increased air resistance) increases the upward force on the parachute and reduces the acceleration</p>		3	B
	c	<p>one variable from</p> <ul style="list-style-type: none"> • mass • weight of parachute • shape of the parachute <p>one description of how variable should be controlled</p> <ul style="list-style-type: none"> • measure the mass/weight each time • use the same mass/weight • use the same shape for the parachute 	<p><i>Detailed explanation is not required</i></p> <p><i>For example: temperature can only be accepted if it is correctly linked to the density of air.</i></p>	3	B

		<p>reason correctly linked to description of how variable should be controlled, either</p> <ul style="list-style-type: none"> the greater the mass/weight the greater the downward force on the parachute (this affects the terminal velocity) <p>or</p> <ul style="list-style-type: none"> the shape of the parachute will affect the aerodynamics of the parachute (this affects the terminal velocity) 			
	d	<p>at least five different values of area for the parachute</p> <p>values evenly spread over a range</p> <p>repetitions of each measurement</p>		3	B
4	a	<p>the moon orbits the Earth</p> <p>or</p> <p>as its position changes</p> <p>(therefore) different bright sections are visible from the Earth</p>		2	A
	b	gravitational force/pull/attraction	<i>Accept gravity</i>	1	A
5		<p>Any two from [2 max]</p> <ul style="list-style-type: none"> the big bang theory states that the universe has a moment of beginning the universe is cooling over time the density of the universe is not constant matter is not being created new evidence about cosmic microwave background radiation does not support “steady-state” theory 	<i>WTTE</i>	2	A

6	a	<p>in the incorrect diagram the ammeter is not in series with the bulb</p> <p>the ammeter is not measuring the current through the bulb</p> <p>or</p> <p>ammeters have a negligible resistance</p> <p>(so in the incorrect diagram) all/most of the current would flow through it and not through the lamp</p>	ORA	2	B
	b	<p>(independent variable =) voltage</p> <p>(dependent variable=) current</p>	<p><i>Accept potential difference</i></p> <p><i>Accept "temperature"</i></p>	2	B
	c	<p>collected data is sufficient as 9 measurements (constitute a sample that allows for analysis)</p> <p>voltage values cover the range proposed by the experiment</p> <p>(but) are not distributed evenly or are clustered around some areas and there are gaps in some others</p>		3	B

7	a	<p>at least 5 values of voltage covering range from 0 to 12 V</p> <p>values are evenly distributed</p> <p>correct observation about the light level for all data points</p>	<p><i>all data points above 10.4 V should indicate that the light is illuminated</i></p>	3	C
	b	<p><i>if data has been recorded over the full range:</i></p> <p>current increases with voltage/p.d</p> <p>relation between p.d and current is linear for p.d below 8V</p> <p>relation between p.d and current is not linear for p.d 8V</p> <p><i>If only data below 10.4V has been recorded:</i></p> <p>current increases with voltage/p.d</p> <p>relation between p.d and current is linear</p> <p>(relation between p.d and current is linear) over the range measured</p> <p><i>If 5 data points above 9.6V have been recorded:</i></p> <p>current increases with voltage/p.d</p> <p>relation between p.d and current is non-linear</p> <p>(relation between p.d and current is non-linear) over the range measured</p>	<p><i>WTTE</i></p> <p>$\pm 0.5 V$</p> <p>$\pm 0.5 V$</p> <p><i>do not award any marks if fewer than 5 data points have been recorded</i></p>	3	C
	c	<p>one correct calculation of resistance</p> <p>a correctly linked comment or observation</p> <p>a second correct calculation of resistance</p> <p>a correctly linked comment or observation for the second calculation</p>	<p><i>Unit not necessary here</i></p>	4	C

	<p>d</p>	<p>for directly proportional relationship the graph of the two factors should be a straight line</p> <p><i>Either, as appropriate to the data recorded:</i> the graph is not a straight line so the relationship is not directly proportional</p> <p>(so) the hypothesis is not supported</p> <p><i>or</i></p> <p>the graph is a straight line so the relationship is directly proportional</p> <p>(so) the hypothesis is supported</p>	<p><i>Give credit where reference is made to not all materials have been tested</i></p> <p><i>Do not award this mark alone</i></p> <p><i>Do not award this mark alone</i></p>	<p>3</p>	<p>C</p>
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8	a	10.4 (V)		1	C
	b	only certain frequencies are visible or only certain wavelengths are visible above a certain temperature the EM waves are in the visible range	<i>Or reverse argument</i>	2	C
	c	current increases with voltage/p.d. the current doesn't increase as much as temperature increases/at higher temperature A higher temperature means that atoms in the filament vibrate faster or A higher temperature means that atoms in the filament have greater kinetic energy flowing charges are slowed down by collisions with the vibrating atoms resulting in a smaller increase of current	<i>WTTE</i>	5	C
	d	any reasonable suggestion of an extension [1 max], for example <ul style="list-style-type: none"> • different component • different material • greater range of voltage/p.d. correctly linked justification of the suggestion		2	C

9	a	<p>all correct – two two correct – one mark transmission time – dependent height – control ground distance – independent</p>	ECF	2	B
	b	<p>statement of hypothesis: links independent and dependent variables</p> <p>correct relationship between variables: increase in ground distance increases transmission time</p> <p>justification: as distance travels increases so does the time taken</p>	<p>ECF from part (a)</p> <p>ORA</p>	3	B
	c	<p>ground distance/independent variable would be unaffected because it is not affected by the height of the satellite</p> <p>transmission time would change</p> <p>(transmission time would) increase if height is increased</p> <p>or</p> <p>(transmission time would) decrease if height is decreased</p>	ECF from part (a)	3	B
	d	<p>beyond the maximum distance the stations are outside the satellite footprint</p> <p>(so) signals cannot be transmitted (to the satellite)</p>	Accept answer that describes effect of the curvature of the Earth on the footprint	2	B
	e	<p>because for short distances, the transmission can be made from station to station</p> <p>using a satellite would cause transmission time to be longer making it inefficient</p>	WTTE	2	B
	f	<p>transmission time increases with ground station distance</p> <p>in a non-linear relationship/graph has a curved line</p>	WTTE	2	C
	g	<p>statement confirming or rejecting the hypothesis</p> <p>justification correctly comparing hypothesis to results</p>	Refer to answer given in part b, no ecf	2	C

10	<ul style="list-style-type: none"> • a statement of an advantage or a disadvantage of satellite internet access 	1				
	<ul style="list-style-type: none"> • a statement of an advantage or a disadvantage of satellite internet access that is relevant and appropriate • a statement of a technological consideration • a statement of an economic factor 	2-3				
	<ul style="list-style-type: none"> • the advantage is relevant and appropriate • the disadvantage is relevant and appropriate • the technological consideration is justified • the economic factor is justified 	4-7				
	<ul style="list-style-type: none"> • the advantage is relevant, appropriate and justified • the disadvantage is relevant, appropriate and justified • more than one technological consideration is justified • more than one economic factor is justified • a concluding appraisal linking all the issues discussed previously 	8-12				
					12	D

11	a	<p>an atom absorbs energy from radiation</p> <p>or</p> <p>a charged particle collides (with an atom)</p> <p>an electron gains enough energy to escape</p> <p>an ion is left behind</p>		3	A
	b	<p>Any two linked points [2 max], for example</p> <ul style="list-style-type: none"> • damage to DNA can lead to mutations • mutations can lead to cancer or health issues <p>or</p> <ul style="list-style-type: none"> • damage to cytoplasm can occur • (damage to cytoplasm) leads to cell death 		2	A
	c	<p>Ultraviolet – X-ray – gamma ray</p> <p>all correct</p>		1	A
	d	<p>UV is blocked/absorbed by all materials</p> <p>gamma rays pass through all materials</p> <p>only x-rays give contrast between bone and soft tissue/skin</p>		3	A

e	<ul style="list-style-type: none"> • a statement of chosen technique • an advantage or disadvantage of chosen technique 	1-2		<i>If candidate refers to more than one technique they are still able to receive maximum marks if advantages and disadvantages are given for any single technique</i>	14	D
	<ul style="list-style-type: none"> • a statement of chosen technique • an advantage • a disadvantage • a comment relating to hospital or patient • at least one piece of information from the table used to support a comment made above 	3-5				
	<ul style="list-style-type: none"> • a statement of chosen technique • an advantage justified with information from the table • a disadvantage justified with information from the table • a comment relating to the hospital • a comment relating to the patient 	6-9				
	<ul style="list-style-type: none"> • a statement of chosen technique • more than one advantage justified with information from the table • more than one disadvantage justified with information from the table • a comment relating to the hospital justified with information from the table • a comment relating to the patient justified with information from the table • a concluding appraisal linking all the issues discussed relating to social or economic factors 	10-14				

12		<p>Any relevant scientific point eg high detail in x-ray</p> <p>Two further reasonable points clearly linked to the image, for example</p> <ul style="list-style-type: none"> • the x-ray shows the foot is in an unnatural/distorted position • information about the construction of the shoe is revealed 	<p><i>first point must refer to the image</i></p>	<p>3</p>	<p>D</p>
13	a	<p>XRFS reveals image B not visible in image A</p> <p>image B resembles image C</p>		<p>2</p>	<p>D</p>
	b	<p>Two reasonable and valid comments [2 max], for example</p> <ul style="list-style-type: none"> • painting is not damaged • hidden information is revealed • the whole painting not just a small area • painting is preserved for people to enjoy 		<p>2</p>	<p>D</p>
