

Physics B

General Certificate of Secondary Education

Unit **B751/01**: Unit 1: Modules P1, P2, P3 (Foundation Tier)

Mark Scheme for June 2012

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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For answers marked by levels of response:

- a. **Read through the whole answer from start to finish**
- b. **Decide the level that best fits** the answer – match the quality of the answer to the closest level descriptor
- c. **To determine the mark within the level**, consider the following:

Descriptor	Award mark
A good match to the level descriptor	The higher mark in the level
Just matches the level descriptor	The lower mark in the level

- d. Use the **L1, L2, L3** annotations in Scoris to show your decision; do not use ticks.
Quality of Written Communication skills assessed in 6-mark extended writing questions include:
 - appropriate use of correct scientific terms
 - spelling, punctuation and grammar
 - developing a structured, persuasive argument
 - selecting and using evidence to support an argument
 - considering different sides of a debate in a balanced way
 - logical sequencing.

Annotations

Annotation	Meaning
	correct response
	incorrect response
	benefit of the doubt
	benefit of the doubt not given
	error carried forward
	information omitted
	ignore
	reject
	contradiction
	Level 1
	Level 2
	Level 3

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Abbreviations, annotations and conventions used in the detailed Mark Scheme.

/	=	alternative and acceptable answers for the same marking point
(1)	=	separates marking points
allow	=	answers that can be accepted
not	=	answers which are not worthy of credit
reject	=	answers which are not worthy of credit
ignore	=	statements which are irrelevant
()	=	words which are not essential to gain credit
—	=	underlined words must be present in answer to score a mark (although not correctly spelt unless otherwise stated)
ecf	=	error carried forward
AW	=	alternative wording
ora	=	or reverse argument

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Question		Answer	Marks	Guidance								
1	(a)	started at a / had / is at higher temperature (1)	1	allow higher level answers eg A has a lower SHC eg rate of cooling is higher if starting temperature is higher allow A was in colder surroundings ignore density / different liquid								
	(b)	(i) freezing (1)	1	mark answer line but if answer line is blank allow correct answer ticked circled or underlined								
		(ii) (J) ✓ in 3 rd box (1)	1	if no box ticked allow J written in space at side / below table more than one tick scores zero								
		<table border="1" style="margin-left: 20px;"> <tr> <td>°C</td> <td></td> </tr> <tr> <td>Hz</td> <td></td> </tr> <tr> <td>J</td> <td>✓</td> </tr> <tr> <td>kg</td> <td></td> </tr> </table>	°C		Hz		J	✓	kg			
°C												
Hz												
J	✓											
kg												
		Total	3									

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Question		Answer	Marks	Guidance
2	(a)	infrared (1)	1	
	(b)	(i) 80 % or 0.8 (2) but if answer is incorrect 16 000 ÷ 20 000 (x 100) (1)	2	allow 80 or 0.8% or incorrect unit eg 0.8 J eg 80N (1)
		(ii) any three from: air is trapped (in double glazed top) (1) air or gap or vacuum or glass reduces / prevents conduction (1) air or gap or vacuum reduces / prevents convection (1) infrared or IR or radiation reflected back or little radiated out (1)	3	allow vacuum / inert gas or named inert gas (eg argon) trapped or between the glass ignore gas allow air or vacuum / inert gas or named inert gas is an insulator ignore heat / light but not UV / ultraviolet ignore bounces
		(iii) black or dull surface is used because it is a (good) absorber of infrared / energy / radiation (from the Sun) (1) shiny surfaces are used because they reflect infrared / energy / radiation (to the cylinder) (1)	2	allow light or waves or heat for radiation allow soaks up for absorbs but not attracts allow light or waves or heat for radiation allow bounces for reflects additional marking points allow cylinder is made of metal so energy is transferred to water efficiently / AW allow outlet at top of cylinder, where water is warmest
Total			8	

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Question	Answer	Marks	Guidance
3	<p>Level 3: (5 – 6 marks) Candidates must conclude that UV presents the hazard then apply their knowledge and understanding to explain the risks and the significance of Jane’s dark skin. Risk reduction should be explained in some detail. If only one point addressed in each area award the lower mark in the level. A good cover of all aspects of the scenario in the question is needed for 5-6 marks. Quality of written communication does not impede communication of the science at this level.</p> <p>Level 2: (3 – 4 marks) Answer will apply knowledge and understanding to most aspects of the scenario and must include some reference to risks from UV or the Sun’s rays or sunlight and either risk reduction or the significance of dark skin. If there is only one risk or a preventative measure, award the lower mark in the level. Quality of written communication partly impedes communication of the science at this level.</p> <p>Level 1: (1 – 2 marks) Answers should include a risk and some awareness of protection or some detail of risk or protection. If only risk or protection is mentioned award the lower mark in the level. The significance of dark skin will not be appreciated. Quality of written communication impedes communication of the science at this level.</p> <p>Level 0: (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p>This question is targeted up to grade C Indicative scientific points may include:</p> <p>risks</p> <ul style="list-style-type: none"> • from UV • sunburn / (sun) tan / skin browns / skin damage • skin cancer • cataracts • premature skin aging • can still get sunburn etc wearing sun cream etc <p>allow higher level answers eg damage to human cells / tissue / DNA</p> <p>Jane’s dark skin</p> <ul style="list-style-type: none"> • absorbs more UV • less UV reaches underlying tissue • dark skin lowers risk • allow higher level ref. to melanin <p>methods that reduce risk</p> <ul style="list-style-type: none"> • use of sun screen / cream / lotion • high factors give more protection • sun creams etc absorb UV <p>allow reduction of risk by</p> <ul style="list-style-type: none"> • reduce time spent in the sun(light) • don’t sunbathe during hottest part of the day • stay in the shade • wear protective clothing
	Total	6	

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Question			Answer	Marks	Guidance
4	(a)	(i)	E (1)	1	
		(ii)	(crest) A (trough) D (1)	1	both required in the correct order for mark
	(b)	(i)	4 (cm/s) (2) but if answer is incorrect $\frac{8}{10} \times 5(1)$ or $0.8 \times 5(1)$	2	allow just (f =) $8 \div 10$ or 0.8 (1) ignore 5×8 or 40
		(ii)	(very) much less than speed of em waves / AW / ora (1)	1	allow examples of much slower eg really slow or tiny compared to allow electromagnetic waves are the fastest
			Total	5	

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Question		Answer	Marks	Guidance
5	(a)	<p>not correct since A or 'it' is analogue or A or 'it' is continuously variable / AW (1)</p> <p>digital signal is D as it is a series of 0 / 1 or on / off / AW (1)</p> <p>if no mark scored allow A is analogue and D is digital (1)</p>	2	<p>allow A is analogue as it has values between 0 and 1 / has any value or many values</p> <p>allow D as it has only two values</p> <p>ignore up / down</p> <p>ignore idea of turned on / off</p> <p>ignore not continuous</p>
	(b)	<p>large volume or amount of data transfer / more signals (carried) / more information (carried) (1)</p>	1	<p>allow higher level answers eg multiplexing</p> <p>allow less interference (than cables)</p> <p>allow better quality of output (signal)</p> <p>allow less heating/lower energy consumption / AW</p> <p>ignore faster</p>
		Total	3	

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Question			Answer	Marks	Guidance							
6	(a)	(i)	<table border="1"> <tr><td>planet</td></tr> <tr><td>Venus</td></tr> <tr><td>(Jupiter)</td></tr> <tr><td>(Mars)</td></tr> <tr><td>(Mercury)</td></tr> <tr><td>Uranus</td></tr> <tr><td>Saturn</td></tr> </table>	planet	Venus	(Jupiter)	(Mars)	(Mercury)	Uranus	Saturn	2	all correct 2 marks 1 or 2 correct 1 mark
		planet										
Venus												
(Jupiter)												
(Mars)												
(Mercury)												
Uranus												
Saturn												
(ii)	<u>1.52</u> (AU)	1										
	(b)	(i)	<table border="1"> <tr><td>large star</td></tr> <tr><td>red supergiant</td></tr> <tr><td>supernova</td></tr> <tr><td>black hole</td></tr> </table>	large star	red supergiant	supernova	black hole	1	all three in correct order needed			
		large star										
red supergiant												
supernova												
black hole												
(ii)	idea of strong gravity (1)	1	allow very heavy / big mass / massive / idea of light bent back ignore density									
			Total	5								

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Question		Answer	Marks	Guidance
7	(a)	<p>any three from:</p> <p>protective clothing (1) so stop beta passing through or beta can cause cancer / harm (human) cells / causes ionisation (1)</p> <p>tongs / keep her distance (1) as beta can travel through air) or beta can cause cancer / harm (human) cells / causes ionisation (1)</p> <p>short exposure time (as beta is dangerous) (1) or beta can cause cancer / harm (human) cells / causes ionisation (1)</p> <p>use a suitable shield / aluminium (1) to stop beta penetrating / beta cannot penetrate aluminium (1)</p> <p>labelled storage (so know it emits beta radiation) or idea of a suitable storage container for a liquid so none of the liquid can spill out (when being moved) (1)</p>	3	<p>maximum of 2 marks for measures</p> <p>eg wear gloves handle with tongs and use for a short time (2) but wear gloves to stop beta, handle with tongs and use for a short time (3)</p> <p>ignore lab coat / goggles</p> <p>allow mask or gloves</p> <p>eg mask so she cannot breath beta particles in (2)</p> <p>allow avoid contact as radiation / rays can cause cancer (1)</p> <p>allow steel or lead or lead glass</p>
	(b)	<p>idea that these are her opinions / ideas / views (1)</p> <p>idea that there is no (scientific) evidence or data (in her notes) (1)</p> <p>but</p> <p>idea that she needs to base her decision on scientific evidence not just opinions (2)</p>	2	<p>allow not proven to be true or not enough information</p> <p>allow more data or testing needed but not she needs to do more tests</p> <p>as an extra marking point:</p> <p>allow exposure dose / time low for treatment or no indication which radiation is harmful / what radiation does or no indication of how radiation is harmful or how radiation causes cancer</p> <p>ignore gamma radiation can cause and cure cancer</p>
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Question			Answer	Marks	Guidance
8	(a)	(i)	2.07 (kilowatts) (2) if answer incorrect then 2070 or 9×230 (1) or $\frac{9 \times 230}{1000}$ (1)	2	allow 2.1 or 2 (kilowatts) (2)
		(ii)	24.84 (Kilowatt hours) (2) if answer incorrect then 2.07 x 12 or 2.1 x 2 or 12 x 2 (1)	2	allow 25 or 24.8 allow 24 or 25.2 allow ecf from 3ai eg 24840 (2) 2484 (2) 2070 x 12 (1) 207 x 12 (1)
	(b)		heater uses most energy / electricity and is only used at night or uses most energy / electricity at night (1) then one from: (so) cheaper to pay just 6p then or new cost / 10p cost more expensive / AW (1) increase in price $10 - 6 = 4\text{p}$ too much (if using large 9 amp heaters or for 12 hours at night) (1) saving of 2p on appliances used during day does not off set increased cost of those used at night (1)	2	allow clear calculation and comparison of all appliances eg 425p @ 10p rate (allow +/- 5p) (1 mark) 331p @ 12p / 6p rate (allow +/- 5p) (1 mark) but 2 marks for both calculations correct difference = 93 – 95p higher @ 10p rate (2 marks) if no marks awarded max one mark: allow comparison of 2.40 (10p rate) to 2.16 (12p / 6p rate) (1) allow comparison of 72p to £1.20 (1) ignore comparison of 18p to 20p
			Total	6	

Question	Answer	Marks	Guidance
9	<p>Level 3: (5 – 6 marks) Applies understanding of the cost considerations, compares the total time required (for 8kg wash), and is aware of importance of wash load. Makes reference to reduced electricity or energy use if more efficient and makes valid conclusions using the data. Quality of written communication does not impede communication of the science at this level.</p> <p>Level 2: (3 – 4 marks) Applies understanding to the wash load and number of washes and the cost considerations or time of wash or power rating or efficiency. Correctly interprets some of the data and may make a valid conclusion. Quality of written communication partly impedes communication of the science at this level.</p> <p>Level 1: (1 – 2 marks) Simple explanation of different efficiency or wash loads or machines having different powers or the idea that power rating and / or time to do the washing increase the cost. Some attempt at using the data. If a conclusion is made it will be simple. Quality of written communication impedes communication of the science at this level.</p> <p>Level 0: (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p>This question is targeted up to grade E</p> <p>Indicative scientific points may include:</p> <p>cost considerations including implied costs</p> <ul style="list-style-type: none"> • greater the power rating the greater the cost /ora • so lowest power would be cheapest to run • the longer it is switched on the greater the cost /ora • so shortest time switched on would be cheapest to run • idea that novel has greatest power / classic least / other two in between • idea that novel has longest wash time / feature least / other two in between <p>number of times 8 kg washing done so total time taken</p> <ul style="list-style-type: none"> • classic needs 4 washes so $4 \times 60 = 240$ minutes • feature needs 2 washes so $2 \times 50 = 100$ minutes • novel needs 2 washes so $2 \times 90 = 180$ minutes • supreme needs 2 washes so $2 \times 60 = 120$ minutes • idea that feature is quickest or novel takes long(est) • idea that novel washes most or classic washes least • idea that wash load of feature and supreme are close to novel / good <p>efficiency and environment</p> <ul style="list-style-type: none"> • the most efficient are rated A / ora • classic or feature are rated A / most or highly efficient • novel only rated C / supreme rated B / least efficient • less electricity generated so less pollution / greenhouse gases / global warming

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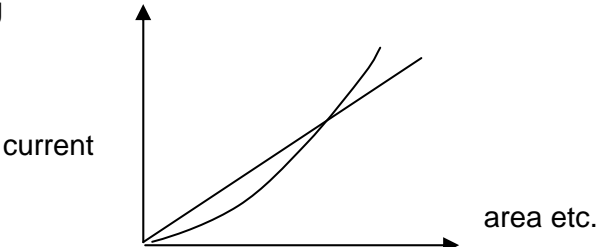
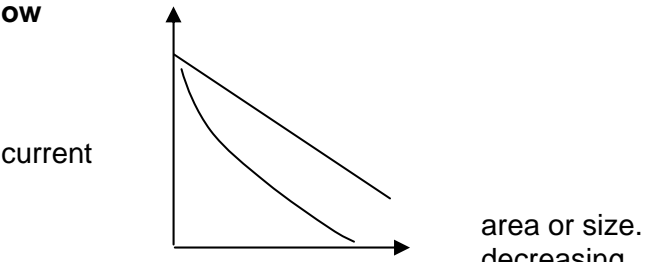
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Question			Answer	Marks	Guidance
					<p>conclusions</p> <ul style="list-style-type: none"> • washing machine with quickest time to wash 8 kg of clothes is feature • washing machine with lowest power rating is classic • most efficient are classic and feature • so choose one of these two washing machines • classic 240 minutes x 700 watts = 168000 • feature 100 minutes x 800 watts = 8000 • so overall feature best to choose
			Total	6	

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Question		Answer	Marks	Guidance
10	(a)	no (no mark) different surface area (1)	1	not merely size but if qualified allow eg some are bigger (0) different size means some collect more photons or light (1) allow surface size
	(b)	x axis labelled with / area / surface area / size and y axis labelled current (1) graph showing an increase in current as surface area or size increases (1) eg 	2	allow bar chart or indicated A B C D E F allow axes are reversed and graph is correct (1) allow  (2)
		Total	3	

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Question		Answer	Marks	Guidance
11	(a)	<p>photographs are a certain time apart / idea of measured time (1)</p> <p>vehicle moves over a measured distance (1)</p>	2	<p>allow named time. eg 0.5 seconds apart or set time or time taken</p> <p>allow moves over marked lines allow measures how far it goes</p> <p>as an additional marking point allow speed = $\frac{\text{distance}}{\text{time}}$ (correct equation) (1)</p>
	(b)	<p>20 (m/s) scores (3)</p> <p>but if calculation incorrect then 10 / 0.5 scores (2)</p> <p>or if no or incorrect calculation silver car named or identified on table (1)</p>	3	<p>allow maximum of 2 for correct calculation of speed for the incorrect vehicle.</p> <p>allow correct listing of units eg 10m and 0.5s (1)</p> <p>allow any other speed calculation eg (bicycle) 5.5 / (scooter) 6.2 or 6.3 / (blue car) 2.5 (1)</p>
	(c)	<p>yes (no mark)</p> <p>idea of 11 m/s = 24-26 mph or 20mph is 9 m/s which is less than her speed (of 11 m/s) (1)</p>	1	<p>allow '5mph over speed limit'</p>
Total			6	

Question	Answer	Marks	Guidance
12	<p>Level 3: (5 – 6 marks) Answer gives a clear and detailed explanation in terms of the affect of the factors of; more speed, road conditions and alcohol on thinking and braking distances and the application to stopping distance and road safety. If road safety is not addressed award the lower mark. Quality of written communication does not impede communication of the science at this level.</p> <p>Level 2: (3 – 4 marks) Answer gives a correct explanation how two factors affect stopping distance or braking distance or thinking distance and how any increase can lead to a greater chance of a crash or accident. If there is no mention of crashes or accidents award the lower mark. Quality of written communication partly impedes communication of the science at this level.</p> <p>Level 1: (1 – 2 marks) Simple explanation of how one of the factors affects thinking or braking distance. Answers may refer to reaction time without mention of thinking distance. Quality of written communication impedes communication of the science at this level.</p> <p>Level 0: (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p>This question is targeted up to grade C</p> <p>Indicative scientific points may include:</p> <p>more / higher speed</p> <ul style="list-style-type: none"> • will increase thinking distance • greater distance travelled at higher speed for the same thinking time • speed will increase braking distance as more KE will need to be absorbed by the brakes • allow longer to stop <p>if answers refer to speed assume it means more speed unless there is a later contradiction</p> <p>road conditions</p> <ul style="list-style-type: none"> • rain / snow / ice / wet leaves / gravel will increase braking distance • reduced friction due to less grip / friction / slippery road • no affect on thinking distance • going downhill increases braking distance <p>ignore references to visibility eg fog</p> <p>alcohol</p> <ul style="list-style-type: none"> • will increase thinking distance as slower • reactions give a longer thinking distance • braking distance is unaffected • stopping distance increased • allow increase reaction time / don't react as quick / reduces concentration (levels) <p>ignore references to other distractions eg mobile phones</p>

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Question			Answer	Marks	Guidance
					<p>road safety link the increased stopping distance to reduction in road safety with an indication of greater chances of accidents or crashes or collisions. ignore increased load or more passengers in answer</p> <p>allow higher level answers at level 3 eg wet road has less friction so less force gives less deceleration</p> <p>higher level quantitative relationships eg thinking distance changes linearly but braking distance depends on v^2</p>
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Question		Answer	Marks	Guidance
13	(a)	<p>mass of dummy (1)</p> <p>speed (of car or dummy) or distance and time (1)</p> <p>momentum = mass x velocity (1)</p>	2	<p>allow mass but not mass of car</p> <p>ignore weight</p> <p>allow how fast it is going</p> <p>allow velocity (of car or dummy)</p> <p>ignore metres per second</p>
	(b)	(i)	1	<p>MARK 13(b)(i) AND (ii) TOGETHER</p> <p>allow inform / help other tests or experiments or investigations</p> <p>allow so they can do more research</p> <p>allow to check their own data</p> <p>allow idea of improving safety if not gained in (b)(ii)</p>
		(ii)	1	<p>ignore to make cars better</p>
	(c)	<p>changes in momentum produces a force / AW (1)</p> <p>but</p> <p>large or quick changes in momentum produce large forces producing greater injuries or harm or damage / AW (2)</p>	2	<p>if no other mark gained</p> <p>allow idea of high momentum produces more force</p> <p>must have the link between momentum change and resulting damage for two marks</p>
	(d)	<p>A is best as it has a greater depth / AW or can change shape better / ability to change shape is high (1)</p> <p>but A is best because it has a greater depth and can change shape better / ability to change shape is high (2)</p> <p>idea that A is better for absorbing energy (1)</p>	3	<p>if no other mark gained</p> <p>A is best as it cushions the impact better (1)</p> <p>allow explanations eg A is better at stopping you hitting the wheel / windscreen</p> <p>ignore counteract the force / absorb the force</p> <p>allow higher level answers: eg allow reduce rate of change of momentum / greater stopping time or distance (2)</p>
		Total	9	

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Question		Answer	Marks	Guidance
14	(a)	(gravitational) potential energy / GPE / PE (1)	1	
	(b)	kinetic / KE (1)	1	
	(c)	idea that ball A / ball dropped from 12m or the biggest height has most (G)PE (because of height) or A has more KE when falling (1) then same (G)PE and / or KE after bouncing (1) or ball A loses more energy when it bounces ora	2	allow higher level answers using $GPE = m \times g \times h$ or explanation of ball B having a greater efficiency in terms of its bounce / ora
		Total	4	

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