

Physics B

General Certificate of Secondary Education

Unit **B751/02**: Unit 1 – Modules P1, P2, P3 (Higher Tier)

Mark Scheme for June 2012

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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

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

Question		Answer	Marks	Guidance
1	(a)	idea that B has a lower specific heat capacity or SHC / AW / ora (1)	1	allow A initially has more energy to transfer / ora allow correct explanation in terms of temperature gradient (1) eg B may have been in colder surroundings (1)
	(b)	Idea of energy flow from liquid / to the surroundings which warm up / AW (1)	1	eg emit energy to warm up surroundings (1) allow hot to cold warming the surroundings (1) eg 'heat flows from hot to cold and warms the air' (1) eg air warms up because it gains energy (1) but merely 'emits energy' (0) and merely 'surroundings warm up' (0)
	(c) (i)	70000 (J) (2) but if answer is incorrect 200 000 x 0.35 (1)	2	allow 70kJ if k J clearly written (2) allow 200 000 x 350 or 70 000 000 (1)
	(ii)	(constant temperature means) change of state / fusion / freezing / AW (1) (energy given out as intermolecular) bonds formed / AW (1)	2	allow description of correct change of state. eg changes from liquid to solid (1) not 'intra-molecular' not 'bonds broken' allow idea of molecules or particles stop moving freely and form a (fixed) structure (1)
		Total	6	

Question			Answer	Marks	Guidance
2	(a)	(i)	radiation (1)	1	Ignore 'Infra red' but infrared radiation (1)
		(ii)	idea or description of convection (1) (warm water rises because) water expands or density falls (1)	2	eg warm water rises / ora (1) not heat rises ignore water circulates ignore conduction eg warm water rises when it expands and becomes less dense (2)
	(b)	(i)	170 000 (2) but if answer is incorrect 200 000 x 0.85 (1)	2	 allow 200 000 x 85 / 100 (1)
		(ii)	any one from: double glazed top traps air / is a good insulator / reduces convection (1) black surface of cylinder is a good absorber (of radiation) (1) idea of shiny surface reflects (radiation back in) (1)	1	ignore 'double glazing traps heat' allow reduces energy loss by conduction (1) eg shiny surfaces reflects heat back in (1) ignore light
	(c)	(i)	$3 \times 10^8 \div 0.001$ / AW (2) but if answer is incorrect $3 \times 10^8 \div 1$ (1)	2	eg $\frac{3 \times 10^8}{1 \times 10^{-3}}$ (2) eg $3 \times 10^8 = 3 \times 10^{11} \times 0.001$ (2) eg $3 \times 10^8 = 3 \times 10^{11} \times 1 \times 10^{-3}$ (2) allow $3 \times 10^8 / 3 \times 10^{11} = 0.001$ (2) allow $3 \times 10^8 / 3 \times 10^{11} = 1 \times 10^{-3}$ (2)

Question			Answer	Marks	Guidance
		(ii)	shorter wavelength means higher frequency (1) but higher frequency has greater energy (2)	2	allow shorter waves have higher energy (1)
			Total	10	

Question	Answer	Marks	Guidance
3	<p>(Level 3) Answers show the idea of sensible government action and idea of increased risk for people and ozone hole linked to CFC's Quality of written communication does not impede communication of the science at this level. (5–6 marks)</p> <p>(Level 2) Answers show the idea of sensible government action and either idea of increased risk for people or ozone hole linked to CFC's Quality of written communication partly impedes communication of the science at this level. (3–4 marks)</p> <p>(Level 1) Answers show a simple idea of (increased) risk for people or sensible government action OR ozone hole created Quality of written communication impedes communication of the science at this level. (1–2 marks)</p> <p>(Level 0) Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>This question is targeted at grades up to A*</p> <p>Relevant points include:</p> <p>ozone</p> <ul style="list-style-type: none"> • CFCs have depleted ozone layer • ozone absorbs UV <p>this causes increased risk due to</p> <ul style="list-style-type: none"> • more chance of skin cancer • more likely to develop cataracts • premature skin aging • more damage to human skin cells / tissue / DNA (eg sunburn) <p>action by governments</p> <ul style="list-style-type: none"> • banned use of CFC's • set targets for implementing the ban / Montreal Protocol • looked for alternatives to CFCs • set about having measures for safe disposal of CFC's currently used • advice on sun protection <p>ignore references to fossil fuels, global warming and CO₂</p> <p>eg UV causes cancer (LOWER mark scored within the level) but UV causes skin cancer (HIGHER mark scored within the level)</p>
	Total	6	

Question		Answer	Marks	Guidance
4	(a)	Real Radio (and) Smooth FM (1) frequencies very close (so cause interference) / AW (1)	2	stations in either order allow 101.2 and 101.8 (1) if stations named are incorrect then no marks awarded for explanation allow frequency difference of 0.6 (mHz can cause interference) (1) allow similar frequencies allow correct responses in terms of wavelength ignore merely 'same frequency'
	(b)	enables more stations / programmes / more information (1)	1	noise / interference can be removed (1) allow higher level answers eg multiplexing (1) allow better quality final signal / improved quality sound (1) ignore merely 'no interference'
		Total	3	

Question		Answer	Marks	Guidance
5	(a)	(at least one complete wave) drawn on A with higher frequency (1)	1	ignore amplitude differences
	(b)	yes (no mark) (voltage) changes from above to below (time) line (as in graph A) (1)	1	if answer is 'no' then award zero marks for explanation eg 'yes' - changes from positive to negative (1) eg 'yes' - changes direction (1) allow correct references to ac current eg changes direction (1)
Total			2	

Question		Answer	Marks	Guidance				
6	(a)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td>large star</td></tr> <tr><td>red supergiant</td></tr> <tr><td>supernova</td></tr> <tr><td>black hole</td></tr> </table> <p style="text-align: right;">(1)</p>	large star	red supergiant	supernova	black hole	1	all three in correct order needed
large star								
red supergiant								
supernova								
black hole								
	(b)	<p>any two from these three different areas:</p> <p>teams of scientists look at different theories / views / ideas / opinions (1)</p> <p>teams bring different equipment / resources / technology / skills (1)</p> <p>different teams can take / check different measurements / data (1)</p>	2	<p>eg other people can develop the work further (1)</p> <p>eg 'More scientists do more research in less time' (1) eg 'More information can be found' (1) eg 'More people means work done faster' (1)</p> <p>eg compare / check results or evidence (1) eg share data (1) eg check reliability (1) not merely 'repeat results' but 'repeat results to check data / reliability' (1)</p>				
Total			3					

Question			Answer	Marks	Guidance
7	(a)	(i)	(a few sheets of) paper / a few cm of air (1)	1	paper / sheet of paper / a few pieces of paper
		(ii)	<p>any one from:</p> <p>idea that the glass / container would absorb / stop the alpha from being detected (1)</p> <p>mention of sensible practical difficulty (1)</p> <p>idea of difficult / not safe to put detector so close to liquid (1)</p>	1	<p>allow background radiation needs taking into account (1)</p> <p>eg placing sheets of paper very close to a liquid without the liquid being absorbed by the paper (1)</p> <p>ignore 'alpha stopped by liquid'</p>
	(b)	(i)	<p>any one from:</p> <p>idea of increasing confidence in results (1)</p> <p>(get better estimate from) mean / average values (1)</p>	1	<p>allow increase reliability (1)</p> <p>ignore fair test</p> <p>ignore more accurate</p> <p>allow to verify / check results / identify anomalies (1)</p> <p>allow to take account of random nature of radioactivity (1)</p>
		(ii)	<p>any two from:</p> <p>count reduced by aluminium and reduced further by lead (1)</p> <p>a sensible reason for link between lead absorber and gamma (1)</p> <p>a sensible link between aluminium absorber and beta or gamma (1)</p>	2	<p>eg lead stops (alpha beta and) gamma (1)</p> <p>eg aluminium stops beta (1)</p> <p>but aluminium stops beta and alpha (2)</p> <p>or aluminium stops beta but lets gamma through (2)</p>
			Total	5	

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 = 4p 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	(a)	<p>energy / light absorbed by photocell / silicon / crystal (1)</p> <p>electrons are knocked loose (from the silicon atoms in the crystal) (1)</p> <p>idea of (free) electron flow / electrons released which creates an electrical current (1)</p>	3	<p>allow higher level answers eg photons absorbed (1) not just light hits not merely 'electrons released' or 'electrons lost'</p> <p>(as alternative to electron flow) allow electrons move to holes (1) allow holes move oppositely to electrons (1)</p> <p>eg 'light knocks the silicon's electrons free which cause a current' (3)</p>

Question	Answer	Marks	Guidance
(b)	<p>(Level 3) Answer shows a sensible detailed or quantitative prediction and explanation and a clear workable plan involving clear fair testing. Quality of written communication does not impede communication of the science at this level. (5–6 marks)</p> <p>(Level 2) Answer shows a sensible prediction or explanation and a clear workable plan involving clear fair testing. Quality of written communication partly impedes communication of the science at this level. (3–4 marks)</p> <p>(Level 1) Answer shows a sensible prediction or a basic workable plan. Quality of written communication impedes communication of the science at this level. (1–2 marks)</p> <p>(Level 0) Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>This question is targeted at grades up to A*</p> <p>Relevant points (with plan as level 2) indicative of level 3 include</p> <ul style="list-style-type: none"> • (prediction / explanation) quantitative or more detailed eg double area double output eg double diameter / length – quadruple output eg more area so more light absorbed and more output eg results in more electrons being knocked loose from the silicon atoms (in the crystal) <p>Relevant points indicative of level 2 include:</p> <ul style="list-style-type: none"> • (clear workable plan) eg measure the current / voltage produced eg use light of the same intensity / same distance from solar cell eg measure the diameter of each photocell to calculate the surface area of each • (sensible prediction / explanation) eg larger photocells more light falls on them eg larger photocells give more output <p>Relevant points indicative of level 1 include:</p> <ul style="list-style-type: none"> • (workable plan) eg shine light / Sun on photocells and measure output eg compare output of different cells <p>or</p> <ul style="list-style-type: none"> • (sensible prediction / explanation) eg larger photocells more light falls on them eg larger photocells give more output
	Total	9	

Question			Answer	Marks	Guidance
10	(a)	(i)	<p>any one from: fewer pedestrians / cyclists killed compared to car occupants (1)</p> <p>fewer pedestrians / cyclists killed compared to previous year(s) (1)</p>	1	<p>allow ratio or proportion going down ignore descriptions of graph eg trend or graph is down / negative correlation</p> <p>ignore answers which simply reword the question</p> <p>ignore references to pedestrian : cyclist ratio</p>
		(ii)	<p>any two from: data does not distinguish pedestrians from cyclists (1)</p> <p>total numbers of deaths for cars not shown (1)</p> <p>total numbers of deaths for pedestrians not shown (1)</p> <p>total numbers of deaths for cyclists not shown (1)</p>	2	<p>allow 'ratio of cyclist deaths compared to pedestrian deaths not known' (2)</p> <p>allow 'total number of deaths for each group unknown' (2)</p>
	(b)		<p>any two from: longer time (to stop) (1)</p> <p>less acceleration (1)</p> <p>less force produced (1)</p> <p>but lower rate of change of momentum produced (2)</p>	2	<p>eg 'Slow down the speed of the passengers more slowly' (1)</p> <p>allow slow down = longer time unless answer shows otherwise eg slow down the change of momentum (1) eg the change in momentum takes longer (1) but slow down the rate of change of momentum (0) (as you cannot 'slow down a rate') allow reduce the rate of change of momentum (2)</p> <p>ignore references to energy but energy absorbed (0) over a longer time (1)</p>
			Total	5	

Question		Answer	Marks	Guidance	
11	(a)	30 (m/s) scores (2) but if answer is incorrect 75 ÷ (0.5 x 5) or 150 ÷ 5 scores or 75 ÷ 2.5 (1)	2		
	(b)	any two from: braking may not (always) leave a skid mark (1) (more or less) tread may affect skidding / AW (1) wet / icy / slippery road (may affect friction) (1) (more / less) weight of / load in car (1) (so) length of skid mark is not the same as braking distance (1)	2	eg ABS brakes may not leave a skid mark (1) eg Non ABS cars may skid more (1) but some cars have ABS (0) allow may have started braking before he skidded (1) ignore references to reaction (time / distance) ignore road and brake conditions unless qualified eg Worn brakes / bad road conditions (0)	
	(c)	(i)	(KE) doubles (with double the mass) / AW (1)	1	
		(ii)	(KE) quadruples / AW (1)	1	
		(iii)	braking distance quadruples / AW (1)	1	
			Total	7	

Question		Answer	Marks	Guidance
12	(a)	drag less than weight (1)	1	allow air resistance or friction for drag allow upward force less than downward force (1) forces unbalanced (0) but unbalanced (resultant) force downwards (1) ignore gravity but allow gravitational force eg gravity more than drag (0)
	(b)	drag = weight (1)	1	allow (upward and downward) forces balanced (1) allow no resultant force / AW (1) ignore gravity but allow gravitational force eg Gravity = drag (0)
	(c)	drag (much) greater than weight (1)	1	allow upward force is (much) greater than the downward force but not merely forces are unbalanced allow surface area increases drag (1)
	(d)	any two from: large surface area / more particles hit (per sec) = more drag (1) surface area to weight ratio has increased (1) drag = weight at a lower speed (1) as speed reduces drag reduces until it equals the weight (1)	2	 eg 'larger area parachute has drag = weight at a lower speed' (2) allow forces balanced at a lower speed (1)
	(e)	more drag needed to balance higher weight / AW (1) the drag (needed for balance) reached at a higher speed (than before) / AW (1)	2	heavier person will need a larger air resistance (1) ignore references to energy
		Total	7	

Question	Answer	Marks	Guidance
13	<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 distance and braking distance and the application to stopping distance and road safety. If road safety is not addressed award the lower mark.</p> <p>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 or thinking 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.</p> <p>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.</p> <p>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> <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.</p>

Question			Answer	Marks	Guidance
					<p>ignore increased load or more passengers in answer</p> <p>allow higher level answers at level 3</p> <p>eg wet road has less friction so less force gives less deceleration</p> <p>higher level quantitative relationships</p> <p>eg thinking distance changes linearly but braking distance depends on v^2</p>
			Total	6	

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