

GCSE

Physics B

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

General Certificate of Secondary Education

Mark Scheme for June 2016

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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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1. Annotations used in scoris

Annotation	Meaning
	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
	correct response
	incorrect response
	benefit of the doubt
	benefit of the doubt not given
	error carried forward
	information omitted
	ignore
	reject
	contradiction

2. 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
<u> </u>	= 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

MARK SCHEME

Question	Answer	Marks	Guidance
1 a i	(industries) need to reduce CFC production or CFC release [1]	1	Look for answers about advice to industry Ignore references to fossil fuels, greenhouse gases, CO ₂
ii	any one from advice / actions on reducing UV exposure [1] advice / actions on disposal of domestic appliances / correct disposal of refrigerators or dehumidifiers [1]	1	Eg. Stay out of the sun / use sun creams Allow reduced use of aerosols [1] Allow reduced use of CFC's [1] Eg. Stop buying products that use CFCs Ignore simply 'don't use fridges / freezers'
C O M M O N b i	any one from repeat measurements [1] use new or different equipment / technology [1]	1	Look for an action Eg. repeat their experiments / use a longer period of time / use measurements from other scientists / collect more evidence / peer review [1] Allow more experiments [1]
C O M M O N b ii	any one from results / findings / patterns or trends confirmed [1] explanations tested by using new experiments / better equipment / techniques / technology [1] CFCs are banned so their effects are reduced [1]	1	Look for a reason Eg. more evidence to support the explanations [1] Eg. more / other scientists come to the same conclusion
	Total	4	

Question	Answer	Marks	Guidance
2 a	1800 (J) [1]	1	
b	60% or 0.6 [2] if answer is incomplete or incorrect then: $\frac{600}{1000} \times 100\%$ [1]	2	allow 60 with incorrect or no unit [1] eg 60 J/s or 60 scores [1] allow 0.6% [1]
c	lowest (useful) energy output / input [1] (usefully) uses a greater proportion of energy / wastes a lower proportion of energy / AW [1] BUT 80% or 0.8 efficient / [2]	3	Eg. Uses least amount of energy [1] allow longer time idea explained e.g. Energy = Power x time, and less power but longer time for slow cooker [1] only uses 160J/s (output) 200J/s (input) or only wastes 40J [1] ignore higher / most efficiency allow wastes less energy (than others) [1] eg only wastes 20% or 0.2 [2] allow 80 (linked to efficiency) with incorrect or no unit [1] eg. 80 J/s or 80 scores [1] allow 0.8% [1] evidence of the correct efficiency calculation [1] eg 160/200 [1]
	Total	6	

Question	Answer	Marks	Guidance
<p>3 a</p> <p>C</p> <p>O</p> <p>M</p> <p>M</p> <p>O</p> <p>N</p>	<p>payback time (of double glazing) is 25 (years) [2]</p> <p>but if incorrect or no calculation then</p> <p>long(est) payback time scores [1]</p>	<p>2</p>	<p>allow 25 on / at side of table clearly linked to double glazing [2]</p> <p>allow CWI saves £50 per year more than DG [2]</p> <p>allow takes a long time to payback / takes a long time to get your money back / AW [1]</p> <p>allow other correct payback calculations to help prove point: eg. CWI 4 years or DP 120/72 (1.67) or LI 3 years [1]</p> <p>allow does not save as much money per year as cavity wall insulation [1]</p> <p>ignore comparisons of the 'cost to fit'</p>
<p>b</p>	<p>Idea that they (different colours) suggest different heat losses / temperatures [1]</p> <p>BUT white / yellow / red / light(er) show most heat loss / highest temperature AW scores [2]</p> <p>Or</p> <p>black / dark blue / purple / dark(er) show least heat loss / lowest temperature [2]</p>	<p>2</p>	<p>Allow (different colours) show where (more) insulation is needed [1]</p> <p>Allow (different colours) show which parts are (well) insulated [1]</p> <p>Allow most heat lost through windows and / roof or less heat lost through walls [1]</p> <p>allow white / yellow / red / light(er) shows where most insulation is needed [2]</p> <p>allow black / dark blue / purple / dark(er) shows where less insulation is needed [2]</p>

Question	Answer	Marks	Guidance
c	<p>Level 3: (5 – 6 marks) Answer identifies conduction and convection and gives one simple description in terms of particles. Quality of written communication does not impede communication of the science at this level.</p> <p>Level 2: (3 – 4 marks) Answer gives two from either - identifying conduction - or identifying convection - or giving a simple description in terms of particles. Quality of written communication partly impedes communication of the science at this level.</p> <p>Level 1: (1 – 2 marks) Answer identifies either conduction or convection or gives a simple description in terms of particles. 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 grade A*</p> <p>Indicative scientific points may include:</p> <p>Particle explanation</p> <ul style="list-style-type: none"> • air particles collide with glass both inside and outside transferring energy • conduction by transfer of KE between particles • particles move further apart in air • warm air particles rise / cause convection ORA • poor conduction in air because particles are more spaced / moving around / rarely collide <p>Conduction explanation</p> <ul style="list-style-type: none"> • conduction through glass • (little) conduction through (still) air / trapped air is an insulator <p>Convection explanation</p> <ul style="list-style-type: none"> • convection through (trapped) air • reference to (small) convection current in trapped air <p>ignore references to vacuum and radiation</p> <p>Use the L1, L2, L3 annotations when useful. Do not use ticks.</p>
	Total	10	

Question	Answer	Marks	Guidance
4 a	<p>warm water expands [1]</p> <p>warm water becomes less dense [1]</p> <p>warm water rises / cold water sinks [1]</p>	2	<p>allow reverse arguments e.g.</p> <p>cool water contracts [1] particles move further apart [1]</p> <p>cool water becomes more dense [1]</p> <p>NOT (for 1st two marking point only) 'particles expand / contract / become less / more dense'</p> <p>ignore heat rises</p>
b i	<p>water 60(°C) [1]</p> <p>beaker 40(°C) [1]</p> <p>but if answer is incorrect or incomplete then:</p> <p>either beaker t = $\frac{13\ 440}{0.2 \times 1680}$ scores [1]</p> <p>OR water t = $\frac{151\ 200}{0.6 \times 4200}$ scores [1]</p>	2	<p>Allow the energies being used the wrong way round. – so gives 5.3(°C) and 450(°C) [1]</p>
ii	<p>(only) water (particles) absorbs microwaves [1]</p> <p>(only) water is heated by the microwaves [1]</p> <p>beaker does not absorb / not heated by microwaves [1]</p>	1	<p>ignore microwaves absorb water</p> <p>allow hot water heats the beaker / plastic heated indirectly [1]</p>
	Total	5	

Question	Answer	Marks	Guidance
5 a	<p>any two for one mark from</p> <p>low maintenance /</p> <p>no cable required /</p> <p>no need for fuel or mains /</p> <p>long life /</p> <p>renewable energy source /</p> <p>idea of no polluting waste</p> <p>[1]</p>	1	<p>Eg. 'Don't need to burn fossil fuels to produce electricity' [1] Ignore sustainable</p> <p>Eg. no CO₂ / acid rain / SO₂ / NO_x [1] Allow no carbon emissions (when in use) [1] Ignore merely 'environmentally friendly / less or no pollution'</p>
b	<p>any two from</p> <p>light / photons absorbed by silicon (atoms) [1]</p> <p>electrons knocked out (of silicon atoms in crystal) [1]</p> <p>(causing) current or electrons to move / flow [1]</p>	2	<p>allow light absorbed by photocell [1]</p> <p>allow 'free electrons' [1] (for electron flow mark)</p>
c	<p>larger area produces more current / energy / power OR larger area absorbs more light / energy / power (from the sun) / AW [1]</p> <p>But</p> <p>when angle of (sun)light is low larger area allows enough or more light / energy / current / power [2]</p>	2	<p>allow on a cloudy / dull day a large area is needed for enough or more energy / current / power [1]</p> <p>allow when sun(light) is low (in sky) larger area allows enough or more light / energy / current / power [2]</p>
	Total	5	

Question	Answer	Marks	Guidance
<p>6 a</p> <p>C O M M O N</p>	<p>(Water vapour) – (water evaporating) from sea / lakes / rivers / clouds / rain / or combustion [1]</p> <p>(CO₂) – combustion / respiration / AW [1]</p> <p>(Methane) – decomposition / AW [1]</p>	3	<p>allow specific examples such as large scale boiling of water [1] eg. (fuel) power stations [1] ignore using kettle and other small scale water vapour production methods. allow volcanoes [1]</p> <p>allow volcanoes / (using) vehicles or engines / (fossil or biofuel) power stations / factories or industry / breathing (out) / release from oceans [1] ignore nuclear power station ignore simply ‘human activity’</p> <p>allow named decomposition e.g. (gas from) cows / animal waste / permafrost / bogs / rice fields / biofuels / fermentation [1] allow volcanoes [1]</p>
<p>b</p> <p>C O M M O N</p>	<p>Atmosphere absorbs IR / AW [1]</p>	1	<p>allow atmosphere traps IR / stops or reduces the IR reaching the Earth [1] allow higher level answers e.g. refracts the IR [1]</p> <p>ignore merely reflects IR / changes the wavelength / ozone</p> <p>ignore references to heat</p>

Question	Answer	Marks	Guidance
C O M M O N c	(UK may be colder but) other places are probably hotter / AW [1] It is just an opinion / belief (rather than based on reliable scientific evidence) [1] average (global) temperature is more reliable [1] temperature fluctuations (locally) do not undermine the trend [1] her experience is over a short period of time [1] global changes need data from longer periods of time / AW [1]	2	Allow only looking at one area / UK [1] Allow (weak / limited) no evidence [1] Allow there are extreme weather events / flooding / melting ice caps (elsewhere) [1] Eg. (local) weather is not a good indicator [1] allow idea that her experience is over a limited time but global temperature changes may take decades [2]
C O M M O N d	(natural) forest fires / volcanoes / decomposition of living matter [1]	1	allow specific examples e.g. peat bogs / gas from cows / animal waste [1]
	Total	7	

Question	Answer	Marks	Guidance
7 a	(Highest current is the) oven [1] 7.83 (A) [2] but if calculation incorrect 1800 / 230 [1]	3	More or less than 2 decimal places or incorrect 2 decimal places scores maximum of [1] for calculation eg. 7.826087 / 7.826 / 7.82 / 7.8 [1] allow if incorrect appliance selected allow correct calculation of current e.g. grill 6.52 (A) / laptop charger 5.00 (A) / slow cooker 2.00 (A) [2] correct substitution for incorrect appliances can score [1]
b	540 (pence) or £5.40 [2] but if answer is incorrect either 20 x 18 x 1.5 [1] or 20 x 18 x 1500 [1] or 540000 (pence) or £5400 [1] or 1.5 x 20 or 30 [1]	2	5.4 scores [1]

Question	Answer	Marks	Guidance
c	lowers current [1] reduces heating effect (in wires) [1]	2	Ignore less energy is lost. Allow less heat loss [1] Allow correct use of I^2R
	Total	7	

Question	Answer	Marks	Guidance
8	<p>Level 3: (5 – 6 marks) The three types of radiation (alpha, beta <u>and</u> gamma) are correctly identified from at least three of the sources with valid explanations. Quality of written communication does not impede communication of the science at this level.</p> <p>Level 2: (3 – 4 marks) Two types of radiation (from alpha, beta or gamma) are correctly identified with reasons given. Quality of written communication partly impedes communication of the science at this level.</p> <p>Level 1: (1 – 2 marks) One type of radiation (from alpha or beta or gamma) with a simple reason is correctly identified OR two types of radiation are correctly identified. 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 grade A*</p> <p>Indicative scientific points may include: Sources</p> <ul style="list-style-type: none"> • A is gamma – affected only by lead • B is alpha – stopped by paper / stopped by all barriers • C is alpha <u>and</u> beta – alpha as reduction with paper and beta as reduction with aluminium • D is alpha <u>and</u> gamma – alpha as reduction with paper, no reduction with aluminium, but gamma as reduction with lead. <p>Ignore any source if all 3 types given (ie. simple guessing)</p> <p>Use the L1, L2, L3 annotations when useful. Do not use ticks.</p>
Total		6	

Question	Answer	Marks	Guidance												
9 C O M M O N	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">A</td> <td></td> <td style="text-align: center;">✓</td> <td></td> </tr> <tr> <td style="text-align: center;">B</td> <td style="text-align: center;">✓</td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">C</td> <td></td> <td></td> <td style="text-align: center;">✓</td> </tr> </table> <p style="text-align: right;">[2]</p>	A		✓		B	✓			C			✓	2	all correct [2] any 1 correct [1] ignore any line with more than one tick
A		✓													
B	✓														
C			✓												
b i	acceleration decreases (as speed increases) / non uniform change in acceleration / acceleration drops more quickly at the start [1]	1													
ii	resistive force / friction / air resistance / drag increases (as speed increases) [1] idea that resultant force decreases / the driving force equals the resistive force [1]	2	Allow forces balance [1]												
	Total	5													

Question	Answer	Marks	Guidance
<p>10 a</p> <p>C O M M O N</p>	<p>Maximum of one for: compare injuries from (a variety of) crashes / compare effects on crash dummies / measure force / acceleration / stretch / momentum [1]</p> <p>and maximum of one from</p> <p>for different materials / seatbelts [1]</p> <p>for different people [1]</p> <p>for different speeds [1]</p> <p>for seat positions [1]</p>	2	<p>Marking points are independent</p> <p>eg. different types of seatbelt [1] old design of belt compared with new designs [1] lap belt compared to 3-point belt [1]</p> <p>eg. sizes</p>
b	<p>they change shape / stretch / get longer [1]</p> <p>(and therefore) absorb energy [1]</p>	2	<p>allow reduce pressure by spreading force over a larger area [1]</p> <p>allow the KE of driver is converted into elastic (potential) energy in the seat belt [1]</p> <p>allow higher level answers referring to eg. increased time / distance [1] eg. reduced force / acceleration [1] eg. decreased rate of change of momentum [2]</p> <p>allow prevents impact with steering wheel, windscreen or dashboard [1]</p>

Question	Answer	Marks	Guidance
c	crumple zones and air bags [1]	1	Allow collapsible steering column / collapsible bumpers
d i	(no) (no mark) doubling speed increases stopping distance [1] but doubling speed more than doubles the braking / stopping distance [2]	2	If yes answered [0] marks Allow anything more than double the affect Eg. doubling speed triples / quadruples braking or stopping distance [2] Allow correct calculation and comparison of two stopping distances, e.g. at 32km/h, stopping distance=12m & at 64km/h it is 36m [2]
ii	any two for one mark bald tyres / smooth tyres / faulty brakes wet road / ice on road more load in car increased gradient / downhill [1]	1	Allow worn tyres / worn brakes Allow reduced friction surface / slippery road [1] Ignore bad weather / tyre condition / road conditions Ignore merely mass / weight / number of passengers But allow more mass / weight / passengers
	Total	8	

Question	Answer	Marks	Guidance
11	<p>[Level 3] Answer describes correctly what happens in all 4 sections AND calculates / states one (average) speed from section A or B or C or over whole journey. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>[Level 2] Answer describes correctly what happens in all 4 sections OR describes correctly 2 sections and calculates / states one (average) speed from section A or B or C or over whole journey. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>[Level 1] Answer describes correctly what happens in 2 sections / times OR calculates /states one (average) speed from any section or over whole journey. 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>Section A</p> <ul style="list-style-type: none"> • accelerates / speeding up • (average) speed = 10m/s <p>Section B</p> <ul style="list-style-type: none"> • constant speed / zero acceleration • (average) speed = 20m/s <p>Section C</p> <ul style="list-style-type: none"> • deceleration / negative acceleration / slowing down • (average) speed = 10m/s <p>Section D</p> <ul style="list-style-type: none"> • Stationary or (average) speed = 0m/s <p>Whole journey (average) speed = 13.3m/s</p> <p>Use the L1, L2, L3 annotations when useful. Do not use ticks.</p>
Total		6	

Question	Answer	Marks	Guidance
12 a	2 (m/s ²) [1]	1	NOT 2m/s
b	280000 (J) [3] but if incorrect 2800 x 100 [2] but if incorrect distance = 100(m) OR 2800 x distance OR evidence of using work done = force x distance [1]	3	Eg 2800 x 200 or 560000 [1]
c	56000 (W) [2] but if answer incorrect 2800 x 20 [1]	2	
Total		6	

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