

GCSE

Physics B

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

General Certificate of Secondary Education

Mark Scheme for June 2017

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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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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

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	completely curved waves (with no straight sections) drawn (1) wavelength remains the same (by eye) (1)	2	Waves do not have to touch the barrier Mark first 4 wave-fronts (on left) only Accept (variation in) wavelengths between $\frac{1}{2}$ and double original wavelength (as checked on central line through the slit)
b	any one from: diffraction is only at the edges (1) there is less / no diffraction (1)	1	Allow straight sections in the middle and curved at edges / waves are straighter (1) Allow less curved / bend less Ignore 'spread out more' and 'spread out less' / smaller diffraction
	Total	3	

Question	Answer	Marks	Guidance
2	Level 3: 5-6 marks Correct material suggested for both types of floors AND an explanation of conductor in room A AND an explanation of insulator in room B. Quality of written communication does not impede communication of science at this level. Level 2: 3-4 marks Correct material chosen for both types of floors AND	6	This question is targeted up to A* Indicative scientific points may include (but are not limited to) the following: Room A <ul style="list-style-type: none"> • under floor heating requires heat to be able to conduct through the floor. • a poor insulator / good conductor is required • ceramic tiles / or Lino are suitable to use Room B <ul style="list-style-type: none"> • for a room without underfloor heating a good insulator is

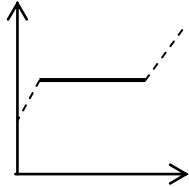
	<p>an explanation of conductor OR insulator for either room. Quality of written communication partly impedes communication of science at this level.</p> <p>Level 1: 1-2 marks Correct material chosen for both types of floor OR An explanation of conductors OR insulators for either room.</p> <p>Quality of written communication impedes the communication of science at this level</p> <p>Level 0: 0 marks Insufficient or irrelevant science. Not worthy of credit.</p>		<p>required (otherwise the floor will feel cold)</p> <ul style="list-style-type: none"> • cork tiles / wool carpet / oak wood would be suitable to use
Total		6	

Question	Answer	Marks	Guidance
3 a i	<p>any two from:</p> <p>(a series of) on/off signals (1)</p> <p>(Idea that) they are sent / received as a code (1)</p> <p>using relay stations (for greater distances) (1)</p>	2	<p>Ignore 'digital'</p> <p>Allow dots and dashes / long and short pulses / flashes (of light) (1)</p> <p>Allow pattern / sequences represent letters / language (1)</p>
ii	it only has two values / it is just on-off signals / AW (1)	1	<p>Allow long and short flashes / dots and dashes (1)</p> <p>Ignore references to multiplexing / noise / signal quality</p>
b	<p>infrared ray entering / leaving the optical fibre at an end (1)</p> <p>they hit the side of the fibre at more than the critical angle / AW (1)</p> <p>the rays are totally internally reflected / reflected AT the surface (on diagram) / AW (1)</p>	3	<p>Allow full marks for correctly drawn diagram</p> <p>Do not allow a poor diagram to negate marking points clarified in the text</p> <p>refraction on entering / leaving the fibre is not required</p> <p>accept reflections with angle $i = 45^\circ$ (by eye) or higher</p> <p>allow 'TIR' for total internal reflection</p> <p>If diagram is correct then check writing for any contradictions.</p>

c	<p>2.2x10¹⁴ Hz (3)</p> <p>if incorrect or incomplete then allow:</p> <p>2.22x10¹⁴Hz or 2.222x10¹⁴Hz (2)</p> <p>or</p> <p>2.0x10¹⁴ or 2.2 or 2.22..etc (1)</p> <p>or (for correct substitution) $f = \frac{2 \times 10^8}{9 \times 10^{-7}}$ (1)</p>	.3	<p>Allow any other value that rounds to 2.2x10¹⁴ (2)</p> <p>Allow 2.2 x 10^x or 2.22... x 10^x (1)</p>
Total		9	

Question	Answer	Marks	Guidance
4 a	<p>any one from:</p> <p>loss of line of sight (due to curvature of the Earth / hills / obstruction) (1)</p> <p>transmitter – receiver distance too large / AW (1)</p> <p>no / little diffraction of microwaves around obstacles (1)</p> <p>interference (between signals) (1)</p>	1	<p>Allow references to satellites combined with a correct statement; Eg. Line of site to satellite is blocked (1)</p> <p>Allow reasonable examples of obstructions eg. hills / buildings / in a tunnel / curvature of earth / (large areas of) water (scatter signals) / AW (1)</p>

<p>b</p>	<p>any one from:</p> <p>put transmitters closer together (1)</p> <p>build more transmitters (1)</p> <p>more power / energy from signals or transmitters / stronger signal (1)</p> <p>position transmitters / receivers at higher levels / AW (1)</p>	<p>1</p>	<p>Ignore any references to digital signals or satellites</p> <p>Allow move closer to a mast (1)</p> <p>Allow more powerful transmitters (1)</p> <p>Allow put masts in line of sight (1)</p>
<p>c</p>	<p>any one reason AGAINST from:</p> <ul style="list-style-type: none"> • (microwave) radiation could be damaging / safety (concerns) (1) • little is known about the effects of (high energy) microwaves (1) • unsightly / visual pollution / occupy (otherwise useful) land (1) <p>any one reason FOR from:</p> <ul style="list-style-type: none"> • improved communication / coverage (1) 	<p>2</p>	<p>Ignore references to cost</p> <p>Ignore references to 'dangerous' (as it is in the question)</p> <p>Eg. Increases health risk / (Radiation may) cause cancer / cause (brain) tumours / harm people (1)</p> <p>Ignore just 'fear'</p> <p>BUT fear of cancers scores (1)</p> <p>Eg.</p> <p>Allow better service / more or stronger signals (1)</p> <p>Allow easier to keep in touch (1)</p> <p>Allow faster service (1)</p>
<p>Total</p>		<p>4</p>	

Question	Answer	Marks	Guidance
5 a	7,910,000J / 7.91MJ / 7910kJ / 7.91×10^6 J (1) if incorrect or incomplete then: 3.5×2260000 (1)	2	allow correctly rounded answers to 2 significant figures
b	horizontal line shown on graph (1)	1	allow written description which covers the marking point 
Total		3	

Question	Answer	Marks	Guidance
6 a	toaster (1)	1	
b	fridge (1)	1	
c	96 (p) (2) if incorrect or incomplete then: 0.5 x 12 x 16 = ? scores (1) OR 0.5 x 12 = 6.0 (1)	2	£0.96 scores [2] 0.96 (p) (1)
	Total	4	

Question	Answer	Marks	Guidance
7 a	1,050,000 J (3) If incorrect or incomplete then: 450000 J (2) or 1,500,000 x 0.3 (1)	3	
b	reduces energy or power waste / heating (in cables) or increases efficiency (1) reduces costs (1) (enables) use of thinner wires (1) reduced current (due to increased voltage) (1)	2	Ignore references to 'electricity' or voltage. Eg. gets more electricity to houses (0) Eg. Less voltage lost (0) No absolutes accepted: Eg. NOT stops energy waste (completely) Eg. NOT wires don't get hot BUT wires do not get as hot scores (1) Allow more power / energy to the consumer / AW (1)
c i	0.4 (seconds) (1)	1	ignore any units
ii	30 or -30 (volts) (1)	1	ignore any units

	Total	7	
Question	Answer	Marks	Guidance
8	<p>Level 3: 5-6 marks Answer shows FOUR simple ideas of which TWO are explained in detail. Quality of written communication does not impede communication of science at this level.</p> <p>Level 2: 3-4 marks Answer shows either FOUR simple ideas OR TWO ideas explained in detail. Quality of written communication partly impedes communication of science at this level.</p> <p>Level 1: 1-2 marks Answer shows TWO simple ideas OR ONE idea explained in detail. Quality of written communication impedes, communication of science at this level</p> <p>Level 0: 0 marks Insufficient or irrelevant science. Not worthy of credit.</p>	6	<p>This question is targeted up to A*</p> <p>Indicative scientific points may include (but are not limited to) the following:</p> <p><u>DETAILED ideas</u> (can be in terms of wavelength or frequency)</p> <p>TRANSMISSION:</p> <ul style="list-style-type: none"> • glass is transparent to the Sun's short-wave radiation • The atmosphere is transparent to the Sun's short-wave radiation <p>ABSORPTION:</p> <ul style="list-style-type: none"> • surfaces in the home absorb short-wave radiation and emit long-wave • the Earth absorbs short-wave radiation and emits long-wave radiation <p>RE-EMMISSION:</p> <ul style="list-style-type: none"> • (warmed) surfaces in the home emit long-wave radiation • (warmed) surface of the Earth emits long-wave radiation <p>TRAPPING:</p> <ul style="list-style-type: none"> • the glass reflects the long-wave radiation back into the room • the (greenhouse gases in the) atmosphere absorbs or reflect the long-wave radiation <p><u>SIMPLE ideas</u></p> <p>TRANSMISSION</p> <ul style="list-style-type: none"> • radiation from the Sun passes through the atmosphere OR radiation from the Sun passes through the glass <p>ABSORPTION</p> <ul style="list-style-type: none"> • radiation is absorbed by the Earth OR radiation is absorbed by the surfaces in the home <p>Re-EMMISSION</p> <ul style="list-style-type: none"> • (warm) surfaces in home emit radiation

			<p>OR (warm) surfaces on Earth emit radiation</p> <p>TRAPPING</p> <ul style="list-style-type: none"> (emitted) radiation / heat is trapped or reflected by glass OR (emitted) radiation is trapped in or by the atmosphere <p>Can then choose, say, 4 comparisons for L3, three comparisons for L2 & two comparisons for L1 ?</p>
	Total	6	

Question	Answer	Marks	Guidance
9 a i	<p>TOP BOX: (Gravitational) collapse / (dust and gas) pulled together / proto-star (1)</p> <p>LEFT BOXES: (planetary) nebula and then white dwarf OR (planetary) nebula and then black dwarf OR white dwarf and then black dwarf (1)</p> <p>RIGHT BOXES: supernova and then neutron star / black hole (1)</p>	3	<p>NOT Proton star</p> <p>in correct order and both required for (1) mark</p> <p>in correct order and both required for (1) mark</p> <p>If middle box is a neutral answer then award this mark if answer is correct in lowest box. Eg. LHS: middle box – it explodes and sheds its outer layer Bottom box – white dwarf then black dwarf (1)</p>
ii	(Difference in) mass / weight (1)	1	<p>Allow (differences in) the number of (hydrogen) nuclei (1)</p> <p>Ignore references to size / large and small stars</p>
b	red shifts (1) ozone layer (1)	3	

	gravitational attraction of Jupiter (1)		
c	gravitational attraction / gravity (1)	1	Ignore weight
	Total	8	
Question	Answer	Marks	Guidance
10 a	<p>Maximum of TWO marks from:</p> <ul style="list-style-type: none"> • increase stopping / collision time (1) • decrease acceleration (1) • reduces the rate of change of momentum / AW scores (2) <p>and ONE mark for:</p> <ul style="list-style-type: none"> • increase stopping / collision distance (1) • 	3	<p>ignore references to energy / changing shape</p> <p>assume 'longer' refers to time unless indicated otherwise Not merely 'Slows it down more gradually' / 'less suddenly' NOT merely 'slower acceleration' or 'rate of acceleration'</p> <p>Look for use of the equation rather than simply stating it.</p>
b i	<p>any one from:</p> <p>driver tiredness (1)</p> <p>influence of alcohol / drugs (1)</p> <p>greater speed (1)</p> <p>distractions (1)</p> <p>lack of concentration (1)</p>	1	<p>not just speed</p> <p>allow named distractions, e.g. radio / talking / mobile phone</p>

ii	<p>any one from:</p> <p>wet / icy / slippery road conditions (1)</p> <p>worn brakes (1)</p> <p>worn / poor tyres (1)</p> <p>greater speed (1)</p>	1	<p>Not merely 'road conditions' Allow poor road conditions (1)</p> <p>allow poor brakes (1) not merely 'condition of brakes'</p> <p>not merely quality /condition of tyre</p> <p>not just speed Allow high speed (1)</p> <p>Allow more mass / heavier car (1)</p>
c	<p>(Idea that) there is not enough reaction time or enough thinking distance to stop the car / AW (1)</p>	1	<p>Allow you will crash before you have reacted (1) Allow not (even) enough time to start braking (1)</p> <p>Ignore there is not enough time to think ignore 'you will crash' / 'you are too close'</p>
	Total	6	

Question	Answer	Marks	Guidance
11 a	<p>any two from:</p> <p>diesel cars:</p> <ul style="list-style-type: none"> • have better / low(er) fuel consumption / ORA (1) • have less carbon emissions / ORA (1) <p>more seats / larger cars:</p> <ul style="list-style-type: none"> • gives more carbon emissions / ORA (1) • gives worse / high(er) fuel consumption / ORA (1) <p>better /low(er) fuel consumption</p> <ul style="list-style-type: none"> • gives low(er) carbon emissions / ORA (1) 	2	<p>For WORSE / HIGH(ER) fuel consumption allow reference to low(er) values in the table</p> <p>For BETTER / LOW(ER) fuel consumption allow reference to high(er) values in the table</p>
b	<p>car D (1)</p> <p>it has the best fuel consumption / is the most efficient (1)</p>	2	<p>If D is not selected then zero marks for the whole question.</p> <p>Look for answers that use the information rather than just quote it</p> <p>For BETTER / LOWER fuel consumption allow reference to high(er) values in the table</p>
c	<p>any two from:</p> <p>so people can make the right decisions /ORA / AW (1)</p> <p>reliable information / unbiased / avoids cheating on tests (1)</p>	2	<p>Ignore 'accurate' as it is in the stem of the question</p> <p>Also read the stem to avoid repetition in answers.</p> <p>Eg. so you can make an informed choice (1)</p> <p>Eg. Car salesmen may tell lies etc.</p> <p>Eg. Need to be confident in the information</p> <p>Do not award marks for vague answers:</p> <p>Eg. Customers will not be happy</p>
Total		6	

Question	Answer	Marks	Guidance
12	<p>Level 3: 5-6 marks Forces discussed and linked to acceleration at three points AND drag linked to acceleration / velocity / speed. Quality of written communication does not impede communication of science at this level.</p> <p>Level 2: 3-4 marks Forces discussed and linked to acceleration at two points. Quality of written communication partly impedes communication of science at this level.</p> <p>Level 1: 1-2 marks Forces discussed and linked to acceleration at one point OR forces discussed at two points OR acceleration described at two points Quality of written communication impedes the communication of science at this level</p> <p>Level 0: 0 marks Insufficient or irrelevant science. Not worthy of credit.</p>	6	<p>This question is targeted up to grade A Ignore references to energy</p> <p>Drag is equivalent to air resistance or friction</p> <p>Indicative scientific points may include (but are not limited to) the following:</p> <p>At point A</p> <ul style="list-style-type: none"> • drag is zero/minimal • weight is greater than drag • there is a resultant force • object accelerates (maximum acceleration) <p>At point B</p> <ul style="list-style-type: none"> • as speed/velocity increases, drag increases • increasing drag means a smaller resultant force • acceleration is reduced, but still positive • object has lower acceleration <p>At point C</p> <ul style="list-style-type: none"> • drag equals weight so no acceleration / terminal velocity • no resultant force so no acceleration / terminal velocity
Total		6	

Question	Answer	Marks	Guidance
13 a	6,250 or – 6,250 (N) (2) if incorrect or incomplete then: 50000/8 (1)	2	
b	1.25 or – 1.25 (m/s ²) (2) if incorrect or incomplete then: 6250/5000 (1)	2	allow ecf from 13a
Total		4	

Question	Answer	Marks	Guidance
14 a	20 or -20 (m/s) (2) if incorrect or incomplete then: $v = \sqrt{2gh}$ or 400 (1)	2	Allow answers using other valid equations of motion: Eg. $v^2 = u^2 + 2as$ $v = \sqrt{2as}$ (1)
b	any one from: top of a mountain (1) under surface of Earth (1)	1	ignore merely 'not at, above or below sea level' But 'standing on the bottom of the sea' (1) Look for any high or low position connected to Earth ignore 'in an aircraft' allow equator / poles (1) allow other correct examples eg. bottom of a mineshaft (1) If answer goes into detail and states the incorrect difference in gravity then ignore the detail: eg. On top of a mountain gravity is 'higher' [1] (This still shows a difference so scores the mark)
Total		3	

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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Head office
Telephone: 01223 552552
Facsimile: 01223 552553

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