

GCSE

Physics B

Unit **B752/02**: Unit 2 – Modules P4, P5, P6 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2017

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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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Annotations used in scoris

Annotation	Meaning
	correct response
	incorrect response
BOD	benefit of the doubt
NBOD	benefit of the doubt not given
ECF	error carried forward
	information omitted
I	ignore
R	reject
CON	contradiction

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

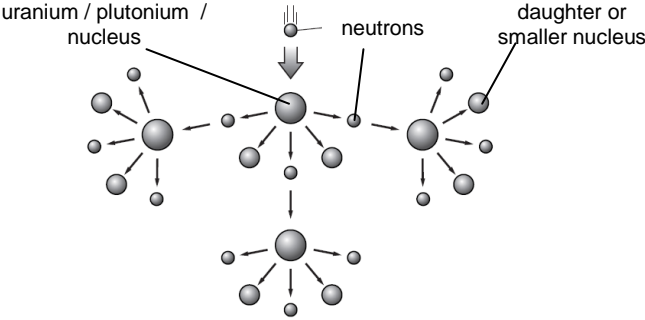
- / = alternative and acceptable answers for the same marking point
- (1)** = separates marking points
- allow** = answers that can be accepted
- not** = answers which are not worthy of credit
- reject** = answers which are not worthy of credit
- ignore** = statements which are irrelevant
- () = words 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

MARK SCHEME

Question	Answer	Marks	Guidance
<p>1 a</p>	<p>EARTH – safety wire / stops appliance becoming live / to allow (large) current or flow of charge to go to Earth / ground (if live touches metal case) (1)</p> <p>.....</p> <p>LIVE – contains fuse or provides (high) voltage / current / energy / power (1)</p> <p>.....</p> <p>NEUTRAL – completes the circuit (1)</p>	<p>3</p>	<p>Reference to shock must be qualified Eg. protects user from shock / can't get a shock ignore reference to fuse for this marking point not merely connects to earth / connects to the ground</p> <hr/> <p>allow 'carries voltage' / 230 to 240V (1) ignore just 'supplies or carries electricity' allow idea of electron flow / charge flow (1)</p> <p>.....</p> <p>allow 'is at zero volts' (1) allow carries current or charges flow (1) allow neutral wire is earthed at the power station (1)</p>
<p>b</p>	<p>any one from:</p> <p>prevents the current / charge flow (1)</p> <p>prevents flex / plug overheating (1)</p> <p>prevents damage to the appliance (1)</p>	<p>1</p>	<p>Ignore electricity Allow breaks circuit / stops power / protects user / stops appliance becoming live (1)</p> <p>Allow reduces fire risk (1)</p>

<p>c i</p>	<p>2 (2)</p> <p>if answer incorrect or incomplete then:</p> <p>$\frac{3}{1.5}$ (1)</p>	<p>2</p>	<p>Ignore any units</p>
<p>ii</p>	<p>any two from:</p> <p>reduce the setting on variable resistor (1)</p> <p>remove the lamp / resistor / ammeter (1)</p> <p>make the wires shorter (1)</p> <p>use thicker wires (1)</p> <p>place resistor and lamp in parallel (1)</p>	<p>2</p>	<p>Allow 'turn the variable resistor down' (1) NOT merely 'adjust the variable resistor'</p> <p>Allow change resistor to one with a lower value (1) Allow replace with a different resistor if qualified Eg. replace bulb with a lower resistance / resistor</p> <p>ignore 'bigger' or 'heavier wire'. Allow lower swg wire / fatter wire (1)</p> <p>Allow short circuit idea: Eg. 'put wire in parallel with resistor' (1)</p>
		<p>8</p>	

Question	Answer	Marks	Guidance
2 a i	<p>gamma has a greater / high penetration power (than alpha of beta) / ORA (1)</p> <p>so it (gamma) can be detected through industrial apparatus / metal / soil / earth / pipes / ORA (1)</p>	1	<p>Eg. Alpha/ Beta stopped or absorbed more easily (1)</p> <p>Eg. Alpha and beta cannot get through but gamma can get through / AW (1)</p> <p>Allow gamma is less ionising / ORA (1)</p> <p>Ignore references to paper, aluminium and lead unless linked to tracers.</p>
ii	<p>C any number greater than 27 and the idea that the blockage stops the flow of tracer so it builds up before the blockage / it emits more radiation (1)</p> <p>D any number less than 26 and the idea that less or no tracer can get past the blockage / it emits less radiation (1)</p>	2	<p>allow the readings in the table if no readings given on answer lines</p> <p>If no marks scored then: C greater (than 27) and D less (than 26) scores (1)</p>
b i	<p>ONE from:</p> <ul style="list-style-type: none"> Either (percentage of ^{14}C decreases because) it is radioactive / decays <p>Or</p> <ul style="list-style-type: none"> no ^{14}C taken in after death (1) <p>ONE from: (percentage of ^{12}C stays the same because)</p> <ul style="list-style-type: none"> ^{12}C is not radioactive / does not decay / is stable (1) 	2	<p>Allow references to half-life</p> <p>Eg. undergoes half-lives</p> <p>Eg. 'it halves every 5730 years' (1)</p> <p>Allow unstable (isotope) (1)</p>
ii	22 920 (years)	1	
	Total	6	

Question	Answer	Marks	Guidance
3	<p>Level 3: (5-6 marks) Diagram with two correct labels AND DETAILED description of a chain reaction AND One difference described. Quality of written communication does not impede communication of science at this level.</p> <p>Level 2: (3-4 marks) Any two from: Diagram with two correct labels OR DETAILED description of a chain reaction OR one difference described. Quality of written communication partly impedes communication of science at this level.</p> <p>Level 1: (1-2 marks) Diagram with two correct labels OR simple description of a chain reaction OR one difference described. 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* Indicative scientific points may include (but are not limited to) the following: Diagram labelled</p>  <p>Simple description of chain reaction (two from)</p> <ul style="list-style-type: none"> • Neutron(s) involved • (uranium) nucleus splits <p>Detailed description of chain reaction (two from)</p> <ul style="list-style-type: none"> • neutron hits (uranium) nucleus / nucleus 'absorbs' a neutron • (uranium) nucleus becomes unstable / splits • two or more neutrons given out • (these) neutrons hit other nuclei and cause more uranium nuclei to split • Daughter / smaller nuclei produced • (large amount of) energy produced <p>Differences described (one from)</p> <ul style="list-style-type: none"> • nuclear reactor is a controlled (chain) reaction • nuclear bomb is an uncontrolled (chain) reaction • nuclear reactor uses control rods / controls the (number of) neutrons
Total		6	

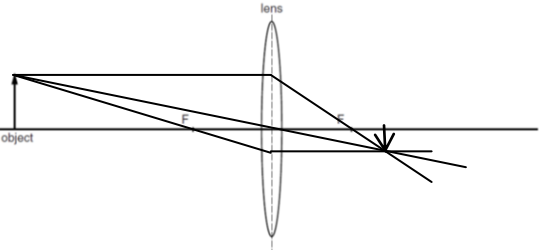
ii	<p>any one from</p> <p>scientists have not been able to repeat the claim (1)</p> <p>(seems to) contradict the laws of physics / AW (1)</p> <p>no model that shows that cold fusion is possible (1)</p>	1	<p>allow fusion requires high temperatures / high energy (1)</p> <p>Eg. it does not produce more energy than amount of energy used (1)</p> <p>ignore merely 'no proof' / 'no evidence' / false or fake results</p>
Total		5	

Question	Answer	Marks	Guidance
5 a	<p>Any two from:</p> <p>If too fast -</p> <ul style="list-style-type: none"> • Satellite goes deeper into space (1) • (centripetal / gravitational) force is too small to maintain orbit (at this speed) (1) <p>If too slow -</p> <ul style="list-style-type: none"> • Satellite goes towards Earth / atmosphere (1) • Hits Earth (1) • (centripetal / gravitational) force is too high to maintain this orbit (at this speed) (1) 	2	<p>If no mark awarded - general unspecified answer of 'just leaves orbit' for (1)</p> <p>Eg. Too fast crashes to Earth scores (1)</p>
b i	7.8 – 7.9 (1)	1	<p>Allow numbers that can be rounded to these values.</p> <p>Eg. 7.78 (1)</p>

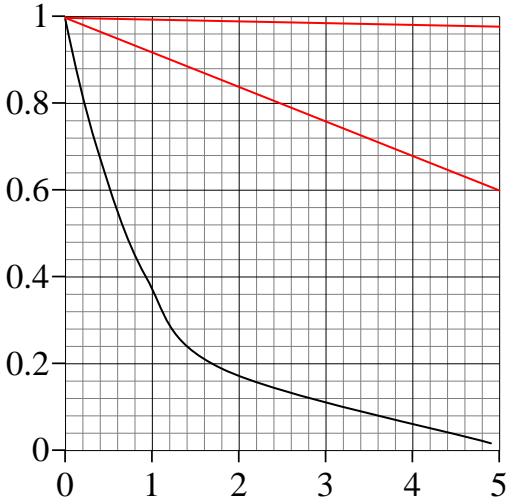
<p>ii</p>	<p>any two from</p> <p>In a high(er) orbital path</p> <ul style="list-style-type: none"> • less gravitational / centripetal force / ORA (1) <p>In a higher (er) orbital path</p> <ul style="list-style-type: none"> • low(er) speed / ORA (1) <p>(sensible reference to) inverse square law (1)</p>	<p>2</p>	<p>Ignore references to the function of the satellite</p> <p>Allow geostationary for higher orbit Allow polar for lower orbit</p> <p>If no other marks scored then different heights / forces give different speeds [1]</p>
<p>iii</p>	<p>any one from</p> <ul style="list-style-type: none"> • higher resolution / detailed images • Scans whole surface of Earth (over a period of time) 	<p>1</p>	<p>Eg. more detailed weather maps / photos (1)</p> <p>Eg. 'can cover more area' (1)</p> <p>Ignore references to merely updates of / changes in weather BUT more frequent weather forecasts scores (1)</p>
<p>c</p>	<p>(ultra-low) LEO satellites use B because: they are reflected by ionosphere (1)</p> <p>(higher) LEO satellites use C because: they can pass through the atmosphere (1)</p> <p>geostationary satellites use C because: they need to pass through the atmosphere (1)</p>	<p>2</p>	<p>Ignore references to ionosphere for satellite C</p> <p>Ignore references to ionosphere for satellite C</p> <p>Reward compound answers: Eg. (they) would use C so they pass through atmosphere scores (2)</p>
		<p>8</p>	

Question	Answer	Marks	Guidance
6 a	vector has size and direction / scalar has size only / scalar has no direction / ORA (1)	1	Allow (difference is that) vector (also) has direction (1)
b	5 (m/s) (2) but if answer is incorrect or incomplete then 11 – 6 (1) or 11 – (0.6 x 10) (1) or 11 = u + (0.6 x 10) (1)	2	Ignore all units

<p>c</p> <p>Vectors / lines labelled 4 and 3 OR drawn to scale (by eye) at right angles to each other (1)</p> <p>BUT vectors / lines labelled 4 and 3 AND drawn to scale (by eye) at right angles to each other (2)</p> <p>Correct resultant drawn (north east) from scale diagram indicating magnitude of 5 (allow 4.8 to 5.2) (1)</p> <p>Calculation route (maximum 2 marks):</p> <p>size of resultant velocity calculated at 5 (m/s) (1)</p> <p>angle calculated as $37^\circ / 53^\circ$ (1)</p>		3	<p>If diagram and calculation routes are both shown do not combine marks but award highest mark.</p> <div data-bbox="1317 320 1574 663" data-label="Diagram"> </div>
Total		6	

Question	Answer	Marks	Guidance
7	<p>Level 3: (5-6 marks) Ray diagram with image completed AND image height or size calculated / measured from diagram AND refraction explained using TWO ideas. Quality of written communication does not impede communication of science at this level.</p> <p>Level 2: (3-4 marks) Any two from: Ray diagram completed OR image height or size calculated / measured from diagram OR refraction explained using TWO ideas. Quality of written communication partly impedes communication of science at this level.</p> <p>Level 1: (1-2 marks) Ray diagram completed OR image height or size calculated / measured from diagram OR refraction explained simply using ONE idea. 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* Indicative scientific points may include (but are not limited to) the following:</p> <p>Diagram</p>  <p>two of the rays drawn as shown in diagram</p> <ul style="list-style-type: none"> • ray parallel to principal axis is refracted to focal point • ray is not refracted when it passes through optical centre of lens • ray through focal point (before it reaches lens) is refracted parallel to principal axis <p>explanation</p> <ul style="list-style-type: none"> • refraction occurs at boundary between two different mediums • speed of light in air is faster than in glass • refractive index of glass is higher than air • light bends towards normal when entering lens / ORA • lens causes light rays to converge • light rays parallel to the principal axis meet at the focal point • image is inverted / image is real / image is after F <p>image height or size</p> <ul style="list-style-type: none"> • image calculated as 0.75 (cm) or partly calculated as $0.5 = \frac{\text{image size}}{1.5}$ • image correctly measured on the diagram accepting a range of 0.5 to 0.8 cm
Total		6	

Question	Answer	Marks	Guidance
8 a	<p>Idea that particles do NOT diffract or interfere. (1)</p> <p>Diffraction or interference is produced by waves (1)</p>	2	<p>Ignore waves are not made of particles</p> <p>Allow 'interference only occurs in waves' scores (2)</p> <p>Allow 'diffraction only occurs in waves' scores (2)</p>
b	<p>any three from</p> <p>vertical motion:</p> <ul style="list-style-type: none"> - idea that vertical motion is under the influence of gravity / an unbalanced force (1) - which means the ball is decelerating / reducing speed/velocity (1) <p>horizontal motion:</p> <ul style="list-style-type: none"> - horizontal motion not influenced by gravity (1) - horizontal speed is constant (assuming air resistance is zero) (1) 	3	<p>Allow compound answers: Eg. 'Only vertical motion is affected by gravity' scores (2)</p>
Total		5	

Question	Answer	Marks	Guidance
9 a i	<p>from 0 to 2.5 seconds any one from:</p> <ul style="list-style-type: none"> • large / fast change in voltage (1) • voltage changes from 0 to about 0.9 (V) (1) • it increases by about 0.9 (1) <p>from 2.5 to 5 seconds any one from:</p> <ul style="list-style-type: none"> • small / slow change in voltage (1) • voltages changes from about 0.9 to 1.0 (V) (1) • it increases by 0.1 (1) 	2	<p>Assume 'it' means voltage unless indicated otherwise.</p> <p>accept if value can be rounded to 0.9</p> <p>allow comparison e.g. there is a greater change in voltage between 0 to 2.5 seconds than 2.5 to 5 seconds (2)</p> <p>If no marks scored then allow for a maximum of ONE mark: Either - 'goes up quicker at the start' / ORA (1) OR - 'gradient higher at the start' / ORA (1)</p>
ii	 <p>(2)</p>	2	<p>line starting at (0, 1.0) (1)</p> <p>graph correct shape by eye:</p> <p>EITHER: concave line extending downwards beyond 3s (1) (Do not penalise a curved concave line that reaches 0V)</p> <p>OR: (apparently) straight line that obviously falls to 0.6V or above (1)</p>

b	<p>RISKS - any one from</p> <ul style="list-style-type: none"> - may not switch on when reach Mars (1) - may not work / break / get damaged (on the way to Mars) (1) - charge may not be stored / may leak (as it takes a long time to get to Mars) (1) <p>BENEFITS - any one from</p> <ul style="list-style-type: none"> - store charge (to be used later) (1) - no need for batteries (1) 	2	
		6	

Question	Answer	Marks	Guidance
10 a i	step-down transformer (1) more turns or coils in primary / LHS / first side / input coil / ORA (1)	2	Allow output voltage lower than input voltage (1) If no marks scored then different numbers of turns on each side (1)
ii	5 000 (V) (2) but if answer is incorrect or incomplete then:	2	

	$\frac{20\,000}{x} = \frac{400}{100}$ (1)		allow any manipulation of this equation (1)
b	no change in voltage (1) appliance or socket is not live / no direct connection between live (to primary coil) and output (from secondary coil) (1)	2	ignore references to current allow isolates from mains (supply) / high voltage (for safety) (1) Allow less chance of an electric shock. Allow can't get a shock (1)
	Total	6	

Question	Answer	Marks	Guidance																																				
11	<p>Level 3: (5-6 marks) Completed truth table AND state when the relay works AND explanation of why a relay is needed Quality of written communication does not impede communication of science at this level.</p> <p>Level 2: (3-4 marks) Any two from: Completed truth table OR state when the relay works OR explanation of why a relay is needed Quality of written communication partly impedes communication of science at this level.</p> <p>Level 1: (1-2 marks) Completed truth table OR state when the relay works OR explanation of why a relay is needed 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*</p> <p>Indicative scientific points may include (but are not limited to) the following: truth table</p> <table border="1" data-bbox="1451 336 1718 839"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table> <p>WHEN relay works (one instance needed)</p> <ul style="list-style-type: none"> • relay will work when input A is on or 1 • relay will work when B and C are both off or 0 • relay works 5 out of 8 times from the truth table <p>WHY relay is used (one reason needed)</p> <ul style="list-style-type: none"> • logic circuit is a low power circuit / logic circuit would be damaged with a mains voltage • motor needs high current / voltage / power • a relay allows mains / motor to be linked to logic circuit (safely) • relay switches on a circuit with larger current • relay isolates the low voltage circuit from the high voltage (mains) 	A	B	C	D	0	0	0	1	0	0	1	0	0	1	0	0	0	1	1	0	1	0	0	1	1	0	1	1	1	1	0	1	1	1	1	1
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Total		6																																					

Question	Answer	Marks	Guidance
12 a i	<p>diode only allows current to flow in one direction (1)</p> <p>on graph, there is only current when there is a + voltage / on graph there is no current when there is a – voltage (1)</p>	2	<p>In addition to the marking points to the left, allow higher level answers: e.g. diode has high resistance in one direction / ORA (1)</p> <p>e.g. a minimum voltage / threshold voltage needed to produce a current (1)</p>
ii	<p>Any three from:</p> <p>1 layer / side has extra electrons (1)</p> <p>1 layer / side has extra (positive) holes / an absence of electrons (1)</p> <p>electrons drop into the holes so charge cancels / current flows / there is a low resistance (1)</p> <p>current only flows when positive terminal is connected to the side containing holes / ORA (1)</p> <p>(current across the junction): holes and electrons move towards each other / opposite directions / across the junction (1)</p> <p>(when there is no current across the junction) holes and electrons move away from each other / holes and electrons move away from the junction (1)</p>	3	<p>Ignore n-type and p-type Ignore references to repel and attract</p> <p>Accept answers that refer to being in depletion or insulating region instead of junction</p>

b	as temperature increases the resistance decreases / AW (1) change in resistance decreases as the temperature(s) increase / ORA / AW (1)	2	allow examples e.g. a 5 (°C) between 15 to 20 (°C) gives a resistance change of 3.4 (ohms) but a 5 (°C) between 35 to 40 (°C) gives a resistance change of 1.2 (ohms) (1)
Total		7	

Question	Answer	Marks	Guidance
13 a	16 / 16.0 / 16.00 (2) If answer incomplete or incorrect then 48 – 15.65 – 16.35 or 48 – 32 scores (1)	2	
b	220 (cm) (2) If answer is incorrect or incomplete then: Evidence on graph showing a line or curve scores (1)	2	Allow 216 → 224 (2) BUT for a reasonable curve extrapolated allow 216 → 230 (2)
c i	Time-period is (directly) proportional to the square root of length / AW (1)	1	Eg. x and y are proportional (1) Eg. 'As square root of length increases in equal steps, the time period increases in equal steps' (1) Allow linear relationship through the origin (1) Allow examples showing this relationship using numbers Ignore merely 'positive correlation'

ii	<p>3.4 (3)</p> <p>But if answer is incorrect or incomplete then:</p> <p>$6.284 \sqrt{\frac{3}{10}}$ or $2 \times 3.142 \times 0.5477$ scores (2)</p> <p>$2 \times 3.142 \sqrt{\frac{3}{10}}$ scores (1)</p>	3	<p>Allow decimal place error: Eg. 3.441 (2)</p> <p>Allow 34.4 (2) (for candidate who has used 300 cm instead of 3 m)</p> <p>Look for correct substitution AND some correct processing Eg. (π or) 22/7 for 3.142</p> <p>Look for the correct substitutions Eg. $2 \times \pi \sqrt{\frac{3}{10}}$ scores (1)</p>
iii	<p>0.3 or 0.25 or 0.253..... etc. (2)</p> <p>But if answer is incorrect or incomplete then evidence of correct substitution (in symbols or numbers) scores (1)</p>	2	<p>Eg. $1 = 2 \times 3.14 \times \sqrt{\frac{L}{10}}$</p> <p>Allow π or 22/7 for 3.142</p>
	Total	10	

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