OCR
Oxford Cambridge and RSA

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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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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Annotations used in scoris

Annotation	Meaning
	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.

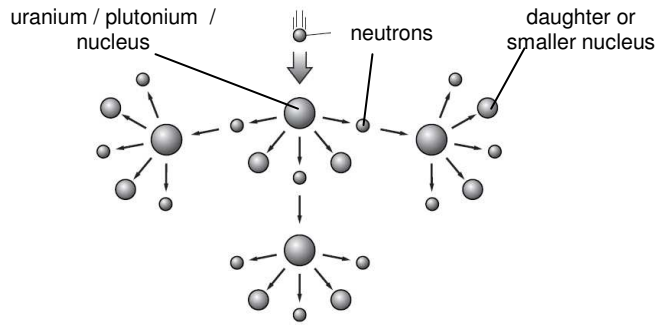
/ = alternative and acceptable answers for the same marking point
(1) = separates marking points
allow = answers that can be accepted
not = answers which are not worthy of credit
reject = answers which are not worthy of credit
ignore = statements which are irrelevant
( ) = words which are not essential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

MARK SCHEME

Question	Answer	Marks	Guidance
1 a	**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) …… **LIVE** – contains fuse or provides (high) voltage / current / energy / power (1) …… **NEUTRAL** – completes the circuit (1)	3	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 **allow** 'carries voltage' / 230 to 240V (1) **ignore** just 'supplies or carries electricity' allow idea of electron flow / charge flow (1) …… **allow** 'is at zero volts' (1) **allow** carries current or charges flow (1) **allow** neutral wire is earthed at the power station (1)
b	**any one from:** prevents the current / charge flow (1) prevents flex / plug overheating (1) prevents damage to the appliance (1)	1	**Ignore** electricity **Allow** breaks circuit / stops power / protects user / stops appliance becoming live (1) **Allow** reduces fire risk (1)

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

Question	Answer	Marks	Guidance
2 a i	gamma has a greater / high penetration power (than alpha of beta) / ORA (1) so it (gamma) can be detected through industrial apparatus / metal / soil / earth / pipes / ORA (1)	1	**Eg**. Alpha/ Beta stopped or absorbed **more** easily (1) **Eg.** Alpha and beta cannot get through but gamma can get through / AW (1) **Allow** gamma is **less** ionising / ORA (1) **Ignore** references to paper, aluminium and lead unless linked to tracers.
ii	**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) **D** any number less than 26 **and** the idea that less or no tracer can get past the blockage / it emits less radiation (1)	2	**allow** the readings in the table if no readings given on answer lines If no marks scored then: C greater (than 27) and D less (than 26) scores (1)
b i	**ONE** from: • Either (percentage of ^{14}C decreases because) it is radioactive / decays **Or** • no ^{14}C taken in after death (1) **ONE** from: (percentage of ^{12}C stays the same because) • ^{12}C is not radioactive / does not decay / is stable (1)	2	**Allow** references to half-life **Eg**. undergoes half-lives **Eg**. 'it halves every 5730 years' (1) **Allow** unstable (isotope) (1)
ii	22 920 (years)	1	
	Total	**6**	

Question	Answer	Marks	Guidance
3	**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. **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. **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 **Level 0: (0 marks)** Insufficient or irrelevant science. Not worthy of credit.	6	This question is targeted up to grade A* Indicative scientific points may include (but are not limited to) the following: **Diagram labelled**  **Simple description of chain reaction (two from)** • Neutron(s) involved • (uranium) nucleus splits **Detailed description of chain reaction (two from)** • 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 **Differences described (one from)** • 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**	

Question	Answer	Marks	Guidance
4 a	3 (1) 3 (1) 1 (1)	3	each correct number scores 1 mark 1 2 **..3..** H + H → He 1 1 2 (1) 2 **..3..** 4 1 (1) H + H → He + n **..1..** 1 2 0 (1)
b i	**any one from** so to confirm the experiment is • repeatable / reproducible (1) so other scientists can • (idea of) peer review (1) • check the method (1) • check for mistakes (1) • confirm / re-test / verify / prove / validate results (1) • inform other scientists / people (1) • further-development / research (1) • use the data (1)	1	**Allow** 'check it' (1)

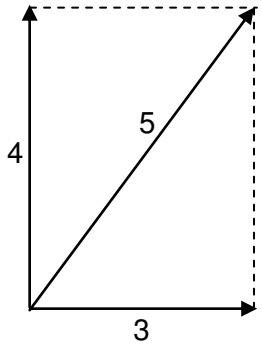
ii	**any one from** scientists have not been able to repeat the claim (1) (seems to) contradict the laws of physics / AW (1) no model that shows that cold fusion is possible (1)	1	 **allow** fusion requires high temperatures / high energy (1) **Eg**. it does not produce more energy than amount of energy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

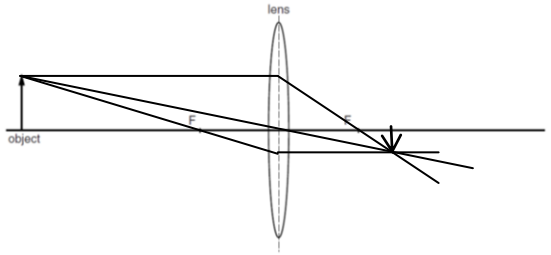
Question	Answer	Marks	Guidance
5 a	Any two from: If too **fast** - • Satellite goes deeper into space (1) • (centripetal / gravitational) force is too small to maintain orbit (at this speed) (1) If too **slow** - • Satellite goes towards Earth / atmosphere (1) • Hits Earth (1) • (centripetal / gravitational) force is too high to maintain this orbit (at this speed) (1)	2	**If no mark awarded** - general unspecified answer of 'just leaves orbit' for (1) Eg. Too fast crashes to Earth scores (1)
b i	7.8 – 7.9 (1)	1	**Allow** numbers that can be rounded to these values. Eg. 7.78 (1)

ii	**any two from** In a high(er) orbital path • less gravitational / centripetal force / ORA (1) In a higher (er) orbital path • low(er) speed / ORA (1) (sensible reference to) inverse square law (1)	2	**Ignore** references to the function of the satellite **Allow** geostationary for higher orbit **Allow** polar for lower orbit If no other marks scored then different heights / forces give different speeds [1]
iii	**any one from** • higher resolution / detailed images • Scans whole surface of Earth (over a period of time)	1	**Eg**. more detailed weather maps / photos (1) **Eg.** 'can cover more area' (1) **Ignore** references to merely updates of / changes in weather **BUT** more frequent weather forecasts scores (1)

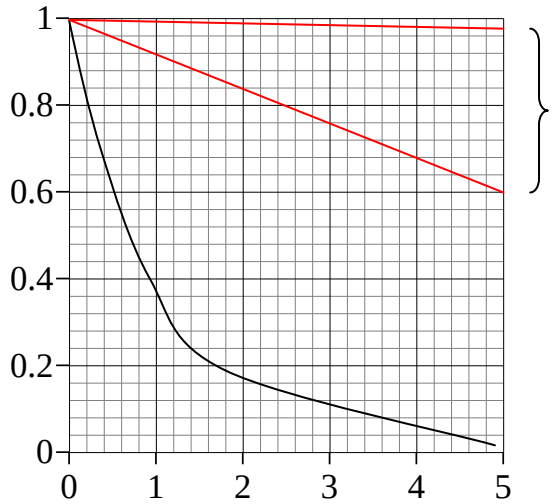
c	(ultra-low) LEO satellites use **B because:** they are reflected by ionosphere (1) (higher) LEO satellites use **C because:** they can pass through the atmosphere (1) geostationary satellites use **C because:** they need to pass through the atmosphere (1)	2	 **Ignore** references to ionosphere for satellite C **Ignore** references to ionosphere for satellite C Reward compound answers: **Eg**. (they) would use C so they pass through atmosphere scores (2)
		8	

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**

c	Vectors / lines labelled 4 and 3 **OR** drawn to scale (by eye) at right angles to each other (1) **BUT** vectors / lines labelled 4 and 3 **AND** drawn to scale (by eye) at right angles to each other (2) Correct resultant **drawn** (north east) from scale diagram **indicating** magnitude of 5 (allow 4.8 to 5.2) (1) **Calculation route (maximum 2 marks):** size of resultant velocity **calculated** at 5 (m/s) (1) angle **calculated** as 37° / 53° (1)	3	If diagram and calculation routes are both shown do not combine marks but award highest mark. 
	Total	**6**	

Question	Answer	Marks	Guidance
7	**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. **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. **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 **Level 0: (0 marks)** Insufficient or irrelevant science. Not worthy of credit.	6	This question is targeted up to grade A* Indicative scientific points may include (but are not limited to) the following: **Diagram**  two of the rays drawn as shown in diagram • 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 **explanation** • 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 **image height or size** • 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	Idea that particles do **NOT** diffract or interfere. (1) Diffraction or interference is produced by waves (1)	2	**Ignore** waves are not made of particles **Allow** 'interference **only** occurs in waves' scores (2) **Allow** 'diffraction **only** occurs in waves' scores (2)
b	**any three from** **vertical motion**: - idea that **vertical** motion is under the influence of gravity / an unbalanced force (1) - which means the ball is decelerating / reducing speed/velocity (1) **horizontal motion:** - horizontal motion **not** influenced by gravity (1) - horizontal speed is constant (assuming air resistance is zero) (1)	3	Allow compound answers: Eg. '**Only** vertical motion is affected by gravity' scores (2)
	Total	**5**	

Question	Answer	Marks	Guidance
9 a i	**from 0 to 2.5 seconds** **any one from:** • large / fast change in voltage (1) • voltage changes from 0 to about 0.9 (V) (1) • it increases by about 0.9 (1) **from 2.5 to 5 seconds** **any one from:** • small / slow change in voltage (1) • voltages changes from about 0.9 to 1.0 (V) (1) • it increases by 0.1 (1)	2	**Assume 'it' means voltage unless indicated otherwise.** **accept** if value can be rounded to 0.9 **allow** comparison e.g. there is a greater change in voltage between 0 to 2.5 seconds than 2.5 to 5 seconds (2) 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)
ii	 **(2)**	2	line starting at (0, 1.0) (1) graph correct shape by eye: **EITHER**: concave line extending downwards beyond 3s (1) (Do not penalise a curved concave line that reaches 0V) **OR:** (apparently) straight line that **obviously falls** to **0.6V or above** (1)

b	**RISKS - any one from** - 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) **BENEFITS - any one from** - store charge (to be used later) (1) - no need for batteries (1)	2	**Allow** stores energy **(1)** **Ignore** references to voltage / power
		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**	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>11</td><td>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.

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.

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

Level 0: (0 marks)
Insufficient or irrelevant science. Not worthy of credit.</td><td>6</td><td>This question is targeted up to grade A*
Indicative scientific points may include (but are not limited to) the following:
truth table
<table>
<tr><th>A</th><th>B</th><th>C</th><th>D</th></tr>
<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>
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<tr><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>
WHEN relay works (one instance needed)
• 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

WHY relay is used (one reason needed)
• 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)</td></tr>
<tr><td></td><td>Total</td><td>6</td><td></td></tr>
</table>

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

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

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