OCR
RECOGNISING ACHIEVEMENT

GCSE

Physics B

General Certificate of Secondary Education

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

Mark Scheme for June 2013

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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

Annotation	Meaning
✔	correct response
✘	incorrect response
BOD	benefit of the doubt
NBOD	benefit of the doubt **not** given
ECF	error carried forward
∧	information omitted
ignore	ignore
reject	reject
contradiction	contradiction
L1	Level 1
L2	Level 2
L3	Level 3

ADDITIONAL OBJECTS: You **must** assess and annotate the additional objects for each script you mark. Where credit is awarded, appropriate annotation must be used. If no credit is to be awarded for the additional object, please use annotation as agreed at the SSU.

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

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Section A

Question			Answer	Marks	Guidance
1	**(a)**			2	ignore reference to waves / wavelengths / frequency
			a compression is a region of high(er) pressure / region where (air) particles are close(r) together / AW (1)		**allow** where lines are close(r) together / more concentrated (1) **allow** area of high(er) density (1) **allow** layers or molecules for particles (1) **ignore** particles more dense
			a rarefaction is a region of low(er) pressure / region where (air) particles are far / further apart / AW (1)		**allow** where lines are far / further apart / less concentrated (1) **allow** area of low(er) density (1) **allow** layers or molecules for particles (1) **ignore** particles less dense if no marks scored allow [1] mark for correct labelling of both the compression and rarefaction on the diagram.
	(b)	**(i)**	(idea that) ultrasound causes **vibrations / oscillations** (in the stone) (1)	1	**allow** resonate (1) NOT gamma rays
		(ii)	able to produce images / scans of soft tissue / does not damage living cells / tissue (1)	1	**allow** non-ionising radiation (1) allow reverse arguments for X-rays. Eg X-rays cannot show soft tissue (1) Eg X-rays only show bones / hard tissues(1) But X-rays show bones (0) Ignore unqualified references to dangers. Eg ultrasound safer / X-rays more damaging
			Total	**4**	

Question			Answer	Marks	Guidance

2	(a)		**[Level 3]**
			Detailed description of what the graph shows **AND** an explanation of how the information could be interpreted **AND** used.
			Quality of written communication does not impede communication of the science at this level
			(5–6 marks)
			
			[Level 2]
			Describes what the graph shows **AND** an explanation of how the information could be interpreted **OR** used.
			Quality of written communication partly impedes communication of the science at this level
			(3–4 marks)
			
			[Level 1]
			Describes what the graph shows **OR** a description of how the information could be interpreted **OR** used.
			Quality of written communication impedes communication of the science at this level
			(1–2 marks)
			
			[Level 0]
			Insufficient or irrelevant science. Answer not worthy of credit.
			(0 marks)
				6	**This question is targeted at grades up to C/D.**
					
					Relevant points include:
					Description of what the graph shows.
					   • level of radioactivity changes as the detector moves along the pipe.
					   • radioactive level is relatively low at the start
					   • as the detector moves along the pipe the level rises rapidly/reaches a peak
					   • level then falls rapidly after peak
					   • level is lower after the peak than it was at the start
					
					Explanation of how the information can be interpreted
					   • to find where there is a problem with the pipe
					   • the peak shows that tracer is leaking and indicates a crack or break
					   • there is a blockage as the level after is lower than before the peak
					   • the blockage is not complete as radioactivity is not zero
					   • radiation used must be gamma
					
					Explanation of use of the information
					   • so that workers dig in the right place
					   • so that workers do not waste time/energy resources digging up the whole pipe
					   • the peak shows where the problem is
					
					Use the L1, L2, L3 annotations in Scoris; do not use ticks.

Question			Answer	Marks	Guidance
	(b)		half-life of **Y** is (approximately) 1 <u>hour/h/hr</u> (1)	2	**allow** range 0.75 - 1 hour correct units required for this marking point
			half-life of substance **X** is (approximately) 4 <u>hour/h/hr</u> (1)		**allow** range 3.5 - 4 hours correct units required for this marking point **ignore** 'between 3 to 4 hours'
					but half-life of **X** is 4 x that of **Y** (2)
			if no marks scored above: the idea that substance **Y** has a shorter half-life (than substance **X**) / ora for X scores (1)		**Ignore** incorrect units if stated for this marking point **ignore** substance X remains radioactive longer as targeting A* for 1 of the marks
			Total	**8**	

Question			Answer	Marks	Guidance
3	**(a)**	**(i)**	0.15 (amps) (3) **but if answer incorrect** (I =) 0.75 / 5 (2) **or** 5 or 4.8 to 5.2 (ohms stated as the resistance) (1)	3	**allow** answer in the range of 0.144 – 0.156 (amps) (3) **allow** 5 in range of 4.8 – 5.2 **allow** 5 (ohms) seen (even in an incorrect calculation) (1) eg. 5 / 0.75 (1) eg. 5 (taken from graph / slope of graph) (1)
		(ii)	as length increases current reduces / AW / ora (1)	1	**allow** inversely proportional **ignore** resistance / faster or stronger current
	(b)		straight line (by eye) on graph starting at / pointing towards (0,0) with a steeper gradient than original line (1)	1	curved line (by eye) scores (0)
			Total	**5**	

Question	Answer	Marks	Guidance
4 (a)	Crossword: **helium** (down) **temperatures** (across) **neutrons** (down) **rods** (down) (2)	2	answers in crossword take precedent but if crossword blank **allow** answers next to the clues 0 or 1 correct = 0 marks 2 or 3 correct = 1 mark 4 correct = 2 marks
(b)	**any two ideas from:** • no data / no evidence • secrecy • cannot be proved / be reproduced / cannot get similar or reliable results • disagrees with fundamental physics	2	Eg. Not all data published (1) Eg. (some) experimental details are (still) secret (1) Eg. fusion needs high temps or pressures / won't happen at low temperatures or pressures / AW (1)
	Total	4	

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Question			Answer	Marks	Guidance
5	**(a)**		**electron transfer idea:** • <u>electrons</u> move between two insulators **OR** • <u>electrons</u> move between the socks and the trampoline (1)	2	mention of positive electrons scores (0) for **this** marking point mention of **movement** of protons scores (0) for **this** marking point **but** 'protons stay fixed and electrons move from trampoline to sock scores' (1) **allow** between girl and trampoline (1)
			earthing idea: • electrons flow through girl / to or from earth / ground (during "shock") (1)		mention of positive electrons scores (0) for **this** marking point mention of **movement** of protons scores (0) for **this** marking point **allow** current / charge movement through girl / to or from earth / discharged to earth (1) eg negative charge goes to earth (1) **ignore** electricity / voltage to earth
	(b)		idea that anti-static sprays leave a conducting layer / coating of material (1) so charge cannot build up (1)	2	**Eg.** enables the trampoline to conduct (1) eg can't store electrons (1) **not** merely static electricity cannot build up. **but** static charge cannot build up (1)
			Total	**4**	

Question			Answer	Marks	Guidance
6	**(a)**		particles hit rocket walls / AW (1)	2	But particles colliding **with each other** (0) Allow particles collide with each other and walls (1)
			causing force / thrust / AW (1)		**ignore** pressure / upthrust
					Reward higher level answers in terms of action and reaction: eg particles move downwards to produce an equal and opposite force on the rocket' (2)
	(b)		more force and acceleration because of: • more frequent collisions / more energetic collisions / twice as many collisions (1) or • faster particles / more particles / more energy / more momentum (1)	1	**but** more frequent collisions between gas particles scores (0) **allow** more frequent collisions between gas particles and walls (1) **allow** higher level answers in terms of kinetic theory (1) **ignore** pressure **ignore** more gas **allow** force applied for longer giving greater acceleration (1)

Question	Answer	Marks	Guidance
(c)	**[Level 3]** Answers must give a comparison and an explanation of at least two ideas with reference to gravitational / centripetal force. (See summary chart) Quality of written communication does not impede communication of the science at this level. **(5–6 marks)** **[Level 2]** Answers must give a comparison and a description of at least two ideas. Quality of written communication partly impedes communication of the science at this level. **(3–4 marks)** **[Level 1]** Answers are limited to one simple description OR a description of an appropriate use of a satellite. Quality of written communication impedes communication of the science at this level. **(1–2 marks)** **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. **(0 marks)**	6	**This question is targeted at grades up to A*.** **allow** reverse arguments for geostationary orbits throughout. **Indicative scientific points may include at level 3:** • high**er** gravitational force **and** low**er** altitude for polar orbit • high**er** gravitational force **and** high**er** speed or acceleration for polar orbit. • high**er** gravitational force **and** short**er** period for polar orbit **Indicative scientific points may include at level 2:** • low**er** altitudes for polar orbit • high**er** speeds for polar orbit. • short**er** period for polar orbit • polar orbit over poles and geostationary orbit over equator **Indicative scientific points may include at level 1:** • short(er) time period for polar orbit • geostationary orbits around equator. • Correct use for a relevant satellite (eg polar – military, mapping, navigation, weather, etc. Geostationary – navigation, communication, weather etc.) **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**

ideas	geostationary	polar
orbit description	equator	Go over poles
period	longer	shorter
speed	lower	higher
gravitational force	lower	higher

At level 3 accept higher level answer in terms of acceleration

Question			Answer	Marks	Guidance
	(d)	**(i)**	703 (N) scores (2) **but if answer is incorrect** 185 x 3.8 scores (1)	2	
		(ii)	**any two from:** weight of Rover on Earth is 1850 (N) / AW (1) too heavy (on Earth) (1) weight too near to safe limits / more likely to break (1)	2	**allow** Rover is 50 (N) more than it can take (2) **allow** heavier / weighs too much (1) eg. Legs / wheels not able to support (1) incorrect statement about mass scores a maximum of (1)
			Total	**13**	

Question			Answer	Marks	Guidance

7	**(a)**		**vector** **scalar**
			velocity mass
			weight speed
			momentum
			   (1) (1)
				2	all three needed
					
					both needed
					
					if no marks scored 2 scalar **and** 2 vector correct scores (1)
					eg.
					   <u>vector</u> **<u>scalar</u>**
					
					   velocity **mass**
					   weight **speed**
					                    momentum **X**
					                        scores (1)

Question			Answer	Marks	Guidance
	(b)		56 (m / s) (1)	1	
	(c)		180 (m) (2) **but if answer is incorrect** {(56 + 4) / 2} x 6 scores (1)	2	Allow 178 to 182. (2) **allow** e.c.f. from (b) eg. 57 (m), 96(m) or 102(m) scores (2)
			Total	**5**	

Question			Answer	Marks	Guidance
8			<table><tr><td></td><td>reflection</td><td>interference</td></tr><tr><td>particle model</td><td>✓</td><td></td></tr><tr><td>wave model</td><td>✓</td><td>✓</td></tr><tr><td></td><td>(1)</td><td>(1)</td></tr></table>	2	**one mark for each correct column**
			Total	**2**	

Question			Answer	Marks	Guidance
9	**(a)**		2.25×10^8 or 2.3×10^8 (m / s) (2) **but if answer is incorrect** $3 \times 10^8 / 1.333$ (1)	2	**allow** 225(056264.1) (2) **allow** 225 563 909.8 (2)
	(b)		glass – arsenic trisulphide (1)	1	
	(c)		blue light is **refracted** more / ORA (1) blue light slows down more (than red) / ORA (1)	2	**eg.** red refracted less than blue (1) **ignore** blue bends / deviates more **allow** blue has a shorter wavelength (1) **ignore** frequency **allow** higher level answers in terms of the equation: n = speed in vacuum / speed in medium eg smaller speed in glass has larger refractive index. Red light travels faster than blue so blue has larger n. (2)
			Total	**5**	

Question			Answer	Marks	Guidance
10	(a)		resistance decreases (1)	2	**ignore** weaker resistance
			brightness of lamp / current increases (1)		**ignore** faster / stronger current
					But resistance increases (0) so brightness of lamp / current decreases (1)
	(b)	(i)	0.92 (Ω) (2) **but if answer is incorrect** $\frac{1}{R_T} = \frac{1}{2} + \frac{1}{3} + \frac{1}{4}$ (1) **or** $\frac{1}{R_T} = 0.5 + 0.33 + 0.25$ (1)	2	**allow** 0.92(307692) (2) **allow** 0.9 (2) **allow** $\frac{12}{13}$ (Ω) (2)
		(ii)	4.3 (amps) (2) **but** $\frac{4}{0.92}$ (1)	2	allow 4.30 to 4.45 (2) allow ecf from bi (2) eg for ecf of 1.08 - allow 3.7 (2) eg for ecf of 9 - allow 0.44 or 0.4 (2) allow 4 / answer to bi (1) eg 4/1.08 (1) **allow** 4.30 to 4.45 (2) **allow** $\frac{4}{\text{answer to b(i)}}$ (1)
	(c)		I$_e$ = 0.60 mA (1)	1	**Allow** 0.6 (1)
			Total	7	

PMT

Question			Answer	Marks	Guidance
11	**(a)**		diode (1)	2	**allow** LED (1)
			(diode) has a high resistance in one direction and a low resistance in the other (1)		**allow** current flows one way only (1) **allow** threshold voltage / current idea (1)
	(b)	**(i)**	<table><tr><th>A</th><th>B</th><th>C</th><th>output</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td></tr><tr><td>0</td><td>0</td><td>1</td><td>**0**</td></tr><tr><td>1</td><td>0</td><td>1</td><td>**0**</td></tr><tr><td>0</td><td>1</td><td>1</td><td>**0**</td></tr><tr><td>1</td><td>1</td><td>1</td><td>**0**</td></tr></table> (1)	1	**all four zeros needed**
		(ii)	dark / not light (1) hot / wet (1)	2	**allow** night(time) / dim (1)

14

Question			Answer	Marks	Guidance
		(iii)	**any two from:** fan needs a large current / voltage to operate (1) logic gates use low current / voltage (1) logic gate would be damaged if connected (directly) to mains (1) relay switches on a high current / voltage by using a low current / voltage (1)	2	**allow** isolation idea of logic gate from fan (1) **ignore** power **ignore** changes low voltage into high voltage
			Total	**7**	

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Question			Answer	Marks	Guidance
12			**[Level 3]** Describes the construction of the transformer **AND** performs a calculation to determine the turns ratio or output current **AND** explains the process of electromagnetic induction. Quality of written communication does not impede communication of the science at this level. **(5–6 marks)** **[Level 2]** Describes the construction of this transformer **AND** **EITHER** performs a simple calculation **OR** gives a partial explanation of electromagnetic induction. Quality of written communication partly impedes communication of the science at this level. **(3–4 marks)** **[Level 1]** Describes two features of the basic construction of a transformer. Quality of written communication does impedes communication of the science at this level. **(1–2 marks)** **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. **(0 marks)**	6	**This question is targeted at grades up to A.** **Level 3 relevant points:** • two coils wrapped around core made of iron secondary less turns than primary • 46 x more turns on primary or calculate current = 2300mA • varying magnetic field in primary and varying magnetic field in secondary inducing an emf. **Level 2 diagram or description of transformer construction:** • two coils wrapped around (iron) core with secondary less turns than primary • ratio 230:5 or 2% or sensibly attempted calculation using transformer equation. **Level 1 diagram or description of transformer construction:** • two coils of wire • wrapped on (iron) core • step down transformer **Use the L1, L2, L3 annotations in Scoris. Do not use ticks.**
			Total	**6**	

Question			Answer	Marks	Guidance
13	(a)		…flows from P to S and through the resistor or to T (1)	2	**ignore** current paths after T
			…flows from R to S and through the resistor or to T(1)		**ignore** current paths after T
	(b)		smoothed output (1)	1	**allow** suitable diagram of smoothing if it shows a comparison (to the original output) (1)
			Total	3	

Question			Answer	Marks	Guidance
14			**any 2 from:** must be robust (to withstand take off) / AW (1) must be reliable / if it breaks in space it cannot be easily repaired / AW (1) must be able to operate without overheating / cooling system or heat sinks needed (during manufacture) (1) must be able to withstand large variations in temperature (in space) (1) must be clean /dust free (1) difficult to make connection to small objects / difficult to see faults (1) (idea that it is) difficult to obtain very pure silicon (1) (idea that) specialised manufacturing equipment or expertise is required (1)	2	 **allow** very expensive to repair (in space) **allow** need to be made in a clean room / must be made in a dust free environment **allow** difficulty to hold small objects / difficult to hold small objects still eg. fiddly **allow** need to use specific equipment e.g. must use microscopes
			Total	2	

Section D

Question			Answer	Marks	Guidance
15	**(a)**	**(i)**	(idea that) the braking distance is greater (for concrete at 3mm) / AW (1)	1	**allow** correct comparisons at other tyre depths eg 26.5 is less than 35.5 (1)
		(ii)	Any two from: same speed / KE (1) same driving conditions (1) same braking force (1) same mass / load in car (1)	2	 **allow** specific examples Eg. same weather conditions (1) Eg. same depth of water on road (1) Eg. Same driver (1) **allow** same tyre size / pressures (1) **ignore** same road surface materials **allow** same braking action (1)
		(iii)	no with 45% (3) 45% (2) **but if 45% incorrect then** 42 – 29 or 13 scores (1)	3	**allow** 44% to 46% (2) 45% on its own or 'Yes with 45%' scores (2) allow and credit reverse arguments: eg. 'It goes from 29 to 42, a 50% increase would be 43.5m' (2) **SO** it is an impossibility to be a 76% (2x38%) increase (1).

Question			Answer	Marks	Guidance
	(b)	**(i)**	30 000 (km) (3) **but if final answer incorrect** $\dfrac{5.1}{0.17}$ or 30 scores (2) **but if none of the above** 5.1 (mm) scores (1)	3	**allow** 30001(km) (3) **allow** $\dfrac{5.2}{0.17}$ (2) **allow** 5.2 (mm) (1)
		(ii)	(idea that) tyres would have a large braking distance (1) Braking distance significantly increases less than 3mm (1)	1	**allow** stopping distance instead of braking distance
			Total	**10**	

PMT

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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