

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.

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Annotations

Annotation	Meaning
	correct response
	incorrect response
	benefit of the doubt
	benefit of the doubt not given
	error carried forward
	information omitted
	ignore
	reject
	contradiction
	Level 1
	Level 2
	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

Section A

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

Question	Answer	Marks	Guidance
2 (a)	<p>[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)</p> <p>[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)</p> <p>[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)</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 C/D.</p> <p>Relevant points include:</p> <p>Description of what the graph shows.</p> <ul style="list-style-type: none"> • 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 <p>Explanation of how the information can be interpreted</p> <ul style="list-style-type: none"> • 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 <p>Explanation of use of the information</p> <ul style="list-style-type: none"> • 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 <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>

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

Question		Answer	Marks	Guidance
3	(a) (i)	<p>0.15 (amps) (3)</p> <p>but if answer incorrect</p> <p>(I =) 0.75 / 5 (2)</p> <p>or</p> <p>5 or 4.8 to 5.2 (ohms stated as the resistance) (1)</p>	3	<p>allow answer in the range of 0.144 – 0.156 (amps) (3)</p> <p>allow 5 in range of 4.8 – 5.2</p> <p>allow 5 (ohms) seen (even in an incorrect calculation) (1) eg. 5 / 0.75 (1) eg. 5 (taken from graph / slope of graph) (1)</p>
	(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)	<div style="text-align: center;"> <table border="1" style="margin: auto;"> <tr><td>h</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>e</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>l</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>i</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>u</td><td></td><td></td><td></td><td>n</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>t</td><td>e</td><td>m</td><td>p</td><td>e</td><td>r</td><td>a</td><td>t</td><td>u</td><td>r</td><td>e</td><td>s</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td>u</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>o</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td>t</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>d</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td>r</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>s</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td>o</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td>n</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td>s</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table> <p style="text-align: right;">(2)</p> </div>	h																				e																				l																				i																				u				n																t	e	m	p	e	r	a	t	u	r	e	s													u								o												t								d												r								s												o																				n																				s																2	<p>answers in crossword take precedent but if crossword blank allow answers next to the clues</p> <p>0 or 1 correct = 0 marks 2 or 3 correct = 1 mark 4 correct = 2 marks</p>
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(b)	<p>any two ideas from:</p> <ul style="list-style-type: none"> • no data / no evidence • secrecy • cannot be proved / be reproduced / cannot get similar or reliable results • disagrees with fundamental physics 	2	<p>Eg. Not all data published (1)</p> <p>Eg. (some) experimental details are (still) secret (1)</p> <p>Eg. fusion needs high temps or pressures / won't happen at low temperatures or pressures / AW (1)</p>																																																																																																																																																																																																																																																
	Total	4																																																																																																																																																																																																																																																	

Question		Answer	Marks	Guidance
5	(a)	<p>electron transfer idea:</p> <ul style="list-style-type: none"> • <u>electrons</u> move between two insulators <p>OR</p> <ul style="list-style-type: none"> • <u>electrons</u> move between the socks and the trampoline (1) <p>earthing idea:</p> <ul style="list-style-type: none"> • electrons flow through girl / to or from earth / ground (during “shock”) (1) 	2	<p>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)</p> <p>mention of positive electrons scores (0) for this marking point mention of movement of protons scores (0) for this marking point</p> <p>allow current / charge movement through girl / to or from earth / discharged to earth (1) eg negative charge goes to earth (1)</p> <p>ignore electricity / voltage to earth</p>
	(b)	<p>idea that anti-static sprays leave a conducting layer / coating of material (1)</p> <p>so charge cannot build up (1)</p>	2	<p>Eg. enables the trampoline to conduct (1)</p> <p>eg can't store electrons (1) not merely static electricity cannot build up. but static charge cannot build up (1)</p>
		Total	4	

Question		Answer	Marks	Guidance
6	(a)	<p>particles hit rocket walls / AW (1)</p> <p>causing force / thrust / AW (1)</p>	2	<p>But particles colliding with each other (0) Allow particles collide with each other and walls (1)</p> <p>ignore pressure / upthrust</p> <p>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)</p>
	(b)	<p>more force and acceleration because of:</p> <ul style="list-style-type: none"> • more frequent collisions / more energetic collisions / twice as many collisions (1) <p>or</p> <ul style="list-style-type: none"> • faster particles / more particles / more energy / more momentum (1) 	1	<p>but more frequent collisions between gas particles scores (0) allow more frequent collisions between gas particles and walls (1)</p> <p>allow higher level answers in terms of kinetic theory (1) ignore pressure ignore more gas</p> <p>allow force applied for longer giving greater acceleration (1)</p>

Question	Answer	Marks	Guidance															
(c)	<p>[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)</p> <p>[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)</p> <p>[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)</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*. allow reverse arguments for geostationary orbits throughout. Indicative scientific points may include at level 3:</p> <ul style="list-style-type: none"> • higher gravitational force and lower altitude for polar orbit • higher gravitational force and higher speed or acceleration for polar orbit. • higher gravitational force and shorter period for polar orbit <p>Indicative scientific points may include at level 2:</p> <ul style="list-style-type: none"> • lower altitudes for polar orbit • higher speeds for polar orbit. • shorter period for polar orbit • polar orbit over poles and geostationary orbit over equator <p>Indicative scientific points may include at level 1:</p> <ul style="list-style-type: none"> • 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.) <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p> <table border="1" data-bbox="1272 1114 2051 1289"> <tbody> <tr> <td>ideas</td> <td>geostationary</td> <td>polar</td> </tr> <tr> <td>orbit description</td> <td>equator</td> <td>Go over poles</td> </tr> <tr> <td>period</td> <td>longer</td> <td>shorter</td> </tr> <tr> <td>speed</td> <td>lower</td> <td>higher</td> </tr> <tr> <td>gravitational force</td> <td>lower</td> <td>higher</td> </tr> </tbody> </table> <p>At level 3 accept higher level answer in terms of acceleration</p>	ideas	geostationary	polar	orbit description	equator	Go over poles	period	longer	shorter	speed	lower	higher	gravitational force	lower	higher
ideas	geostationary	polar																
orbit description	equator	Go over poles																
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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)	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">vector</td> <td style="width: 50%;">scalar</td> </tr> <tr> <td>velocity</td> <td>mass</td> </tr> <tr> <td>weight</td> <td>speed</td> </tr> <tr> <td>momentum</td> <td></td> </tr> <tr> <td>(1)</td> <td>(1)</td> </tr> </table>	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. <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;"><u>vector</u></td> <td style="width: 50%;"><u>scalar</u></td> </tr> <tr> <td>velocity</td> <td>mass</td> </tr> <tr> <td>weight</td> <td>speed</td> </tr> <tr> <td></td> <td><i>momentum</i> X</td> </tr> </table> scores (1)	<u>vector</u>	<u>scalar</u>	velocity	mass	weight	speed		<i>momentum</i> X
vector	scalar																					
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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 border="1"> <thead> <tr> <th></th> <th>reflection</th> <th>interference</th> </tr> </thead> <tbody> <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> </tbody> </table>		reflection	interference	particle model	✓		wave model	✓	✓		(1)	(1)	2	one mark for each correct column
	reflection	interference														
particle model	✓															
wave model	✓	✓														
	(1)	(1)														
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 3×10^8 / 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: $n = \text{speed in vacuum} / \text{speed in medium}$ 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) brightness of lamp / current increases (1)	2	ignore weaker resistance 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 $\frac{1}{R_T} = \frac{1}{2} + \frac{1}{3} + \frac{1}{4} \quad (1)$ or $\frac{1}{R_T} = 0.5 + 0.33 + 0.25 \quad (1)$	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)	$I_e = 0.60 \text{ mA}$ (1)	1	Allow 0.6 (1)
Total	7		

Question		Answer	Marks	Guidance																																				
11	(a)	diode (1) (diode) has a high resistance in one direction and a low resistance in the other (1)	2	allow LED (1) allow current flows one way only (1) allow threshold voltage / current idea (1)																																				
	(b) (i)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>output</th> </tr> </thead> <tbody> <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> </tbody> </table> <p style="text-align: right;">(1)</p>	A	B	C	output	0	0	0	0	1	0	0	1	0	1	0	1	1	1	0	1	0	0	1	0	1	0	1	0	0	1	1	0	1	1	1	0	1	all four zeros needed
A	B	C	output																																					
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	(ii)	dark / not light (1) hot / wet (1)	2	allow night(time) / dim (1)																																				

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

Question	Answer	Marks	Guidance
12	<p>[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)</p> <p>[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)</p> <p>[Level 1] Describes two features of the basic construction of a transformer. Quality of written communication does impede 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. Level 3 relevant points:</p> <ul style="list-style-type: none"> • 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. <p>Level 2 diagram or description of transformer construction:</p> <ul style="list-style-type: none"> • two coils wrapped around (iron) core with secondary less turns than primary • ratio 230:5 or 2% or sensibly attempted calculation using transformer equation. <p>Level 1 diagram or description of transformer construction:</p> <ul style="list-style-type: none"> • two coils of wire • wrapped on (iron) core • step down transformer <p>Use the L1, L2, L3 annotations in Scoris. Do not use ticks.</p>
	Total	6	

Question		Answer	Marks	Guidance
13	(a)	...flows from P to S and through the resistor or to T (1) ...flows from R to S and through the resistor or to T(1)	2	ignore current paths after T ignore current paths after T
	(b)	smoothed output (1)		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 $\frac{5.1}{0.17}$ or 30 scores (2) but if none of the above 5.1 (mm) scores (1)	3	allow 30001(km) (3) allow $\frac{5.2}{0.17}$ (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	

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