



GCE

Physics A

Advanced Subsidiary GCE

Unit **G481**: Mechanics

Mark Scheme for June 2012

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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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










Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

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Annotations available in scoris

Annotation	Meaning
	Benefit of doubt given
	Contradiction
	Incorrect response
	Error carried forward
	Follow through
	Not answered question
	Benefit of doubt not given
	Power of 10 error
	Omission mark
	Rounding error
	Error in number of significant figures
	Correct response
	Arithmetic error
	Wrong physics or equation

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The abbreviations, annotations and conventions used in the detailed mark scheme are:

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
(1)	Separates marking points
reject	Answers which are not worthy of credit
not	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ecf	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

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CATEGORISATION OF MARKS

The marking schemes categorise marks on the MACB scheme.

- B** marks: These are awarded as independent marks, which do not depend on other marks. For a **B**-mark to be scored, the point to which it refers must be seen specifically in the candidate's answers.
- M** marks: These are method marks upon which **A**-marks (accuracy marks) later depend. For an **M**-mark to be scored, the point to which it refers must be seen in the candidate's answers. If a candidate fails to score a particular **M**-mark, then none of the dependent **A**-marks can be scored.
- C** marks: These are compensatory method marks which can be scored even if the points to which they refer are not written down by the candidate, providing subsequent working gives evidence that they must have known it. For example, if an equation carries a **C**-mark and the candidate does not write down the actual equation but does correct working which shows the candidate knew the equation, then the **C**-mark is given.
- A** marks: These are accuracy or answer marks, which either depend on an **M**-mark, or allow a **C**-mark to be scored.

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Note about significant figures:

If the data given in a question is to 2 sf, then allow answers to 2 or more sf.

If an answer is given to fewer than 2 sf, then penalise once only in the entire paper.

Any exception to this rule will be mentioned in the Additional Guidance.

Question		Answer	Marks	Guidance
1	(a)	A vector quantity has <u>direction</u> / scalar quantity does not have <u>direction</u>	B1	Not: 'Scalar only has magnitude' because there is no mention of <u>direction</u>
	(b)	(i) acceleration	B1	
		(ii) power <u>and</u> energy	B1	
		(iii) stress <u>and</u> pressure unit: pascal / Pa / N m ⁻² / kg m ⁻¹ s ⁻²	M1 A1	Note: The A1 mark can only be scored if M1 is awarded
	(c)	10 ¹²	B1	
	(d)	$\rho \mu c k$	B1	
Total			7	

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Question		Answer	Marks	Guidance
2	(a)	vertically down(wards) / vertically towards the ground	B1	Not: vertical / down
	(b)	horizontal velocity = $24 \times \cos 30$ = $21 \text{ (m s}^{-1}\text{)}$ vertical component = $24 \times \sin 30$ = $12 \text{ (m s}^{-1}\text{)}$	B1 B1	Note: Answer to 3 sf is $20.8 \text{ (m s}^{-1}\text{)}$ Allow: $12\sqrt{3}$ Allow: 1 mark if the answers have been swapped. Allow: 1 mark for answers of '3.7 and -23.7' obtained using '30 rad'
	(c)	The ball is (still) moving at B / has horizontal motion at B / has horizontal velocity (of 20.8 m s^{-1}) at B / has KE at B	B1	Allow: 'The ball has KE at the top / peak / maximum point'
	(d)	$v^2 = u^2 + 2as$ Using the vertical component $12 \text{ (m s}^{-1}\text{)}$ $0 = 12^2 - 2 \times 9.81 \times h$ $h = 7.3 \text{ (m)}$	C1 C1 A1	Possible ecf from (b) Note: Answer to 3sf is 7.34 (m) Allow: $mgh = \frac{1}{2}mv^2$ Using $12 \text{ (m s}^{-1}\text{)}$ C1 $h = 12^2 / (2 \times 9.81)$ C1 $h = 7.3 \text{ (m)}$ A1 Allow: $m \times 9.81 \times h = \frac{1}{2} \times m \times 24^2 - \frac{1}{2} \times m \times 20.8^2$ C1 $h = (24^2 - 20.8^2) / 2 \times 9.81$ C1 $h = 7.3 \text{ (m)}$ A1
Total			7	

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Question		Answer	Marks	Guidance
3	(a)	velocity = rate of change of <u>displacement</u>	B1	Allow: Equation if labels are defined Not: velocity = displacement/time Not: A mixture of quantity and unit, e.g: 'change in displacement per second'
	(b)	work done = force × distance <u>moved</u> in direction of force	M1 A1	Allow: 'force × displacement' for the M1 mark
	(c) (i)	It is at right angles to motion	B1	Allow: It is at right angles to slope / sledge
	(ii)	The component of the weight / W / mg (down the slope)	B1	Allow: $W \sin \theta$ or $mg \sin \theta$ Not: 'component of gravity' Allow: <u>Resultant</u> of W and N
	(d) (i)	1 acceleration = gradient / $a = (v - u) / t$ $a = 3.0 / 1.5$ $a = 2.0 \text{ (m s}^{-2}\text{)}$ 2 $a = g \sin \theta$ $\sin \theta = 2.0 / 9.81$ $\theta = 12^\circ$	C1 A1 C1 A1	Allow: 1 sf answer Possible ecf from incorrect value of acceleration a Answer to 3 sf is 11.8° Note: Using 10 m s^{-2} gives an answer of 11.5° - award 2 marks
	(ii)	$a = (-) 15 / 3.5$ or $a = (-) 4.29 \text{ (m s}^{-2}\text{)}$ $m = 510 / 4.29$ mass = 120 (kg)	C1 C1 A1	Ignore sign Answer to 3 sf is 119 (kg)
Total			12	

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Question			Answer	Marks	Guidance
4	(a)	(i)	Two equal but opposite forces	B1	
		(ii)	torque = one of the forces \times <u>perpendicular</u> distance between the forces	B1	Use tick or cross on Scoris  perpendicular must be spelled correctly to gain the mark
	(b)	(i)	It will rotate / spin / turn Rotation is clockwise / (continue) to travel from left to right/ the rotational speed increases (with time)	B1 B1	
		(ii)	It will accelerate The idea that acceleration is to the right / Suggestion that satellite will 'turn'	B1 B1	Allow: 'speed up' / 'speed increases' / 'velocity increases' / 'move faster'
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Question		Answer	Marks	Guidance
5	(a)	(net vertical force =) $120 - 90$ $F^2 = 30^2 + 18^2$ net force = 35 (N) $\tan \theta = 30/18$ angle = 59°	C1 C1 A1 B1	<p>Allow: 2 marks for 1224 (N) - answer not square-rooted Allow: 1 mark for resultant of 18 and 90; equal to 91.8 (N) Allow: 1 mark for resultant of 18 and 120; equal to 121.3 (N)</p> <p>Alternative for scale drawing: (net vertical force =) 30 (N) C1 Correct 'triangle'; at least one of the sides labelled C1 F in the range 34 to 36 (N) A1</p> <p>Possible ecf from net force</p>
	(b)	Any <u>two</u> from: <ul style="list-style-type: none"> • speed of balloon • (frontal) area • texture of balloon • temperature of air / density of air / viscosity (of air) 	B1×2	Not: size / shape of balloon
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Question		Answer	Marks	Guidance	
6	(a)	<p>Material X It is a brittle material No plastic deformation / It is elastic / It returns to same length when stress / force is removed</p> <p>Material Y It is a polymeric / polymer (material) It is elastic / It returns to same length when stress / force is removed</p> <p>X obeys Hooke's law / Y does not obey Hooke's law</p>	<p>B1 B1</p> <p>B1 B1</p> <p>B1</p>	<p>Use ticks on Scoris to show where the marks are awarded ✍ Brittle must be spelled correctly to gain the mark.</p> <p>Allow: rubber / 'elastic band' Allow: energy 'lost' (when unloaded)</p>	
	(b)	<p>Place the 100 g mass on the spring / hang the 100 g mass from the spring Determine the extension / compression of the spring (using a ruler) force constant = 0.98(1)/extension</p>	<p>B1 B1 B1</p>	<p>Allow: $k = (0.1 \times 9.8)/\text{extension}$ Allow: $k = 1.0 \text{ (N)/extension}$</p>	
	(c)	(i)	<p>$F = kx$</p> <p>$F = 50 \times 0.070$ / $F = 3.5 \text{ (N)}$ $a = 3.5/0.180$ acceleration = 19 (m s⁻²)</p>	<p>C1 C1 A1</p>	<p>Answer to 3 sf is 19.4 (m s⁻²)</p>
		(ii)	<p>average work done = <u>average</u> force × displacement = 1.75 × 0.070 (= 0.1225) av rate of work done = 0.1225/0.094 av rate of work done = 1.3 (J s⁻¹)</p>	<p>C1 A1</p>	<p>Alternative (allow full credit for other correct methods) $E = \frac{1}{2} \times 50 \times 0.070^2 (= 0.1225)$ C1 power = 0.1225/ 0.094 power = 1.3 (J s⁻¹) A1</p>
Total			13		

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Question		Answer	Marks	Guidance
7	(a)	power = work done/ time or energy/time or 'rate of work done'	B1	
	(b)	power = KE/time Using $\frac{1}{2}mv^2$ (power =) $\frac{1}{2} \times 9.7 \times 10^5 \text{ (kg s}^{-1}\text{)} \times 3.0^2$ (power =) $4.365 \times 10^6 \text{ (W)}$	C1 C1 A0	Allow: 1 mark for a bald answer of 4.37×10^6 since this is a 'show' question
	(c)	efficiency = $\frac{1.2}{4.4} \times 100$ efficiency = 27 %	B1	Note: Answer to 3 sf is 27.3% if 4.4×10^6 is used Note: Answer is 27.5% if 4.365×10^6 is used Not: 0.27
	(d)	(volume per second =) $9.7 \times 10^5 / 1030$ or 941.7 mass per second = density \times volume per second $9.7 \times 10^5 = 1030 \times (3.0 \times \pi \times r^2)$ $r^2 = \frac{9.7 \times 10^5}{1030 \times 3\pi}$ radius = 10 (m)	C1 C1 A1	Allow any subject Allow: 2 marks for 100 (m); answer not square rooted
	(e) (i)	water has greater density or water has greater mass / KE for the <u>same volume</u>	B1	
	(ii)	Any <u>one</u> from: <ul style="list-style-type: none"> • Not an eyesore / cannot be seen • Not noisy • Predictable energy (with in and out tides) • Do not occupy space on the land 	B1	Allow other sensible suggestions
Total			9	

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

OCR Customer Contact Centre

Education and Learning

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