OCR
RECOGNISING ACHIEVEMENT

GCE

Physics A

Advanced Subsidiary GCE

Unit **G481:** Mechanics

Mark Scheme for June 2012

Oxford Cambridge and RSA Examinations

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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.

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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

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

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.

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 direction / scalar quantity does not have direction	B1	**Not**: 'Scalar only has magnitude' because there is no mention of direction
	(b)	(i)	acceleration	B1	
		(ii)	power and energy	B1	
		(iii)	stress and 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)		*p μ c k*	B1	
			Total	**7**	

Question			Answer	Marks	Guidance
2	(a)		vertically down(wards) / vertically towards the ground	B1	**Not**: vertical / down
	(b)		horizontal velocity = 24 × cos30 = 21 (m s^{-1}) vertical component = 24 × sin30 = 12 (m s^{-1})	B1 B1	**Note**: Answer to 3 sf is 20.8 (m s^{-1}) **Allow**: 12√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 (m s^1) $0 = 12^2 - 2 \times 9.81 \times h$ h = 7.3 (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 (m s^1) C1 $h = 12^2/(2 \times 9.81)$ C1 h = 7.3 (m) A1 **Allow**: $m \times 9.81 \times h = ½ \times m \times 24^2 - ½ \times m \times 20.8^2$ C1 $h = (24^2 - 20.8^2)/2 \times 9.81$ C1 h = 7.3 (m) A1
			Total	**7**	

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* sinθ or *mg*sinθ **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 (m s^{-2}) 2 $a = g\sin\theta$ $\sin\theta = 2.0/9.81$ θ = 12°	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 (m s^{-2}) $m = 510/4.29$ mass = 120 (kg)	C1 C1 A1	**Ignore** sign Answer to 3 sf is 119 (kg)
			Total	**12**	

Question			Answer	Marks	Guidance
4	(a)	(i)	Two equal but opposite forces	B1	
		(ii)	torque = one of the forces × <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'
			Total	**6**	

Question			Answer	Marks	Guidance
5	(a)		(net vertical force =) 120 – 90	C1	
			$F^2 = 30^2 + 18^2$	C1	
			net force = 35 (N)	A1	**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) **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
			$\tan\theta = 30/18$		
			angle = 59°	B1	Possible ecf from net force
	(b)		Any <u>two</u> from: • speed of balloon • (frontal) area • texture of balloon • temperature of air / density of air / viscosity (of air)	B1×2	**Not**: size / shape of balloon
			Total	**6**	

Question			Answer	Marks	Guidance
6	(a)		Material **X** It is a ***brittle*** material No plastic deformation / It is elastic / It returns to same length when stress / force is removed Material **Y** It is a polymeric / polymer (material) It is elastic / It returns to same length when stress / force is removed **X** obeys Hooke's law / **Y** does not obey Hooke's law	 B1 B1 B1 B1 B1	**Use ticks on Scoris to show where the marks are awarded** ✍ ***Brittle*** must be spelled correctly to gain the mark. **Allow**: rubber / 'elastic band' **Allow**: energy 'lost' (when unloaded)
	(b)		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	B1 B1 B1	 **Allow**: k = (0.1 × 9.8)/extension **Allow**: k = 1.0 (N)/extension
	(c)	(i)	$F = kx$ $F = 50 \times 0.070$ / F = 3.5 (N) a = 3.5/0.180 acceleration = 19 (m s^{-2})	 C1 C1 A1	 Answer to 3 sf is 19.4 (m s^{-2})
		(ii)	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})	 C1 A1	 **Aternative** (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
			Total	**13**	

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 =) ½ × 9.7 × 10^5 (kg s^{-1}) × 3.0^2 (power =) 4.365 × 10^6 (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 × 10^5/1030 or 941.7 mass per second = density × volume per second 9.7 × 10^5 = 1030 × (3.0 × π × 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: • 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**	

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