OCR
Oxford Cambridge and RSA

GCE

Physics A

Unit **G481/01**: Mechanics

Advanced Subsidiary GCE

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.

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Annotations

Annotation	Meaning
BP	Blank Page – this annotation **must** be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
BOD	Benefit of doubt given
CON	Contradiction
	Incorrect response
ECF	Error carried forward
FT	Follow through
NAQ	Not answered question
NBOD	Benefit of doubt not given
POT	Power of 10 error
^	Omission mark
RE	Rounding error or reading/transcription error (*dual purpose*)
SF	Error in number of significant figures
	Correct response
AE	Arithmetic error
	Wrong physics or equation

Abbreviations used in detailed mark scheme

Abbreviation	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

Subject-specific Marking Instructions

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 and rounding errors:

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 Guidance.

Penalise a rounding error once only in the entire paper.

Question			Answer	Marks	Guidance
1	a		Power is the rate of work done / power is the rate of energy transfer	B1	**Allow**: power = energy/time or energy <u>per</u> (unit) time or power = work/time **Allow**: equation using symbols if meanings are stated **Ignore** any reference to units
	b	i	(The tension is) equal to the weight / 30 N Since object has constant speed / no acceleration the <u>net / resultant</u> force on the object is zero.	B1 B1	
		ii	rate of work done = 30×0.084 rate of work done = 2.5 ($J\ s^{-1}$)	C1 A1	**Allow** 1 mark for 252 ($J\ s^{-1}$); cm not converted into m
		iii	input power = 2.5/0.05 input power = 50 (W)	 B1	 Possible ecf from **ii**
		iv	The tension would be greater than 30 N / weight of object Explanation in terms of resultant / net upward force (*F)* = *ma*	B1 B1	**Allow** tension would be larger **Not** acceleration **causes** a (resultant/net) force
			Total	**8**	

Question			Answer	Marks	Guidance
2	a	i	force, acceleration and displacement all underlined.	B1	
		ii	force and displacement	B1	**Not** force and distance
		iii	Force	B1	
	b	i	An arrow at an angle upwards and to the right	B1	Allow a single arrow without the label **R**
		ii	(The resultant velocity is not the sum of the speeds because) velocity is a vector quantity / velocity (also) has direction (AW)	B1	
		iii	A suitable vector triangle with at least **two** vectors correctly labelled $8.8^2 = 7.0^2 + v^2$ (Any subject) v = 5.3 (m s^{-1}) θ = 53°	B1 C1 A1 A1	**Note**: Ignore arrows **Allow** full credit for a scale drawing when v is within $\pm$ 0.1 m s^{-1} and θ is within $\pm$ 1°
		iv	Weight acts vertically down Drag / air resistance is opposite to the direction of the velocity (9.3 m s^{-1}) The resultant of the two forces is downward and to the left and at a greater angle to the horizontal (or steeper) than the velocity (9.3 m s^{-1}) vector / between drag and weight	B1 B1 B1	 **Allow** use of labelled diagram
			Total	**12**	

Question			Answer	Marks	Guidance
3	a		($v = u + at$); $0 = 1.6 - 2.5t$ (Any subject) $t = 0.64$ (s)	C1 A1	
	b		($v^2 = u^2 + 2as$); $0 = 1.6^2 - 2 \times 2.5 \times s$ (Any subject) distance = 0.51 (m)	 C1 A1	**Allow** alternative methods Possible ecf from **a**
	c		Initial $E_k = ½ \times 0.310 \times 1.6^2$ (= 0.3968) At midpoint $E_k = ½ \times$ [initial E_k] = $½ \times 0.3968$ $E_k = 0.20$ (J)	C1 C1 A1	**Allow** alternative methods with possible ecf from **b** . eg At midpoint v^2 is halved or $v^2 = 1.6^2/2$ or SUVAT using distance = ½ x 0.51 hence $v_{1/2} = 1.1(3)$ m s^{-1}) At midpoint $E_k = ½ \times 0.310 \times (1.6^2/2)$ **Allow** 1 sf answer
	d		$½ \times 0.310 \times 1.6^2 = 0.310 \times 9.81 \times h$ $h = 0.13$ (m)	C1 A1	**Allow** alternative methods E.g: $(0.51 \times 2.5)/9.81 = 0.13$ (m) Possible ecf from **b**
			Total	**9**	

Question			Answer	Marks	Guidance
4	a	i	force constant = force/extension or force per (unit) extension	B1	**Allow** tension instead of force and compression instead of extension **Allow**: equation using symbols if meanings are stated
		ii	For the same force **A** has a smaller extension Wire **A** has the greater force constant	M1 A1	**Alternative**: For the same extension **A** has the greater force / Use of Young modulus = stress/strain to show k ∝ A M1 Wire **A** has greater force constant A1
	b	i	The gradient of graph / tangent (to graph) is equal to the speed Draw a tangent to the graph at $t = 0$ s and find its gradient	B1 B1	**Allow** any t between 0.0 and 0.04 s
		ii	$E = ½ kx^2$ and $x = 3.0$ cm (from Fig. 4.2) $E = ½ \times 24 \times 0.03^2$ $E = 1.1 \times 10^{-2}$ (J)	C1 C1 A1	**Allow** 2 marks for 110 (J); cm not converted into m
		iii	The GPE and KE of the block decreases The strain/elastic potential energy in the spring increases / (KE and GPE) energy transferred /converted to EPE in the spring At $t = 0.2$ s, the block has no KE and the spring has maximum strain/elastic potential energy	B1 B1 B1	Ignore any reference to the GPE and KE of the spring since it has negligible mass Ignore reference to GPE of block at t = 0.2 s
			Total	**11**	

Question			Answer	Marks	Guidance
5	a		Moment of a force is the product of force and the <u>perpendicular</u> distance from a point / pivot / fulcrum	B1	✍ The term **perpendicular** must be spelled correctly to gain this mark
	b	i	mass = 35/9.81 (= 3.57 kg) volume = $0.82 \times 12 \times 10^{-4}$ (= 9.84 x 10^{-4} m³) $\rho = \frac{3.57}{0.82 \times 12 \times 10^{-4}}$ ρ = 3.6×10^{3} (kg m^{-3})	C1 C1 A1	**Allow** 2 marks for an answer 3.6×10^{n}, where $n \neq 3$
		ii	Either (moment =) 0.41×35 or (moment =) 0.82 x Tsin50° $0.41 \times 35 = T \times 0.82 \times \sin 50°$ T = 23 (N)	C1 C1 A1	Answer to 3 sf =22.8 N
		iii	Upward arrow through **A** at an angle <u>less than 90°</u> to the vertical and to the right of the pole Line passes through intersection of weight and tension vectors	M1 A1	
			Total	**9**	

Question			Answer	Marks	Guidance
6	a		The diameter of the wire measured using a micrometer / vernier (calliper)	B1	✍ The term **micrometer** or **vernier** must be spelled correctly to gain this mark
			The mass *M* suspended is measured using a balance / tension(or force) *F* in the wire is measured with the mass suspended using a force(or newton) meter	M1	
			(cross-sectional) area $A = \frac{\pi d^2}{4}$, where *d* is the diameter	M1	**Not** surface area **Allow** $A = \pi r^2$, where *r* (= *d/2)* is the radius
			stress = $\frac{Mass \times g}{Area}$ or stress = $\frac{Weight}{Area}$ or stress = $\frac{Force}{Area}$	A1	**Allow**: Use of M, W F and A if the words mass, weight, force (or tension) and area have been used previously
	b	i	material **A**: Elastic / obeys Hooke's law (AW) Brittle	 B1 B1	
			material **B**: Elastic / obeys Hooke's law up to elastic limit / over straight section / for strain < 0.25% (AW) Then shows **plastic** behaviour (for strain > 0.25% AW)	 B1 B1	 **Allow** malleable or ductile
		ii	*E* = gradient (linear region)	C1	
			$E = \frac{0.75 \times 10^9}{0.25 \times 10^{-2}}$	C1	
			E = 3.0×10^{11} (Pa)	A1	**Allow** $\pm 0.1 \times 10^{11}$ (Pa) **Allow** 2 marks if answer is 3.0×10^n, where $n \neq 11$ **Allow** 1 sf answer
			Total	**11**	

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