OCR
RECOGNISING ACHIEVEMENT

GCE

Physics A

Advanced GCE **H558**

Advanced Subsidiary GCE **H158**

Mark Scheme for the Units

January 2009

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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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G481 Mechanics

Question			Expected Answers	Marks	Additional Guidance
1	(a)		A quantity that has (both) magnitude / size and direction	B1	**Not** 'A quantity that has direction'
	(b)		Circled /underlined quantities are: acceleration, displacement and weight	B1	**Note**: All three need to be identified for a mark
	(c)	(i)	Constant / steady / uniform acceleration (up to 4 s) Or Velocity increases at a steady / constant / uniform rate Or Has acceleration of 3.5 (m s^{-2}) Constant / steady / uniform velocity (after 4 s) Or Zero acceleration Or Travels at a velocity of 24 (m s^{-1})	B1 B1	**Not** Accelerates up to 4 s / 'uniform motion' for the first B1 mark **Not** 'Accelerates at a constant rate'. **Allow**: 'speed' instead of velocity **Allow**: 2 mark for 'Constant acceleration and then constant speed / velocity'
		(ii)	distance = area (under graph) distance = 68 (m)	C1 A1	**Allow**: The C1 mark is for … distance = $\frac{1}{2}(10+24)\times 4.0$ **Allow**: Bald 68 (m) scores 2 marks Bald $\frac{1}{2}(4\times 14)$ or 28 (m) scores 1 mark for 'area of triangle'
		(iii) 1	Answer in the range: 1.1 to 1.2 (s)	B1	
		(iii) 2	Same areas under graphs $14t = 10t + (0.5\times 3.5\times t^2)$ t = 2.28 (s) ≈ 2.3 (s)	 C1 A1	 **Note**: The C1 mark is for substitution **Allow**: Bald 2.3 (s) scores 2 marks **Allow:** Bald 't = 2 × **(iii)1**.' Scores 2 marks
			Total	9	

Question			Expected Answers	Marks	Additional Guidance
2	(a)		Downward arrow at **P**	**B1**	Arrow must be close to or at point **P**
	(b)		From gravitational potential (energy) to kinetic (energy) / KE / E_k (wtte) Any further detail: KE maximum at bottom / Zero (G)PE at bottom / (G)PE is maximum at top / (G)PE and KE at top (wtte)	**B1** **B1**	The term gravitational to be included and spelled correctly in **(b)** to gain the first B1 mark **Not**: Heat / sound at ground
	(c)		The acceleration / force / weight is at right angles to horizontal motion / velocity (wtte)	**B1**	**Allow**: 'In this direction the force / acceleration is zero'
	(d)		time = $\frac{3.6}{7.0}$ (= 0.514 s)	**B1**	**Allow**: time = $\sqrt{(1.3\times 2)/9.81}$ (= 0.515 s) **Allow**: Use of 9.8 (m s^{-2})
	(e)		u = 0 and $v = u + at$ or $v^2 = u^2 + 2as$ 'vertical' velocity = 9.81× 0.5(14) or 'vertical' velocity = $\sqrt{2\times 9.81\times 1.3}$ 'vertical' velocity = 5.0 (m s^{-1}) $v^2 = 7.0^2 + 5.0^2$ $v = 8.6$ (m s^{-1})	**C1** **C1** **C1** **A0**	**Watch out for**: '$v^2 = u^2 + 2as = 7^2 + (2\times 9.81\times 1.3) = 8.6$' – this scores **no** marks because of **wrong** physics. **Note**: Getting an answer 5.0 (m s^{-1}) scores the first 2 marks **Note**: Using t = 0.5 (s) gives 8.55 (m s^{-1}) **Note**: Bald answer scores zero marks – since this is a 'show' question (Allow full marks for correct analysis using the principle of conservation of energy.)
			Total	**8**	

Question			Expected Answers	Marks	Additional Guidance
3	(a)		(Force is 1 N) when a **1 kg** mass has an acceleration of **1 m s^{-2}**	B1	**Not**: '1 kg and 1 m **s^{-1}**' **Allow**: (1 N =) **1 kg** × **1 m s^{-2}**
	(b)		The mass of particles increases (at its speed gets closer to the speed of light)	B1	**Not**: 'weight of particle increases' **Not**: 'mass changes / different'
	(c)	(i)	net force = 120 (N) $a = \frac{120}{900}$ *a* = 0.13 (m s^{-2})	C1 A1	 **Note**: Bald answer scores 2 marks; answer must be 2 sf or more
		(ii)	The drag force changes with speed / acceleration is not constant	B1	
	(d)		$F = 72 \times 1.4$ (= 100.8 N) / weight = 72 × 9.81 (= 706.32 N) *T* = (72 × 9.81) + (72 × 1.4) *T* = 807 (N) or 810 (N)	C1 C1 A1	**Note**: Bald 101 (N) or 706 (N) scores 1 mark **Note**: Bald answer scores 3 marks Bald 605.52 to at least 2 sf scores 1 mark
			Total	8	

Question			Expected Answers	Marks	Additional Guidance
4	(a)		torque of a couple = one of forces × perpendicular distance (between forces)	B1	**Not**: 'force × perpendicular distance'
	(b)		Torque and moment are to do with 'distance multiplied by force'	B1	
	(c)	(i)	moment = 6.0 × 0.40 moment = 2.4 (N m)	B1	
		(ii)	Weight / force acts through the pivot Or (perpendicular) distance from pivot is (reduced to) zero (wtte)	B1	**Allow**: weight is 'vertically below' / 'directly below' the pivot Reference to pivot / point **P** (wtte) is essential
	(d)		Any three from: 1. (Suspend plate from a point and then) mark a vertical line on the plate (wtte) 2. Plumb line / 'pendulum' (used to find the vertical line) 3. Hang from another point / place (and draw another vertical line) (wtte) 4. Where the lines intersect gives position of centre of gravity (wtte)	B1×3	**Note**: For 1st point accept 'mark line of string' **Allow**: 1 mark for 'By trial and error find a position where the plate balances'
	(e)		(sum of) clockwise moment(s) = (sum of) anticlockwise moment(s) $(18 \times 0.14) + (60 \times 0.32) = 0.035F$ $F \approx 620$ (N)	C1 C1 A1	**Not**: 'CWM = ACWM' **Allow**: working in consistently in cm **Note**: Bald answer scores 3 marks **Allow**: 1 mark for 21.72 (N m) or 2172 (N cm)
			Total	10	

Question			Expected Answers	Marks	Additional Guidance
5	(a)		$F_H = 20\cos 38 = 15.76 \approx 15.8$ (N)	B1	**Allow**: 2 sf answers of 16 (N) and 12 (N)
			$F_V = 20\sin 38 = 12.31 \approx 12.3$ (N)	B1	**Allow**: 1 mark if vertical and horizontal components have been interchanged
	(b)	(i)	net force vertically = 0 / weight = upward forces	C1	
			weight = 12.3 + 12.3	C1	Possible ecf from F_V value from **(a)**
			weight = 24.6 (N) ≈ 25 (N)	A0	
			---------- Or ----------		
			correct triangle of forces diagram	C1	At least one label needed (e.g: 20, correct angle, etc) – arrows not needed
			correct determination of weight	C1	Weight in the range 22 – 27 (N)
			weight = 24.6 (N) ≈ 25 (N)	A0	
		(ii)	mass = $\frac{25}{9.81} = 2.55$ (kg)	C1	**Note**: 2.51 kg if 24.6 N is used
			density = $\frac{2.55}{2.9\times10^{-4}}$	C1	
			density = 8.8×10^3 (kg m^{-3})	A1	**Note**: 'weight/volume' scores zero **Note**: Answer is 8.7×10^3 if 2.51 kg is used **Allow**: 2 marks if g = 10 used and 25 N → 2.5 kg $\therefore \rho$ = 8620 (kg m^{-3}) **Note**: Bald 8.7×10^3 or 8.8×10^3 scores 3 marks **Allow**: 1 mark if 20 N is used instead of 25 N – this gives 7030 (kg m^{-3})
			Total	7	

Question			Expected Answers	Marks	Additional Guidance
6	(a)		stopping distance = thinking distance + braking distance	B1	
	(b)		Any <u>two</u> factors from: speed, mass, condition of tyres, condition of brakes, condition of road, gradient of road For each factor, correct description of how braking distance is affected E.g: • Greater speed means greater distance Or distance $\propto$ speed^2 (ora) • Greater mass means greater distance Or distance $\propto$ mass (ora) • Worn tyres / brakes implies less friction therefore greater distance (ora) • Wet / slippery / icy road means less friction therefore greater distance (ora) • Uphill means shorter distance (ora)	B1×2 B1×2	**Allow**: KE if neither mass nor speed is mentioned. For description marks, reference to 'distance' instead of 'braking distance' is fine For 1st bullet point allow reference to kinetic energy **Allow**: 'more' or 'longer' instead of 'greater' when referring to distance Do not allow 'grip' for friction for 3rd and 4th bullet points
	(c)		1. (Several) <u>satellites</u> used 2. Distance from (each) satellite is determined 3. Position / distance is determined using *c* / speed of e.m waves / radio waves / microwaves and delay time (wtte) 4. Trilateration is used to locate the position of the car Or position of car is where circles / spheres cross (wtte)	B1 B1 B1 B1	**Note**: The term 'satellite(s)' to be included and spelled correctly, on all occasions, to gain this first (or second) B1 mark (Deduct this mark only <u>once</u>.) Do not allow this 4th mark for just a diagram of intersecting spheres / circles
			Total	9	

Question			Expected Answers	Marks	Additional Guidance
7	(a)		elastic potential (energy) / strain (energy)	B1	**Note**: The candidates do not need to include 'energy' since it is in the stem of the question **Not**: 'stored energy' / 'elastic energy'
	(b)	(i)	strain = $\frac{0.35\times10^{-3}}{1.2} = 2.9(2)\times10^{-4}$	B1	
		(ii)	stress = $1.9 \times 10^{11} \times 2.92 \times 10^{-4}$ (= 5.55×10^{7} Pa) tension = $5.55 \times 10^{7} \times 1.4 \times 10^{-7}$ tension = 7.8 (N)	C1 A1	Possible ecf from **b(i)** **Allow**: Bald answer scores 2 marks
	(c)	(i) 1	10^{-9} (m)	B1	
		(i) 2	Material does not return to original length / shape/ size when the force / stress is removed	B1	There must be reference to stress / force removed to score this mark **Note**: If there is no reference to unloading then allow 'material is <u>permanently</u> deformed'
		(ii)	50 times (stronger)	B1	
		(iii)	Less mass / less weight / lighter Stronger / greater tensile strength	B1 B1	
			Total	9	

Grade Thresholds

Advanced GCE Physics A (H158/H558)
January 2009 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A	B	C	D	E	U
G481	Raw	60	42	37	32	27	23	0
	UMS	90	72	63	54	45	36	0

Specification Aggregation Results

No aggregation was available in this session.

For a description of how UMS marks are calculated see:
http://www.ocr.org.uk/learners/ums_results.html

Statistics are correct at the time of publication.

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