RECOGNISING ACHIEVEMENT

GCE

Physics A

Advanced GCE **G484**

The Newtonian World

Mark Scheme for June 2010

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Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
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NOTTINGHAM
NG15 0DL

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

Question	Expected Answers	Marks	Additional guidance
1(a)	The magnitude of the impulse on each object is the same Total energy is conserved	B1 B1	For 3 or 4 ticks mark and deduct 1 mark for each error.
(b) (i)	Correct use of ½ mv^2 Loss of KE = 0.03(144-81) = **1.9** (or 1.89) **J**	C1 A1	0.27 J scores 1st mark Do not allow 1.8
(b) (ii)	Change in momentum = (0.06x12)+(0.06x9) = 1.26 (Ns) Average force=rate of change of momentum = 1.26/0.15 = **8.4** (or 8) **N**	C1 A1	Award 1 mark for 1.2 N ignore minus signs
(b) (iii)	**8.4 N** (or - 8.4)	B1	Allow ecf from (ii)
(c) (i)	ANY 3 of the following particles move with rapid, random motion (WTTE) elastic collisions negligible (or zero) volume of atoms (compared with volume of container) no intermolecular forces (except during collisions)/all internal energy is KE collision time negligible (compared to time between collision).	 B1 B1 B1	Allow " gravitational force on molecules is negligible" Do not allow a bare "large number of particles".
(c) (ii)	molecules make collisions with walls/surface (WTTE) (hence) exerts a force on the wall (or each collision has a change of momentum) Pressure = force/area	B1 B1 B1	Do not allow a bare "molecules collide with each other"
	Total	13	

Question	Expected Answers	Marks	Additional guidance
2 (a) (i)	Horizontal <u>component</u> of **L** provides the centripetal force (WTTE) Vertical <u>component</u> of **L** balances the weight (WTTE)	B1 B1	
(a) (ii)	$F = mv^2/r$ correct rearranged into $v = \sqrt{(Fr/m)}$ $v = \sqrt{(1.8 \times 10^6 \times 2000/1.2 \times 10^5)}$ = **173** m s^{-1} (or 170)	C1 A1	Allow correct substitution of values into $F = mv^2/r$ for C1 mark
(b)	$mv^2/r = GMm/r^2$ $T = 2\pi r/v$ Correct manipulation of equations to give $T^2 = \dfrac{4\pi^2 r^3}{GM}$	B1 M1 A1	Do not allow a bare $v^2 = GM/r$ for the first mark – we need to see where this has come from.
(c) (i)	**Equatorial** orbit (WTTE) (<u>QWC mark</u>) Period is 24h/1day/same as Earth **OR** moves from West to East (WTTE)	B1 B1	QWC <u>equatorial</u> or <u>equator</u> must be spelled correctly
(c) (ii)	Correct rearrangement of $T^2 = (4\pi^2 r^3/GM)$ to give $r^3 = T^2GM/4\pi^2$ correct sub. $r^3 = \{6.67 \times 10^{-11} \times 6.0 \times 10^{24} \times (8.64 \times 10^4)^2\}/4\pi^2 = 7.57 \times 10^{22}$ r = **4.23 x 10^7 m** (or 4.2 or 4.3 x 10^7)	C1 C1 A1	(1 day = 8.64 x10^{4}s is given on the data sheet). For those who use $g = GM/r^2$ with g = 9.81 award 1 mark for r= 6.4 x 10^6 m.
	Total	12	

Question	Expected Answers	Marks	Additional guidance
3(a)	Acceleration is (directly) proportional to the displacement/distance (from the equilibrium position/central pt) Acceleration is always directed towards the equilibrium position/central point.	B1 B1	Allow "fixed point" or "point" Allow acc. is in opposite direction to displacement (WTTE) If formula is used: allow $a \propto -x$ for 1st mark and 2nd mark if x is stated as displacement.
(b) (i)	Curve symmetrical about energy axis with maximum at 18 zero at +0.04 and – 0.04	B1 B1	Ignore points where graphs cross Give bod if not labelled **K** but correct
(b) (ii)	Horizontal straight line passing 18	B1	Give bod if not labelled **T** but correct
(c) (i)	0.04 m	B1	
(c) (ii)	$\frac{1}{2}m(v_{max})^2 = 0.018$ $v_{max} = \sqrt{(2 \times 0.018/0.12)} =$ **0.55** ms^{-1} (0.548)	C1 A1	Many will use 18 instead of 0.018. This results in 17.3 and scores 1 mark. Allow ecf for cand's value of max KE. Do not allow 0.54 for second mark.
(c) (iii)	correct use of $v_{max} = 2\pi fA$ $f = (0.55/0.04 \times 2\pi) =$ **2.2** (or 2.19 or 2.18)Hz	C1 A1	Allow ecf for cand's values from (c)(i) and/or (c) (ii). E.g for 17.3 f = 68.8 Hz. This scores 2 marks e.c.f. Do not allow 2.1
(d)	Award first mark for stating the **'driver'** of the oscillations and the second mark for stating what is **'driven'** i.e. oscillating useful applications: e.g. Cooking: **micro waves** cause **water molecules** to resonate Woodwind: **reed** causes **air column** to resonate Brass: **lips** cause **air column** to resonate MRI: **radio waves** (in a magnetic field) cause **nuclei/proton** to resonate Radios: **radio waves** cause **electrons/current** to resonate Person on swing: **intermittent pushes** cause **swing** to resonate problem: Bridges: **wind/walkers** causes **bridge** to resonate Vehicles: **engine vibrations** cause **panels/mirrors** to resonate Earthquakes: **ground vibrating** causes **buildings** to resonate	B1 B1 B1 B1	No marks to be awarded for a bare statement of the example e.g MRI. Please allow any other valid examples.
	Total	14	

Question	Expected Answers	Marks	Additional guidance
4 (a) (i)	**Brownian** (motion) (QWC mark)	B1	QWC Brownian spelled correctly
(a) (ii)	ANY two from the following three: air molecules are moving in different directions/randomly with different speeds mass/size of air molecules is smaller than smoke particles	 B1 B1	Answers that refer to smoke particles only cannot score the marks.
(b) (i)	vol = (4/3) $\pi r^3 = 5.58 \times 10^{-3}$ correct sub into pV = nRT i.e. with T as 290K n = $(2.6\times10^5 \times 5.58\times10^{-3})/8.31\times290 = 0.602$ moles mass = n x 0.028 = **0.0169** kg (0.016856)	C1 C1 A1 A1	Allow ecf for wrong volume Allow use of pV = NkT and $n = N/N_A$ Allow ecf for cand's value for n If 17^o C used allow maximum of 2 marks for n = 10.3 moles and m = 0.29 kg
(b) (ii) 1	no net heat flow between objects (WTTE)	B1	Allow "they are at the same temp."
(b) (ii) 2	correct use of P/T = constant: e.g. P = (273/290) x 2.6×10^5 P = $\mathbf{2.45 \times 10^5}$ (or 2.4×10^5 or 2.5×10^5)Pa	C1 A1	Allow correct use of pV=nRT
	Total	10	

Question	Expected Answers	Marks	Additional guidance
5(a) (i)	Initial KE of car = $0.5 \times 970 \times 27^2$ = $\mathbf{3.5 \times 10^5}$ **J** (353565J)	B1	
(a) (ii)	Work done = Av Force x distance moved Av Force = 3.5×10^5 J/40 = $\mathbf{8.8 \times 10^3}$ **N** (or 8750 N) (or 353565/40 = 8836.7 N) Assumption: <u>**no air resistance**</u>	C1 A1 B1	If $v^2 = u^2 + 2as$ is used. accept $a = 0-27^2/(2\times40) = 9.113$ ms^{-2} C1 F = ma = 970x9.11 = 8.84×10^3 N A1 Allow air friction or drag
(b) (i)	correct use of $E = mc\Delta\theta$: $3.5 \times 10^5/4 = 1.2\times520\times\Delta\theta$ $\Delta\theta$ = $\mathbf{140^OC}$ (if 353565 is used $\Delta\theta = 142^OC$)	C1 A1	If cand. forgets to divide by 4 allow any value between 560 and 570 for 1 mark.
(b) (ii)	<u>Air resistance</u> will be acting (slowing down the car) (hence) <u>reducing the KE of the car</u> (WTTE) The <u>discs are hotter</u> than the surroundings (hence) <u>energy/heat</u> will be lost from <u>discs/brakes</u> (WTTE)	M1 A1 B1 B1	Do not allow sound since only a tiny proportion of energy is lost in this way. Allow other valid comments as alternative ways of scoring one or both of the 'B' marks: e.g. 'hot spots' on discs; discs are different. Try to credit a well argued case based upon correct physics- e.g. wheels locking.
(b) (iii)	Any valid suggestion: e.g. use a material with a higher s.h.c use a disc with a higher heat capacity Use discs of greater mass put holes in the discs (to increase air flow)	 B1	Confusion between shc and heat capacity should not be penalised.
	Total	11	

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

OCR Customer Contact Centre

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Facsimile: 01223 552627
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