

Markscheme

May 2018

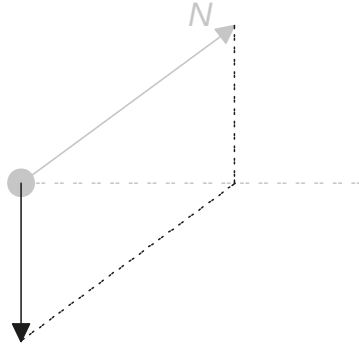
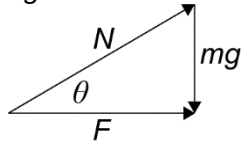
Physics

Standard level

Paper 2

8 pages

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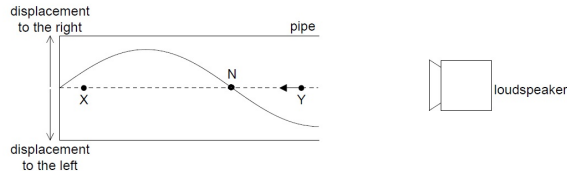
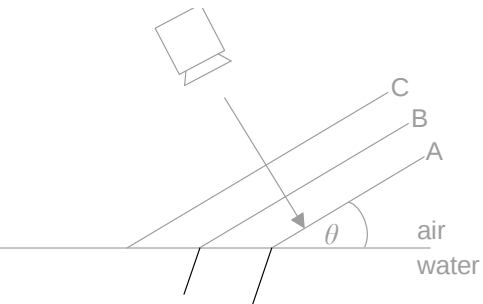
Question			Answers	Notes	Total
1.	a	i	towards the centre «of the circle» / horizontally to the right ✓	<i>Do not accept towards the centre of the bowl</i>	1
1.	a	ii	downward vertical arrow of any length ✓ arrow of correct length ✓	<i>Judge the length of the vertical arrow by eye. The construction lines are not required. A label is not required</i> eg: 	2
1.	a	iii	ALTERNATIVE 1 $F = N \cos \theta$ ✓ $mg = N \sin \theta$ ✓ dividing/substituting to get result ✓ ALTERNATIVE 2 right angle triangle drawn with F , N and W/mg labelled ✓ angle correctly labelled and arrows on forces in correct directions ✓ correct use of trigonometry leading to the required relationship ✓	eg:  $\tan \theta = \frac{O}{A} = \frac{mg}{F}$ $F = \frac{mg}{\tan \theta}$	3

(continued...)

(Question 1 continued)

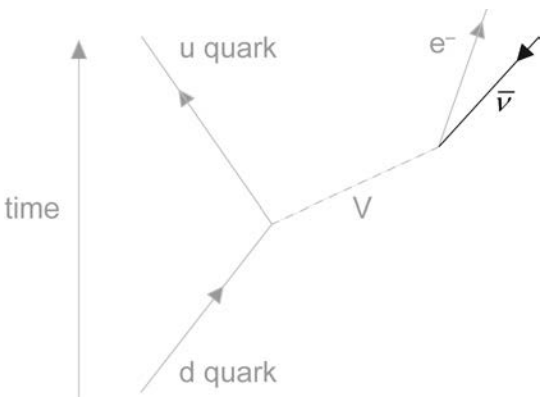
1.	b	$\frac{mg}{\tan \theta} = m \frac{v^2}{r} \checkmark$ $r = R \cos \theta \checkmark$ $v = \sqrt{\frac{gR \cos^2 \theta}{\sin \theta}} / \sqrt{\frac{gR \cos \theta}{\tan \theta}} / \sqrt{\frac{9.81 \times 8.0 \cos 22}{\tan 22}} \checkmark$ $v = 13.4 / 13 \text{ «ms}^{-1}\text{»} \checkmark$	Award [4] for a bald correct answer Award [3] for an answer of 13.9/14 «ms⁻¹». MP2 omitted	4
1.	c	there is no force to balance the weight/N is horizontal $\checkmark$ so no / it is not possible $\checkmark$	Must see correct justification to award MP2	2
1.	d	speed before collision $v = \sqrt{2gR} = 12.5 \text{ «ms}^{-1}\text{»} \checkmark$ «from conservation of momentum» common speed after collision is $\frac{1}{2}$ initial speed «$v_c = \frac{12.5}{2} = 6.25 \text{ ms}^{-1}$» $\checkmark$ $h = \frac{v_c^2}{2g} = \frac{6.25^2}{2 \times 9.81} = 2.0 \text{ «m»} \checkmark$	Allow 12.5 from incorrect use of kinematics equations Award [3] for a bald correct answer Award [0] for $mg(8) = 2mgh$ leading to $h = 4 \text{ m}$ if done in one step. Allow ECF from MP1 Allow ECF from MP2	3

Question			Answers	Notes	Total
2.	a	i	a gas in which there are no intermolecular forces OR a gas that obeys the ideal gas law/all gas laws at all pressures, volumes and temperatures OR molecules have zero PE/only KE ✓	Accept atoms/particles.	1
2.	a	ii	$N = \left\langle \frac{pV}{kT} = \frac{5.3 \times 10^5 \times 2.1 \times 10^{-4}}{1.38 \times 10^{-23} \times 310} \right\rangle 2.6 \times 10^{22} \checkmark$		1
2.	a	iii	«For one atom $U = \frac{3}{2} kT$» $\frac{3}{2}$ è $1.38 \times 10^{-23} \times 310 / 6.4 \times 10^{-21}$ «J» ✓ $U = \left\langle 2.6 \times 10^{22} \times \frac{3}{2} \times 1.38 \times 10^{-23} \times 310 \right\rangle 170$ «J» ✓	Allow ECF from (a)(ii) Award [2] for a bald correct answer Allow use of $U = \frac{3}{2} pV$	2
2.	b	i	$p_2 = \left\langle 5.3 \times 10^5 \times \frac{2.1 \times 10^{-4}}{6.8 \times 10^{-4}} \right\rangle 1.6 \times 10^5$ «Pa» ✓		1
2.	b	ii	«volume has increased and» average velocity/KE remains unchanged ✓ «so» molecules collide with the walls less frequently/longer time between collisions with the walls ✓ «hence» rate of change of momentum at wall has decreased ✓ «and so pressure has decreased»	The idea of average must be included Decrease in number of collisions is not sufficient for MP2. Time must be included. Accept atoms/particles.	2 max

3.	a	i	the incident wave «from the speaker» and the reflected wave «from the closed end» superpose/combine/interfere ✓	Allow superimpose/add up Do not allow meet/interact	1
3.	a	ii	Horizontal arrow from X to the right ✓	MP2 is dependent on MP1 Ignore length of arrow	1
3.	a	iii	P at a node ✓		1
3.	a	iv	wavelength is $\lambda = \frac{4 \times 0.30}{3} = 0.40 \text{ «m»}$ ✓ $f = \frac{340}{0.40} = 850 \text{ «Hz»}$ ✓	Award [2] for a bald correct answer Allow ECF from MP1	2
3.	b	i	$\frac{\sin \theta_c}{340} = \frac{1}{1500}$ ✓ $\theta_c = 13 \text{ «°»}$ ✓	Award [2] for a bald correct answer Award [2] for a bald answer of 13.1 Answer must be to 2/3 significant figures to award MP2 Allow 0.23 radians	2
3.	b	ii	correct orientation ✓ greater separation ✓	Do not penalize the lengths of A and B in the water Do not penalize a wavefront for C if it is consistent with A and B MP1 must be awarded for MP2 to be awarded eg: 	2

Question			Answers	Notes	Total
4.	a		the work done per unit charge ✓ in moving charge from one terminal of a cell to the other / all the way round the circuit ✓	Award [1] for “energy per unit charge provided by the cell”/“power per unit current” Award [1] for “potential difference across the terminals of the cell when no current is flowing” Do not accept “potential difference across terminals of cell”	2
4.	b	i	the resistance is proportional to length / see 0.35 AND 1«.00»✓ so it equals 0.35×80 ✓ « = 28 Ω »		2
4.	b	ii	current leaving 12 V cell is $\frac{12}{80} = 0.15$ « A » OR $E = \frac{12}{80} \times 28$ ✓ $E = \text{«} 0.15 \times 28 = \text{» } 4.2$ « V » ✓	Award [2] for a bald correct answer Allow a 1sf answer of 4 if it comes from a calculation. Do not allow a bald answer of 4 «V» Allow ECF from incorrect current	2

Question			Answers	Notes	Total
5.	a	i	Average height = 127 «m» ✓ Specific energy «$= \frac{mgh}{m} = gh = 9.81 \times 127 = 1.2 \times 10^3 \text{ J kg}^{-1}$» ✓	<i>Unit is essential</i> <i>Allow $g = 10$ gives $1.3 \times 10^3 \text{ J kg}^{-1}$</i> <i>Allow ECF from 110m ($1.1 \times 10^3 \text{ J kg}^{-1}$) or 144m ($1.4 \times 10^3 \text{ J kg}^{-1}$)</i>	2
5.	a	ii	mass per second leaving dam is $\frac{1.2 \times 10^5}{60} \times 10^3 = 2.0 \times 10^6 \text{ kg s}^{-1}$ ✓ rate of decrease of GPE is $= 2.0 \times 10^6 \times 9.81 \times 127$ ✓ $= 2.49 \times 10^9 \text{ «W»} / 2.49 \text{ «GW»}$ ✓	<i>Do not award ECF for the use of 110m or 144m</i> <i>Allow 2.4 GW if rounded value used from (a)(i) or 2.6 GW if $g = 10$ is used</i>	3
5.	a	iii	efficiency is «$\frac{1.8}{2.5} =$» 0.72 / 72% ✓		
5.	b		water is pumped back up at times when the demand for/price of electricity is low ✓		1

6.	a		«most of» the mass of the atom is confined within a very small volume/nucleus ✓ «all» the positive charge is confined within a very small volume/nucleus ✓ electrons orbit the nucleus «in circular orbits» ✓		2 max
6.	b	i	the energy needed to separate the nucleons of a nucleus OR energy released when a nucleus is formed from its nucleons ✓	Allow neutrons AND protons for nucleons Don't allow constituent parts	1
6.	b	ii	$Q = 106 \times 8.550 - 106 \times 8.521 = 3.07$ «MeV» ✓ «$Q \approx 3$ MeV»		1
6.	c	i	line <u>with arrow</u> as shown labelled anti-neutrino/$\bar{\nu}$ ✓	Correct direction of the “arrow” is essential The line drawn must be “upwards” from the vertex in the time direction i.e. above the horizontal eg: 	1
6.	c	ii	$V = W^-$ ✓		1