Rewarding Learning

ADVANCED SUBSIDIARY
General Certificate of Education
2011

Physics

Assessment Unit A2 1

assessing

Momentum, Thermal Physics, Circular Motion, Oscillations and Atomic and Nuclear Physics

[AY211]

TUESDAY 24 MAY, MORNING

MARK SCHEME

			AVAILABLE MARKS
1	**(a)**	The total momentum of particles before a collision is equal to the total momentum after the collision [1] provided no external forces act (or in a closed system) [1] [2]	
	(b)	**(i)** Total mtm before collision $= 0.8 \times 0.4 - 0.3 \times 0.6 = 0.14$ N s [1] (After collision $= 0.14 = 1.4 \times$ combined velocity) Combined velocity $= 0.1$ (m s^{-1}) [1] To the right [1] [3] **(ii)** inelastic [1] because KE not conserved [1] [2]	7
2	**(a)**	**(i)** at constant temperature [1] a fixed mass of gas [1] [2] **(ii)** • Diagram (generous) • Measure/record l or v and p • Repeat at new p • Allow temp to return or detail on l and v • Plot p against 1/l or equivalent • Expect straight line through origin [6] **Quality of written communication** **2 marks** The candidate expresses ideas clearly and fluently, through well-linked sentences and paragraphs. Arguments are generally relevant and well structured. There are few errors of grammar, punctuation and spelling. **1 mark** The candidate expresses ideas clearly, if not always fluently, Arguments may sometimes stray from the point. There are some errors in grammar, punctuation and spelling, but not such as to suggest a weakness in these areas. **0 marks** The candidate expresses ideas satisfactorily, but without precision. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling are sufficiently intrusive to disrupt the understanding of the passage. [2]	
	(b)	$T_2 = T_1 \times p_2/p_1 = 288 \times 310/280$ subs [1] $= 318.8$ K $= 45.9$ (°C) [1] [2] S.E. 16.6 °C → [0]/[2]	12

						AVAILABLE MARKS
3	(a)	(i)	$\omega = 2 \times \pi/T = 2 \times \pi/24 \times 3600$ Eqn + subs	[1]		
			$= 7.27 \times 10^{-5}$ (rad s^{-1})	[1]	[2]	
		(ii)	$v = r\,\omega = 6.38 \times 10^{6} \times 7.27 \times 10^{-5}$ Eqn + subs e.c.f	[1]		
			$= 464$ (m s^{-1})	[1]	[2]	
		(iii)	$F = mv^2/r = 74.2 \times 464^2/6.38 \times 10^{6}$ Eqn + subs e.c.f	[1]		
			$= 2.50$ (N)	[1]	[2]	
	(b)		(728 − 2.5 = 724.5 N) less than	[1]		
			Some of the gravitational pull is "used up" providing the centripetal force	[1]	[2]	8
			"Same" or "More than" → [0]/[2]			
4	(a)	(i)	Negative sine wave	[1]		
		(ii)	Phase difference = $\pi/2$ (rad) or 90°	[1]	[2]	
	(b)	(i)	No energy transferred to or from the system	[1]		
		(ii)	Forced to oscillate at the frequency of an external oscillator (giving it energy)	[1]	[2]	
	(c)	(i)	Driving frequency equals the natural frequency		[1]	
		(ii)	e.g. opera singer + wine glass, damped by filling glass with wine Example [1] Method of damping [1]		[2]	
		(iii)	Correct curve B inside curve A with peak lower [1] broader [1] to left of A's [1] No labels – lose 1st mark		[3]	10

					AVAILABLE MARKS
5	**(a)**	• Most alpha particles pass through without deflection hence nucleus very small or few particles back scattered hence nucleus very small [1] • back scattering implies nucleus has positive charge as alphas are positive [1]		[2]	
	(b)	**(i)** mass number		[1]	
		(ii) 3 protons and 4 neutrons [1] 3 electrons [1]		[2]	
		(iii) radius $= 1.2 \times 10^{-15} \times 7^{1/3}$ subs [1] $= 2.30 \times 10^{-15}$ (m) [1] N.B. 2.30 → [0]/[2] otherwise apply 10^n error		[2]	
		(iv) mass in kg $= 1.66 \times 10^{-27} \times 7.014$ [1] volume $= 4 \times \pi \times (2.30 \times 10^{-15})^3/3$ e.c.f. [1] density $= m/v = 2.30 \times 10^{17}$ (kg m^{-3}) [1]		[3]	10
6	**(a)**	Take count rate, measure background count-rate [1] every e.g. minute [1]		[2]	
		either plot (corrected) count rate against time and find the time it takes the count rate to halve and repeat and average		[3]	
		or plot log (corrected) count rate against time and (– gradient) $= \lambda$ $t_{\frac{1}{2}} = 0.693/\lambda$ use of equation appreciated [3] Safety: Shielding, distance, duration (any one) [1]		[6]	
	(b)	$\lambda = 0.693/t_{\frac{1}{2}} = 0.693/(5.26 \times 365 \times 24 \times 3600)$ [1] $= 4.18 \times 10^{-9}$ (s^{-1}) **or** 0.132 (yr^{-1}) [1] N = rate of decay/λ $8.72 \times 10^5/4.178 \times 10^{-9} = 2.078 \times 10^{14}$ atoms [1] Mass $= 2.08 \times 10^{-11}$ (kg) [1] SE: 6.59×10^{-11} kg → [2]/[4]		[4]	10
7	**(a)**	Energy supplied, $E = VIt$ Eqn [1] $= 4.2 \times 0.7 \times 90 \times 60 = 15\,880$ J [1] $\Delta m = E/c^2 = 15880/9 \times 10^{16} = 1.76 \times 10^{-13}$ (kg) [1]		[3]	
	(b)	**(i)** Mass defect $= 0.1873$ u [1] $= 3.11 \times 10^{-28}$ kg [1] $= 2.798 \times 10^{-11}$ (J) [1]		[3]	
		(ii) Number of moles $= 1.00/0.235 = 4.2$ [1] Number of atoms $= 4.26 \times 6.02 \times 10^{23}$ $= 2.56 \times 10^{24}$ atoms [1] Energy released $= 2.80 \times 10^{-11} \times 2.56 \times 10^{24}$ $= 7.18 \times 10^{13}$ (J) e.c.f. **(i)** [1]		[3]	9

AVAILABLE MARKS

8 (a) (i) $^{2}_{1}D + {}^{3}_{1}T \longrightarrow {}^{4}_{2}He + {}^{1}_{0}n$ (+ energy) [1]

(ii) Tritium generated when lithium absorbs neutrons
deuterium and lithium readily available
one stage reaction
large yield per fusion
fusion temperature is relatively low
no long lived radioactive waste
2 × [1] [2]

(b) (i) (Charged) plasma particles [1]
circulate in helical paths [1]
produced by field coils [1]
transformer heating action [3]

(ii) Difficult to achieve high temperatures [1]
for sufficient time [1] [2]

8

9 (a) (i)

Frequency/Hz	Tension/N	$(\frac{T}{\mu})$/N m kg^{-1}	Log (f/Hz)	Log $[(\frac{T}{\mu})$/N m kg$^{-1}]$
178	15	45455	2.250	4.658
229	25	75758	2.361	4.879
271	35	106061	2.433	5.026
308	45	136364	2.488	5.135
340	55	166667	2.532	5.222
370	65	196970	2.568	5.294

Tabulated values of T/μ, log f, log T/μ (ignore sf) [3]
Penalty [−1] each mistake or omission to [−3] maximum

(ii) Labelled axes [1]
Suitable scales [1]
5 correctly plotted points [2]
Best straight line [1] [5]

(iii) Evidence of large triangle [1]
Their correct values of Δ(log f) and Δ (log (T/μ)) [1]
n = 0.50(8) ±0.10 [1] [3]

(iv) $\pi r^2 \times \rho = \pi r^2 \times$ mass/($\pi r^2 \times$ length) = mass/length = μ [1]

(v) $\pi r^2 \times \rho = 3.3 \times 10^{-4} = \pi r^2 \times 7700$
$r^2 = 3.3 \times 10^{-4}/(\pi \times 7700)$ [1]
$r = 1.17 \times 10^{-4}$ (m) [1] [2]

(b) transverse and standing
longitudinal and progressive
[$\frac{1}{2}$] each and round down [2]

16

Total **90**