OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

PHYSICS B (ADVANCING PHYSICS) G494 MS

Unit G494: Rise and Fall of the Clockwork Universe

Specimen Mark Scheme

The maximum mark for this paper is **60**.

This document consists of **4** printed pages and **4** blank pages.

Section A		
Question Number	**Answer**	**Max Mark**
1(a)	B ✓	**[1]**
(b)	A ✓	**[1]**
2(a)	A ✓	**[1]**
(b)	B ✓	**[1]**
3	A ✓	**[1]**
4	✓method: V = 2 x 8.3 x 310/1.5 x 10^5 ✓evaluation: = 3/2 x 10^{-2} m^3	**[2]**
5(a)	A ✓	**[1]**
(b)	C ✓	**[1]**
6	Calculation of rate of change = 2.7 x 7.3 = 19.7 kg m s^{-1} ✓ Force on clown is rate of change of momentum ✓ Clear Newton III/ conversation of momentum argument ✓	**[3]**
7(a)	First line of table: 2.4 x 10^{-3}, 4.8 x 10^{-3} ✓ 2nd line of table: 2.2 x 10^{-3}, 4.4 x 10^{-3}, 4.7 x 10^{-2} ✓	**[2]**
(b)	Any sensible point ✓: e.g. to test theories against real situations, to predict outcomes when experimental evidence is not available.	**[1]**
	Total Section A	**[15]**
8(a)	Straight line ✓ Through origin ✓	**[2]**
(b)	$M_p (2\pi)^2/T^2 R = GM_PM_s/R^2$ worked through to $T^2/R^3 = (2\pi)^2/ GM_s$ ✓ rearrangement to find M_s ✓ Substitution of correct values M_s ✓ Calculation to give M_s ✓ ecf possible $M_s = 4\pi^2(1.5 \times 10^{11})^3/ (6.67 \times 10^{-11} \times (3.2 \times 10^7)^2) = 1.8 \times 10^{30}$ kg	**[4]**
(d)	Kepler's (3^{rd}) Law was empirical/ Newton's (gravitational) was analytical✓ Kepler's law was limited to orbits / Newton's is applicable to wider applications e.g. tides, space flight✓ Any one point. Must be comparison between K's approach and N's approach for the mark	**[1]**
	Total	**[10]**
9(a)	Calculating energy as 108 kJ (can be implicit) ✓ Temp change calculated to 65 K ✓	**[2]**
(b)	BF gives proportion of particles with sufficient energy to join vapour/ probability of a particle having sufficient energy. ✓ As T increases –E/kT becomes smaller therefore BF increases ✓ Therefore greater chance/proportion of molecules entering vapour state ✓ QWC: appropriate form and style ✓	**[4]**
(c)	Pressure exerted by molecular collisions, force given by $\Delta p/\Delta t$. ✓ Pressure given by F/A ✓ Increase in number of molecules increases $\Delta p/\Delta t$. ✓ Increase in temperature increases $\Delta p/\Delta t$. ✓	**[4]**

Section A		
Question Number	**Answer**	**Max Mark**
	QWC: Clear organised answer ✓ There will be a number of paths to mark-worthy points. High quality answers needed for award of marks.	
	Total	**[10]**
10(a)(i)	Period = 1/2500 = 4 x 10^{-4} s ✓	**[1]**
(ii)	Period ✓ amplitude ✓ sinusoidal shape ✓	**[3]**
(iii)	a = 4 π^2 x 1 x10^{-7} ✓ = 24.7 m s^{-2} ✓	**[2]**
(iv)	Mark on crest or trough ✓	**[1]**
(b)	driving frequency matches natural frequency of oscillator ✓ amplitude of oscillations at resonance will be greater for a specific amplitude of driving wave. ✓ Suggested circumstances should consider and justify variations in the auditory canal e.g. longer a.c. gives lower resonant frequency or changes in speed of sound (due to density of medium) in e.g. less dense air, water Stated and justified difference in a.c. / medium ✓ Consisten explanation of consequence ✓ Clear understanding must be displayed. QWC: clear organisation✓	**[5]**
	Total	**[12]**
11(a)	Calculating λ =4.8 x 10^{-18} ✓ Half life = 0.693/ = 1.44 x 10^{17} s ✓ = 4.5 billion years ✓ Allow implicit working	**[3]**
(b)	Stating 5.6 is a little more than a half life✓ Initial number is a bit more than double 10 (accept 21 to 25) ✓ Reason why estimate is the best that can be done: Radioactive decay is random ✓ Need large numbers in random processes for predictable results✓.	**[4]**
(c)	0.12 = $e^{-\lambda t}$ → ln 0.12 = -4.8 x 10^{-18} t = 1.4 x 10^{10} years ✓method ✓evaluation Allow ecf for evaluation mark 1 mark for time in seconds	**[2]**
(d)	Lengthening of wavelength with expansion of space✓ Allow energy arguments.	**[1]**
(e)(i)	Min = 9.8 x 10^9 yr✓ max = 1.9 x 10^{10} yr ✓ Allow values in seconds	**[2]**
(ii)	Shows younger age is not correct ✓	**[1]**
	Total	**[13]**
	Section B Total	**[45]**
	Paper Total	**[60]**