

A Level Physics A
H556/01 Modelling physics

Question Set 11

- 1 (a) Write an expression for the gravitational potential V_g at the surface of a planet of mass M and radius r . $V_g = -\frac{GM}{r}$ [1]

(b) The table below shows some data for Mercury and Pluto.

	Mass/kg	Radius/m	Mean distance from Sun/m
Mercury	3.30×10^{23}	2.44×10^6	57.9×10^9
Pluto	0.131×10^{23}	1.19×10^6	5910×10^9

- (i) Show that the escape velocity v of a gas molecule on the surface of Pluto is given by the equation

$$v = \sqrt{\frac{2GM}{r}} \quad \text{Loss in KE} = \text{Gain in GPE}$$

$$\frac{1}{2} m v^2 = \frac{GMm}{r}$$

where M is the mass of Pluto and r is its radius.

$$v^2 = \frac{2GM}{r} \rightarrow v = \sqrt{\frac{2GM}{r}} \quad [2]$$

- (ii) Calculate the escape velocity v of gas molecules on the surface of Pluto.

$$v = \sqrt{\frac{2 \times 6.67 \times 10^{-11} \times 0.131 \times 10^{23}}{1.19 \times 10^6}} = 12.12 \quad v = \dots\dots\dots 12.10 \dots\dots\dots \text{ms}^{-1} \quad [1]$$

- (iii) Explain why Mercury has no atmosphere whilst Pluto still has a thin atmosphere. Use data from the table to support your explanation. [3]

- Mercury does have a higher escape velocity than Pluto

- However, since Mercury is close to the Sun and is much hotter than Pluto, molecules in its atmosphere are much more likely to have a speed higher than the escape velocity.

Total Marks for Question Set 11: 7

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