1 Fig. 3.1 represents the planet Jupiter. The centre of the planet is labelled as **O**.

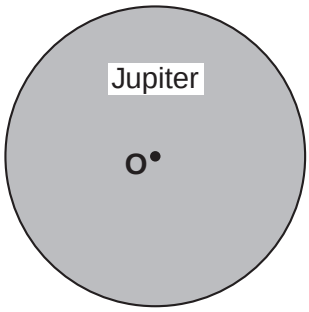

Fig. 3.1

(a) Draw gravitational field lines on Fig. 3.1 to represent Jupiter's gravitational field. **[2]**

(b) Jupiter has a radius of 7.14×10^{7} m and the gravitational field strength at its surface is $24.9\,\text{N kg}^{-1}$.

(i) Show that the mass of Jupiter is about 2×10^{27} kg.

[3]

(ii) Calculate the average density of Jupiter.

density = ... kg m^{-3} **[2]**

[Total: 7]

2 **(a)** The molar mass of hydrogen gas is $2.02 \times 10^{-3}\,\text{kg mol}^{-1}$. Calculate the mass of a hydrogen molecule.

mass = ... kg **[2]**

(b) The temperature of the Earth's upper atmosphere is about 1100 K. Show that at this temperature the mean kinetic energy of an air molecule is about 2×10^{-20} J.

[2]

(c) Show that the speed of a helium atom of mass 6.6×10^{-27} kg at a temperature of 1100 K is about $2.5\,\text{km s}^{-1}$.

[2]

(d) The *escape velocity* from the Earth is $11\,\text{km s}^{-1}$. The escape velocity is the minimum vertical velocity a particle must have in order to escape from the Earth's gravitational field. Explain why helium atoms still escape from the Earth's atmosphere.

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..... **[2]**

[Total: 8]