

- 3 (a) State what is meant by a *gravitational field*.

.....

.....

..... [2]

- (b) The Sun is one star in the Milky Way galaxy and is a distance r of 2.4×10^{20} m from its centre.

The Sun travels around the centre of the galaxy in a circular orbit at a linear speed v of 230 km s^{-1} .

Assume that the effective mass M of the galaxy is a point mass at its centre.

- (i) Show that the speed v of the Sun in its orbit is given by the expression

$$v = \sqrt{\frac{GM}{r}}$$

where G is the gravitational constant.

Explain your working.

[2]

- (ii) The mass of the Sun is 2.0×10^{30} kg.

Calculate the ratio

$$\frac{\text{effective mass } M \text{ at centre of galaxy}}{\text{mass of Sun}}$$

ratio = [3]

