2 The Sun may be considered as a uniform sphere with a mass of 1.99×10^{30} kg and a surface temperature of 5780 K.

A probe with a mass of 2.63 kg moves in a straight line towards the Sun.
When it is at a distance x from the centre of the Sun, the probe measures the gravitational field strength g due to the Sun and the radiant flux intensity F of radiation from the Sun.

(a) Define gravitational field.

.....

..... [1]

(b) For the position of the probe where $x = 1.47 \times 10^{11}$ m:

(i) calculate g

$g =$ ..... N kg^{-1} [2]

(ii) determine the gravitational potential energy E_P of the probe.

$E_P =$ ..... J [2]

(c) **(i)** Show that, for any particular value of x, the numerical values of g and F are related by

$$g = \frac{4\pi GM}{L} F$$

where M is the mass of the Sun, L is the luminosity of the Sun and G is the gravitational constant.

[3]

(ii) Fig. 2.1 shows the variation of g with F.

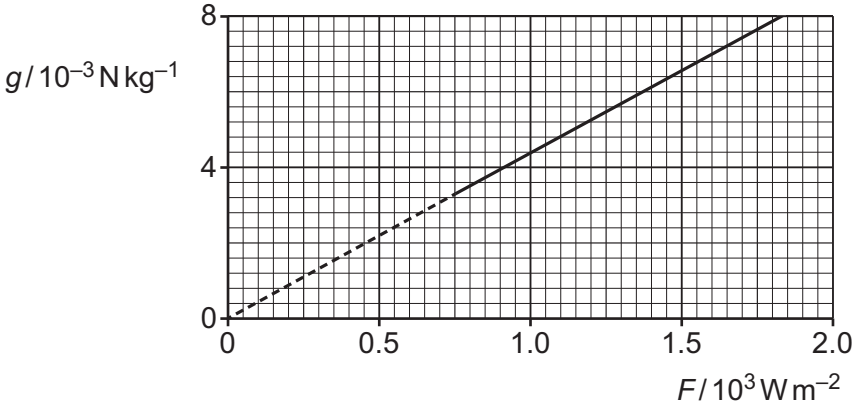

Fig. 2.1

Determine a value for the luminosity L of the Sun. Give a unit with your answer.

L = ... unit ..... [2]

(iii) Use your answer in **(c)(ii)** to determine the radius r of the Sun.

r = ... m [2]

[Total: 12]