2 **(a)** Fig. 2.1 also shows two equipotential lines around Star X.

The gravitational potentials at points Q and R are -3.0×10^{12} J kg^{-1} and -1.0×10^{12} J kg^{-1} respectively.

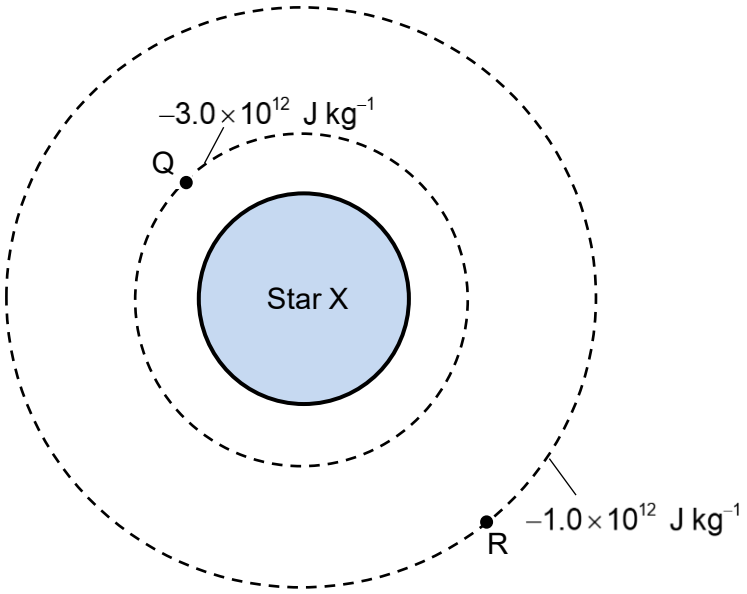

Fig. 2.1

(i) Explain why the gravitational potential at a point is always negative.

.....

.....

.....

.....

..... [2]

(ii) The gravitational potential at point Q which is 0.98×10^{7} km from the centre of Star X is -3.0×10^{12} J kg^{-1}.

What is meant by the above statement?

.....

.....

..... [1]

.....

(iii) Calculate the distance from the centre of star X to point R.

distance = ... km [2]

(iv) Calculate the work done by an external force in bringing a body of mass 1200 kg from points R to Q.

work done = ... J [2]

(b) Star Y forms part of a binary star system with Star Z. Both stars orbit about a common centre C as shown in Fig. 2.2.

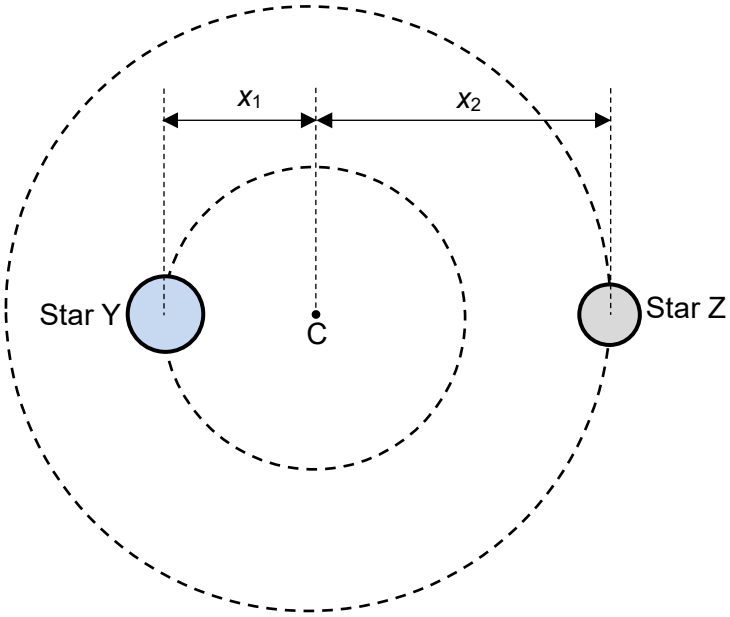

Fig. 2.2

The following data are given:

mass of Star Y $= 2.62 \times 10^{30}$ kg
mass of Star Z $= 1.45 \times 10^{28}$ kg

(i) The orbital radii of Stars Y and Z are x_1 and x_2 respectively.

Determine the ratio $\frac{x_1}{x_2}$.

$\frac{x_1}{x_2}$ = ... [2]

(ii) Explain why both stars must rotate with the same angular velocity about C.

.....

.....

..... [1]