

**Question 17****(13 marks)**

One way of accelerating a spacecraft without using fuel is to 'slingshot' the craft around a planet. The Juno probe that entered Jupiter's atmosphere recently in 2016 used this method, travelling around Earth after the initial launch. The probe reached a maximum velocity of  $7.36 \times 10^4 \text{ m s}^{-1}$  as it went past the Earth at a height above the surface of 559 km.

- (a) Use appropriate formulae and calculations to show that the probe was able to move away from the Earth and not be captured in orbit around it. (6 marks)

- (b) The Juno probe was launched from Earth on 5 August 2011 and entered Jupiter's orbit on 5 July 2016, a trip of 1796 days. It had an average velocity of  $7.15 \times 10^4 \text{ m s}^{-1}$ . Assume there was no effect from gravitational fields.

- (i) Compared to a clock on Earth, would a clock on the Juno probe be reading faster or slower? (1 mark)

- A faster  
B slower

Your answer \_\_\_\_\_

- (ii) Calculate the time difference between the two clocks. (4 marks)

Answer \_\_\_\_\_ s

- (iii) Apart from gravitational effects, what **two** assumptions did you make in your calculations? (2 marks)

One: \_\_\_\_\_

\_\_\_\_\_

Two: \_\_\_\_\_

\_\_\_\_\_