15 In 2015 the Messenger spacecraft crashed into the surface of the planet Mercury after four years in orbit observing the surface of Mercury.

Messenger's orbit was highly elliptical, varying between 200 km and 15 000 km above the surface of Mercury. Messenger completed one full orbit every 12 hours.

mass of Messenger spacecraft = 565 kg
mass of planet Mercury = 3.30×10^{23} kg
radius of planet Mercury = 2430 km

(a) It has been suggested that the same orbital period of about 12 hours could have been achieved if Messenger was in a circular orbit 7690 km above the surface of Mercury.

(i) Determine whether this suggestion is correct.

(4)

(ii) The elliptical orbit chosen had advantages over this circular orbit.

Explain one advantage.

(2)

(b) Calculate the velocity an object would have as it reached the surface of Mercury if it was released from Messenger's maximum orbital height.
Assume the object is released from rest and that Mercury has no atmosphere.

(4)

Velocity = ...

(Total for Question 15 = 10 marks)