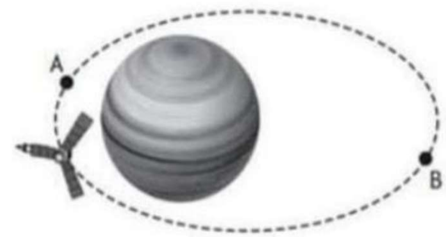
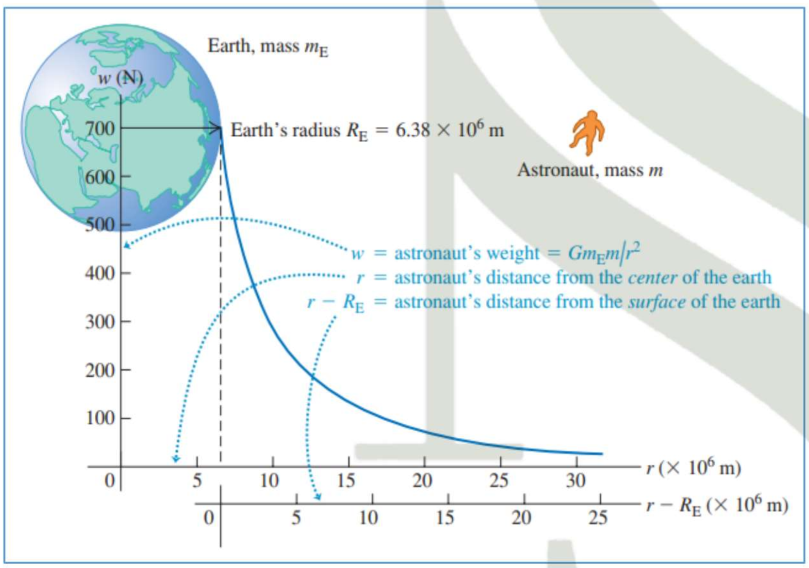
Exam Model Questions:

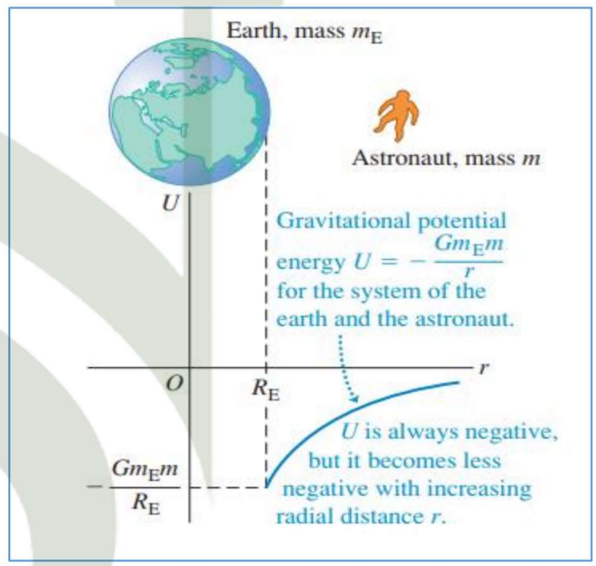
1. You wish to put a $1000\ kg$ satellite into a circular orbit $300\ km$ above the earth's surface.
   a. What speed, period and radial acceleration will it have?
   b. How much work must be done to the satellite to put it in orbit?
   c. How much additional work would have to be done to make the satellite escape the earth.

   The earth radius and mass are $R = 6.37\ X\ 10^6\ m\ and\ M = 5.97\ X\ 10^{24}\ kg.$

2. a. Juno is a NASA orbiter with a mission to survey Jupiter. It is in an elliptical orbit around Jupiter as shown in the figure below. The gravitational potential at point A in the orbit of Juno is $-1.70\ x\ 10^9\ Jkg^{-1}$
   i. State what is meant by a gravitational potential at point A is $-1.70\ x\ 10^9\ J\ kg^{-1}$.
   ii. At point B, Juno is $1.69\ x\ 10^8\ m$ from the centre of Jupiter. If the mass of Jupiter is $1.90\ X\ 10^{27} kg$, calculate the gravitational potential at point B.
   b. Draw graphs showing the variation of acceleration due to gravity with (i) height (ii) depth from the surface of the earth.







Orbits: When a satellite moves in a circular orbit, the centripetal acceleration is provided by the gravitational attraction of the earth. Kepler's three laws describe the more general case: an elliptical orbit of a planet around the sun or a satellite around a planet. (See Examples 13.6–13.9.)

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

(speed in circular orbit) (13.10)

$$T = \frac{2\pi r}{v} = 2\pi r\sqrt{\frac{r}{Gm_E}} = \frac{2\pi r^{3/2}}{\sqrt{Gm_E}}$$

(period in circular orbit) (13.12)