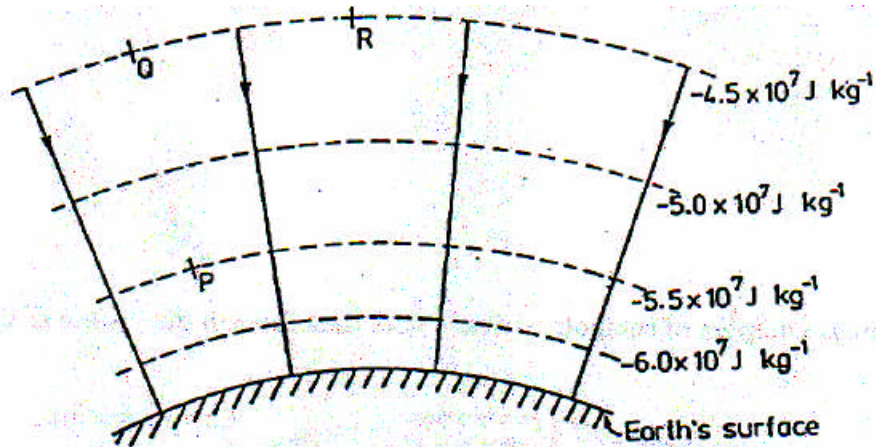


Chapter 11
Short answer question

The diagram below shows a section through part of the Earth's gravitational field. The broken lines, representing equipotentials, drawn at intervals of $0.5 \times 10^7 \text{ J kg}^{-1}$ are perpendicular to the field lines. The gravitational potential, relative to a zero value at infinity, is shown at each of the broken lines.



(a) State why:

1. The potential at Q is greater than at P.
- But
2. The potential at Q is still negative.

1. More work is done on 1kg moving it from the surface of the Earth to Q than moving to P. Hence Q is at a larger potential.

2. Potential at infinity is defined to be zero, so in order to increase the potentials just become less negative.

(b) Calculate the change in gravitational potential energy of a spacecraft of mass 2000 kg when it moves from:

1. P to Q

$$\text{DGPE} = (-4.5 \times 10^7 - (-5.5 \times 10^7)) \times 2000$$

$$= 2 \times 10^{10} \text{ J}$$

2. Q to R

Since Q and R are on a line of equipotential there is no change in V_g . No work is done in moving from Q to R.

- (c) Explain why the spacing of the equipotentials is closer near the surface of the Earth than further above it.

Force is minus the potential gradient. As the force is changing more rapidly closer to the Earth, the potential must also be changing more rapidly.