Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Q1.

The gravitational field associated with a planet is radial, as shown in **Figure 1**, but near the surface it is effectively uniform, as shown in **Figure 2**.

Alongside each figure, sketch a graph to show how the gravitational potential V associated with the planet varies with distance r (measured outwards from the surface of the planet) in each of these cases.

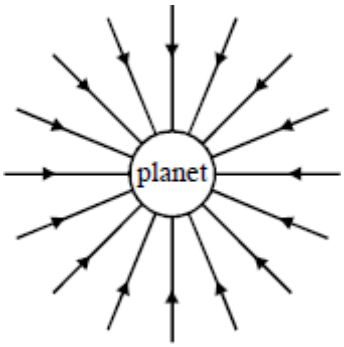


Figure 1

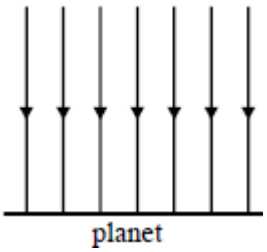


Figure 2

(Total 4 marks)

Q2.

When a deuterium nucleus and a tritium nucleus overcome their Coulomb barrier and fuse together they may be considered as charged spheres in contact. The constant r_o which relates the nuclear radius, R, to the cube root of the mass number A may be assumed to be 1.3 fm.

(a) (i) Calculate the radius of the deuterium nucleus and, R, the radius of the tritium nucleus before fusion.

R_D _____

R_T _____

(ii) Calculate the minimum energy, in MeV, which must be supplied to the deuterium nucleus and the tritium nucleus when they fuse together.

(5)

(b) Estimate the temperature at which deuterium and tritium nuclei would have enough kinetic energy to undergo fusion.

(3)

(Total 8 marks)

Q3.

(a) (i) Explain what is meant by the *gravitational field strength* at a point in a gravitational field.

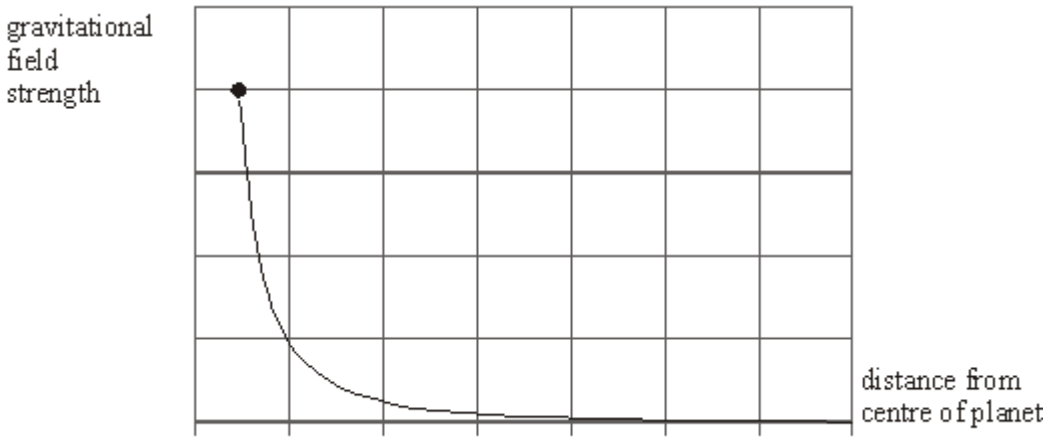
(ii) State the SI unit of gravitational field strength.

(2)

(b) Planet **P** has mass *M* and radius *R*. Planet **Q** has a radius 3*R*. The values of the gravitational field strengths at the surfaces of **P** and **Q** are the same.

(i) Determine the mass of **Q** in terms of *M.*

(ii) The figure below shows how the gravitational field strength above the surface of planet **P** varies with distance from its centre. Draw on the diagram the variation of the gravitational field strength above the surface of **Q** over the range shown.



(6)

(Total 8 marks)