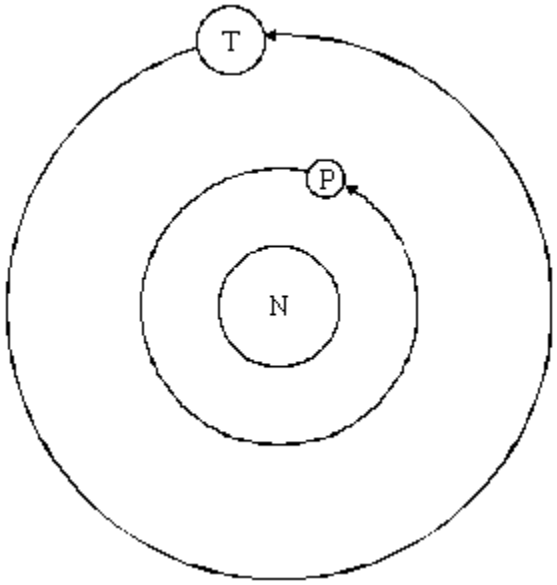
**Name of the Student**:_____
**Max. Marks : 22 Marks** **Time : 22 Minutes**

## Q1.

The diagram below (not to scale) shows the planet Neptune (N) with its two largest moons, Triton (**T**) and Proteus (**P**). Triton has an orbital radius of $3.55 \times 10^8$ m and that of Proteus is $1.18 \times 10^8$ m. The orbits are assumed to be circular.




(a) Explain why the velocity of each moon varies whilst its orbital speed remains constant.

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**(1)**

(b) Write down an equation that shows how Neptune's gravitational attraction provides the centripetal force required to hold Triton in its orbit. Hence show that it is unnecessary to know the mass of Triton in order to find its angular speed.

**(3)**

(c) Show that $\frac{\text{the orbital period of Triton}}{\text{the orbital period of Proteus}}$ is approximately 5.2.

**(4)**
**(Total 8 marks)**

## Q2.

(a) (i) Explain what is meant by *gravitational field strength*.

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**(1)**

(ii) Describe how you would measure the gravitational field strength close to the surface of the Earth. Draw a diagram of the apparatus that you would use.

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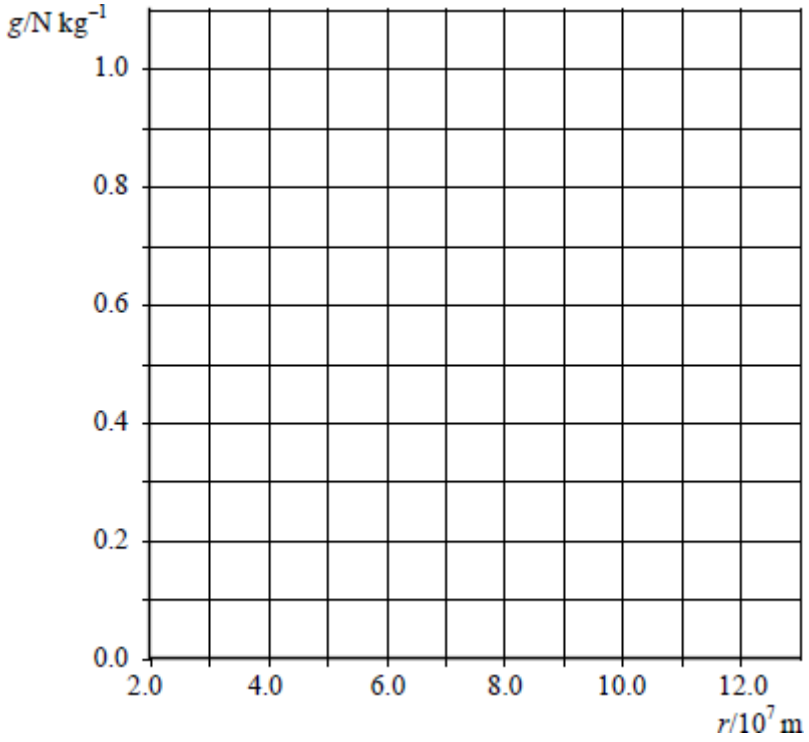
**(6)**

(b) (i) The Earth's gravitational field strength ($g$) at a distance ($r$) of $2.0 \times 10^7$ m from its centre is 1.0 N kg$^{-1}$. Complete the table with the 3 further values of $g$.

| $g$/N kg$^{-1}$ | 1.0 | | | |
|---|---|---|---|---|
| $r/10^7$ m | 2.0 | 4.0 | 6.0 | 8.0 |

**(2)**

(ii) Below is a grid marked with $g$ and $r$ values on its axes. Draw a graph showing the variation of $g$ with $r$ for values of $r$ between $2.0 \times 10^7$ m and $10.0 \times 10^7$ m.




**(2)**

(iii) Estimate the energy required to raise a satellite of mass 800 kg from an orbit of radius $4.0 \times 10^7$ m to one of radius $10.0 \times 10^7$ m.

**(3)**

**(Total 14 marks)**