Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

Q1.

(a) Define the electric field strength at a point in an electric field.

_____

_____

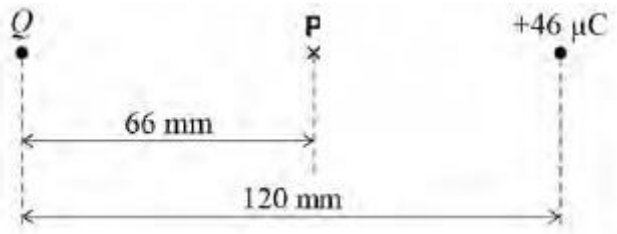
_____

_____

(2)

(b) **Figure 1** shows a point charge of +46 μC placed 120 mm from a point charge Q.

Figure 1



Position **P** is on the line joining the charges at a distance 66 mm from charge Q.
The resultant electric field strength at position **P** is zero.

Calculate the charge Q.

Q = _____ C

(3)

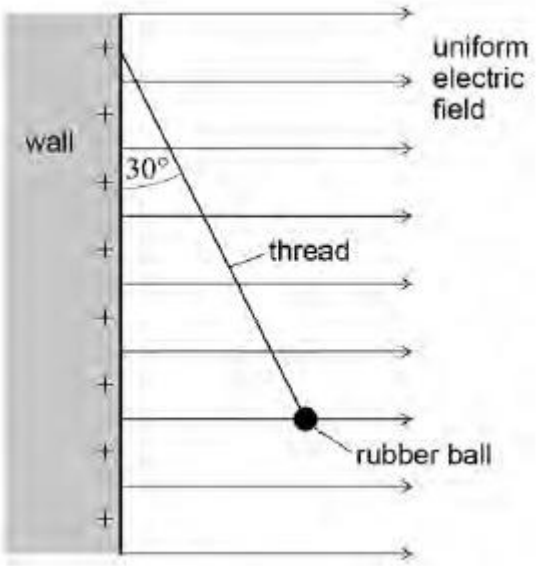
(c) Explain, without calculation, whether net work must be done in moving a proton from infinity to

position **P** in **Figure 1**.

(2)

(d) A small rubber ball coated with a conducting paint carries a positive charge.
The ball is suspended in equilibrium from a vertical wall by an uncharged non-conducting thread of negligible mass. The wall is positively charged and produces a horizontal uniform electric field perpendicular to the wall along the whole of its length.
Figure 2 shows that the thread makes an angle of 30° to the wall.

Figure 2



The thread breaks.

Explain the motion of the ball.

(2)

(Total 9 marks)

Q2.

(a) Derive an expression to show that for satellites in a circular orbit

$$T^2 \propto r^3$$

where T is the period of orbit and r is the radius of the orbit.

(2)

(b) Pluto is a dwarf planet. The mean orbital radius of Pluto around the Sun is 5.91×10^9 km compared to a mean orbital radius of 1.50×10^8 km for the Earth.

Calculate in years the orbital period of Pluto.

orbital period of Pluto = _____ yr

(2)

(c) A small mass released from rest just above the surface of Pluto has an acceleration of 0.617 m s^{-2}.

Assume Pluto has no atmosphere that could provide any resistance to motion.

Calculate the mass of Pluto.

Give your answer to an appropriate number of significant figures.

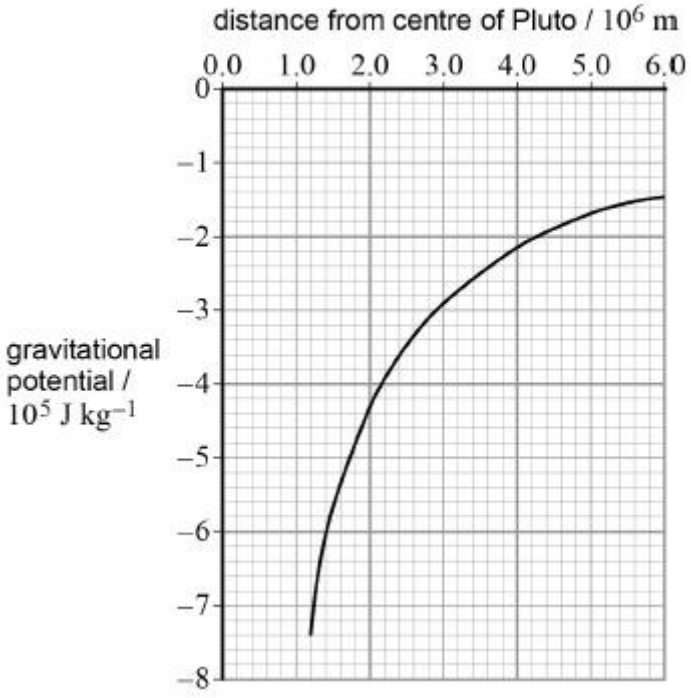
radius of Pluto = 1.19×10^6 m

mass of Pluto = _____ kg

(3)

(d) The graph shows the variation in gravitational potential with distance from the centre of Pluto

for points at and above its surface.



A meteorite hits Pluto and ejects a lump of ice from the surface that travels vertically at an initial speed of 1400 m s^{-1}.

Determine whether this lump of ice can escape from Pluto.

(3)
(Total 10 marks)