8 Worksheet

permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12}$ F m^{-1}
elementary charge $e = 1.6 \times 10^{-19}$ C

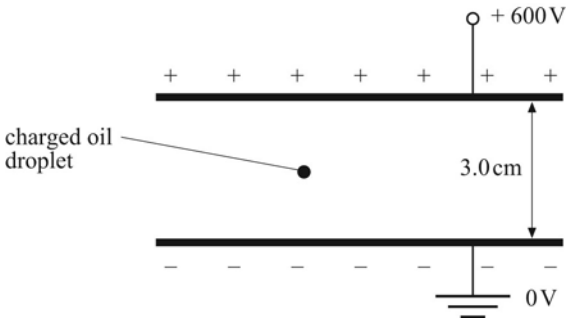
Intermediate level

1 State two possible SI units for electric field strength. [2]

2 A $+5.0 \times 10^{-8}$ C point charge experiences a force of 1.5×10^{-3} N when placed in a uniform electric field. Calculate the electric field strength. [2]

3 Calculate the force experienced by an oil droplet with a charge of 3.2×10^{-19} C due to a uniform electric field of strength 5.0×10^{5} V m^{-1}. [2]

4 The diagram shows two parallel, horizontal plates separated by a vertical distance of 3.0 cm. The potential difference between the plates is 600 V.



a Calculate the magnitude and direction of the electric field between the plates. [3]

b Describe the electric field between the plates. [2]

c An oil droplet of weight 6.4×10^{-15} N is held stationary between the two plates.

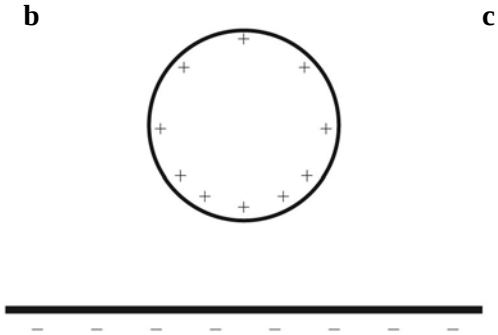
i State whether the charge on the droplet is positive or negative.
Explain your answer. [2]

ii Determine the charge on the oil droplet. [2]

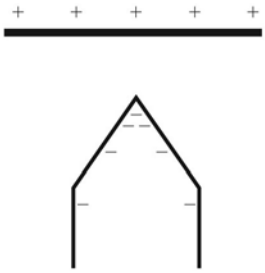
5 Draw the electric field patterns for the charged conductors shown. [6]

a

b



c



6 Calculate the electrical force between a proton and an electron separated by a distance of 5.0×10^{-11} m. [3]

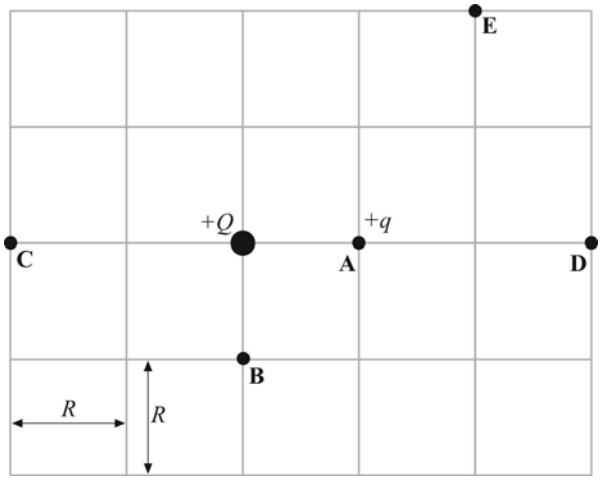
7 The electric field strength E at a distance r from a point charge Q may be written as:

$$E = k\frac{Q}{r^2}$$

What is the value for k? [2]

Higher level

8 The diagram shows a point charge $+q$ placed in the electric field of a charge $+Q$.



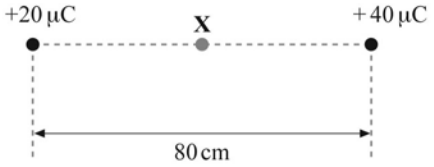
The force experienced by the charge $+q$ at point **A** is F. Calculate the magnitude of the force experienced by this charge when it is placed at points **B**, **C**, **D** and **E**. In each case, explain your answer. [9]

9 A spherical metal dome of radius 15 cm is electrically charged. It has a positive charge of +2.5 μC distributed uniformly on its surface.

a Calculate the electric field strength on the surface of the dome. [3]

b Explain how your answer to **a** would change at a distance of 30 cm from the surface of the dome. [2]

10 The diagram shows two point charges. The point **X** is midway between the charges.



a Calculate the electric field strength at point **X** due to:

i the + 20 μC charge [3]

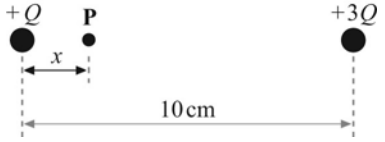
ii the + 40 μC charge. [2]

b Calculate the resultant electric field strength at point **X**. [2]

11 Describe some of the similarities and differences between the electrical force due to a point charge and the gravitational force due to a point mass. [6]

Extension

12 The diagram shows two point charges. Calculate the distance x of point **P** from charge $+Q$ where the net electric field strength is zero.



[6]

13 Show that the ratio:

$$\frac{\text{electrical force between two protons}}{\text{gravitational force between two protons}}$$

is about 10^{36} and is independent of the actual separation between the protons.
(Mass of a proton = 1.7×10^{-27} kg; gravitational constant $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}.) [5]

Total: _____ Score: %
64