

23 Worksheet (A2)

Data needed to answer questions can be found in the Data, formulae and relationships sheet.

- 1 a Explain what is meant by the **electric field strength** at a point. [1]
- b Explain what is meant by the **electric potential** at a point. [1]

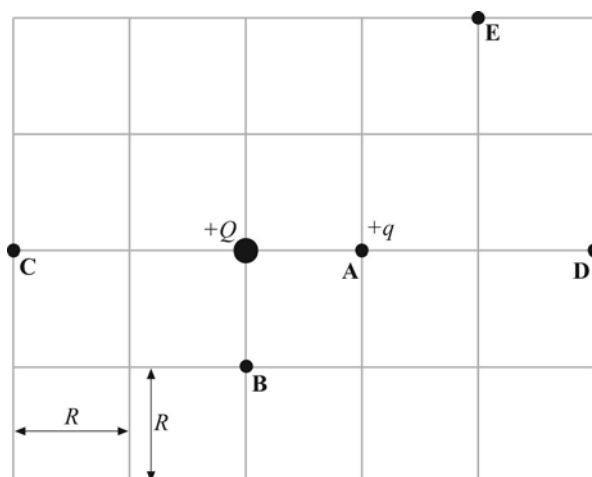
- 2 A pair of parallel metal plates has a potential difference of 5000 V across them. The electric field strength between them is 400 kN C^{-1} . Calculate:
 - a the separation between the plates [2]
 - b the force on a dust particle between the plates which carries a charge of $1.6 \times 10^{-19} \text{ C}$. [2]

- 3 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 ? [1]

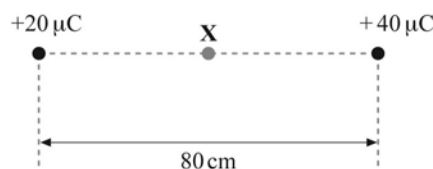
- 4 The diagram shows a point charge $+q$ placed in the electric field of a charge $+Q$.



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]

- 5 A spherical metal dome of radius 15 cm is electrically charged. It has a positive charge of $+2.5 \mu\text{C}$ 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]

- 6 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 $+20\ \mu\text{C}$ charge [3]
 - ii the $+40\ \mu\text{C}$ charge. [2]
- b Calculate the resultant electric field strength at point **X**. [2]
- 7 The dome of a van de Graaff generator has a diameter of $30\ \text{cm}$ and is at a potential of $+20\ 000\ \text{V}$. Calculate:
- a the charge on the dome [2]
 - b the electric field strength at the surface of the dome [2]
 - c the force on a proton near the surface of the dome. [1]
- 8 a An isolated charged sphere of diameter $10\ \text{cm}$ carries a charge of $-2000\ \text{nC}$. Calculate the potential at its surface. [3]
- b Calculate the work that must be done to bring an electron from infinity to the surface of the dome. [2]
- 9 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]
- 10 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]



- 11 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. [6]

- 12 A helium nucleus consists of two protons and two neutrons. Its diameter is about $10^{-15}\ \text{m}$.
- a Calculate the force of electrostatic repulsion between two protons at this separation. [2]
 - b Calculate the potential at a distance of $10^{-15}\ \text{m}$ from the centre of a proton. [2]
 - c How much work would need to be done to bring two protons this close to each other? [2]
 - d If one proton were stationary, at what speed would the second proton need to be fired at it to get this close? (Ignore any relativistic effects.) [3]

Total: _____ Score: _____ %

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