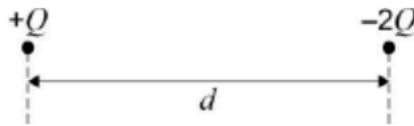


1 Two isolated point charges are separated by 0.04 m and attract each other with a force of 20 μN . If the distance between them is increased by 0.04 m, what is the new force of attraction?

- A** 40 μN
- B** 20 μN
- C** 10 μN
- D** 5 μN

(Total 1 mark)

2 The diagram shows two particles at distance d apart. One particle has charge $+Q$ and the other $-2Q$. The two particles exert an electrostatic force of attraction, F , on each other. Each particle is then given an additional charge $+Q$ and their separation is increased to distance $2d$.



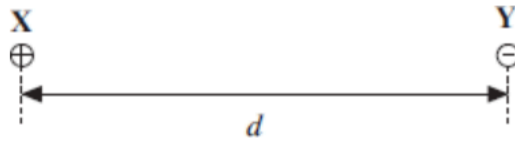
Which of the following gives the force that now acts between the two particles?

- A** an attractive force of $\frac{F}{4}$ ☐
- B** a repulsive force of $\frac{F}{4}$ ☐
- C** an attractive force of $\frac{F}{2}$ ☐
- D** a repulsive force of $\frac{F}{2}$ ☐

(Total 1 mark)

3

Two point charges, **X** and **Y**, exert a force F on each other when they are at a distance d apart.



When the distance between them is 20 mm, the force they exert on each other is $0.5 F$.

What is the distance d ?

- A** 7 mm
- B** 14 mm
- C** 15 mm
- D** 28 mm

(Total 1 mark)

4

The force between two point charges is F when they are separated by a distance r .
If the separation is increased to $3r$, what is the force between the charges?

- A** $\frac{F}{3r}$
- B** $\frac{F}{9r}$
- C** $\frac{F}{3}$
- D** $\frac{F}{9}$

(Total 1 mark)

5

A repulsive force F acts between two positive point charges separated by a distance r .
What will be the force between them if each charge is doubled and the distance between them is halved?

- A** F
- B** $2F$
- C** $4F$
- D** $16F$

(Total 1 mark)

6

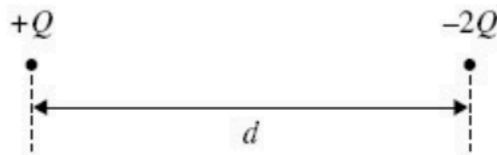
The repulsive force between two small negative charges separated by a distance r is F .

What is the force between the charges when the separation is reduced to $\frac{r}{3}$?

- A $\frac{F}{9}$
- B $\frac{F}{3}$
- C $3F$
- D $9F$

(Total 1 mark)

7



The diagram shows two particles at a distance d apart. One particle has charge $+Q$ and the other $-2Q$. The two particles exert an electrostatic force of attraction, F , on each other. Each particle is then given an additional charge $+Q$ and their separation is increased to a distance $2d$. Which one of the following gives the force that now acts between the two particles?

- A an attractive force of $\frac{F}{4}$
- B a repulsive force of $\frac{F}{4}$
- C an attractive force of $\frac{F}{2}$
- D a repulsive force of $\frac{F}{2}$

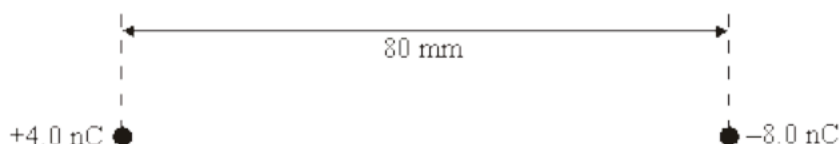
(Total 1 mark)

8

- (a) (i) Define the *electric field strength*, E , at a point in an electric field.

- (ii) State whether E is a scalar or a vector quantity.

- (b) Point charges of $+4.0 \text{ nC}$ and -8.0 nC are placed 80 mm apart, as shown in the figure below.



- (i) Calculate the magnitude of the force exerted on the $+4.0 \text{ nC}$ charge by the -8.0 nC charge.

- (ii) Determine the distance from the $+4.0 \text{ nC}$ charge to the point, along the straight line between the charges, where the electric potential is zero.

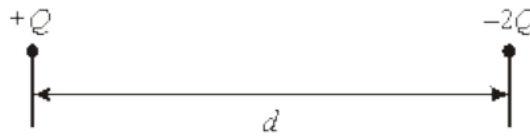
(4)

- (c) Point **P** in the figure above is equidistant from the two charges.

- (i) Draw two arrows on the figure above at **P** to represent the directions and relative magnitudes of the components of the electric field at **P** due to each of the charges.
- (ii) Hence draw an arrow, labelled **R**, on the figure above at **P** to represent the direction of the resultant electric field at **P**.

(3)

(Total 10 marks)

9

The diagram shows two particles at a distance d apart. One particle has charge $+Q$ and the other $-2Q$. The two particles exert an electrostatic force of attraction, F , on each other. Each particle is then given an additional charge $+Q$ and their separation is increased to a distance of $2d$. Which one of the following gives the force that now acts between the two particles?

- A** an attractive force of $\frac{F}{4}$
- B** a repulsive force of $\frac{F}{4}$
- C** an attractive force of $\frac{F}{2}$
- D** a repulsive force of $\frac{F}{2}$

(Total 1 mark)**10**

The force between two point charges is F when they are separated by a distance r . If the separation is increased to $3r$ what is the force between the charges?

- A** $\frac{F}{3r}$
- B** $\frac{F}{9r}$
- C** $\frac{F}{3}$
- D** $\frac{F}{9}$

(Total 1 mark)

Mark schemes

1	D	[1]
2	A	[1]
3	B	[1]
4	D	[1]
5	D	[1]
6	D	[1]
7	A	[1]
8	(a) (i) force per unit charge (1) acting on a positive charge (1) (ii) vector (1)	

3

$$(b) (i) F = \frac{Q_1 Q_2}{4\pi\epsilon_0 r^2} = \frac{4.0 \times 10^{-9} \times 8.0 \times 10^{-9}}{4\pi \times 8.85 \times 10^{-12} \times (80 \times 10^{-3})^2} \quad (1)$$

$$= 4.5(0) \times 10^{-5} \text{N} \quad (1)$$

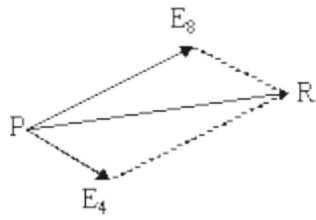
$$(ii) \text{ (use of } V = \frac{Q}{4\pi\epsilon_0 r} \text{ gives) } 0 = \left(\frac{4.0 \times 10^{-9}}{4\pi\epsilon_0 x} \right) - \left(\frac{8.0 \times 10^{-9}}{4\pi\epsilon_0 (80 \times 10^{-3} - x)} \right)$$

$$\text{or } \frac{4}{x} = \frac{8}{80 - x} \quad (1)$$

$$x = 26.7 \text{mm} \quad (1)$$

4

- (c) correct directions for E_4 and E_8 (1)
 E_8 approx twice as long as E_4 (1)
 correct direction of resultant R
 shown (1)



3

[10]

9 A

[1]

10 D

[1]