

Q1.

Which is equal to ϵ_0 ?

- A** the relative permittivity of a vacuum
- B** the charge stored on a capacitor consisting of two parallel plates of area 1 m^2 separated by 1 m when the potential difference between the plates is 1 V
- C** the work done when moving a 2 C charge from infinity to a distance of $\pi \text{ m}$ from the centre of a metal sphere that carries 2 C of charge
- D** the charge on a metal sphere which experiences a force of 1 N when its centre is placed 1 m from the centre of a metal sphere that carries 1 C of charge

☐☐☐☐

(Total 1 mark)

Q2.

The force between two point charges is F .

The magnitude of each charge is doubled and the distance between them is halved.

What is the new force between the two charges?

A $16F$

☐

B $8F$

☐

C $2F$

☐

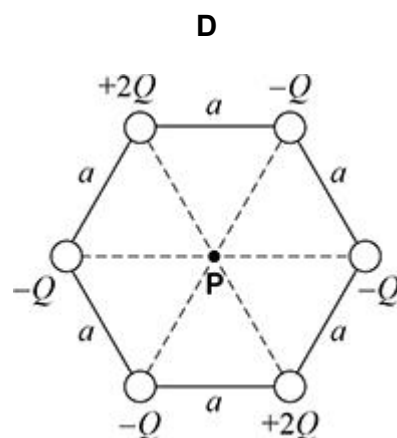
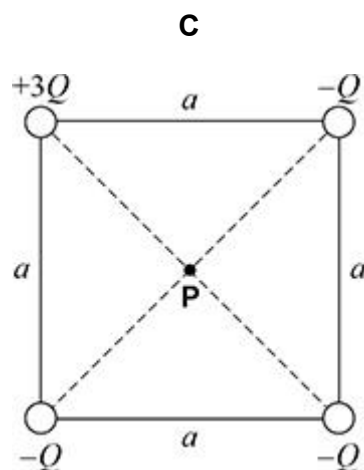
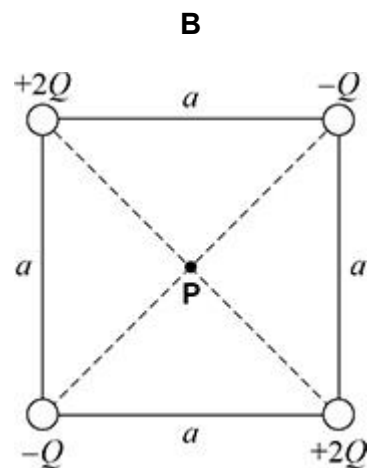
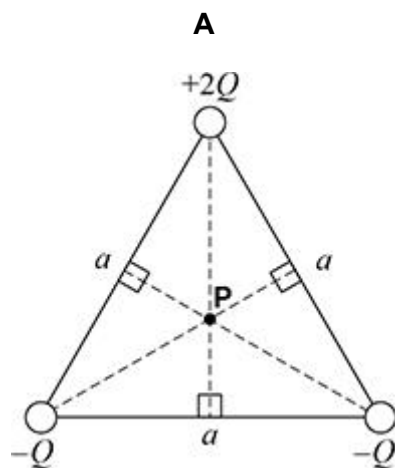
D F

☐

(Total 1 mark)

Q3.

Which diagram shows a distribution of charge where the electric potential at **P** and the electric field at **P** are both zero?



- | | |
|----------|--------------------------|
| A | ☐ |
| B | ☐ |
| C | ☐ |
| D | ☐ |

(Total 1 mark)

Q4.

An ion has a specific charge of $-7.1 \times 10^7 \text{ C kg}^{-1}$.

It is held stationary in a vertical electric field on the surface of the Earth.

What are the magnitude and direction of the electric field?

- | | |
|---|-----------------------|
| A $1.38 \times 10^{-7} \text{ V m}^{-1}$ upwards | ☐ |
| B $1.38 \times 10^{-7} \text{ V m}^{-1}$ downwards | ☐ |
| C $7.24 \times 10^6 \text{ V m}^{-1}$ upwards | ☐ |
| D $7.24 \times 10^6 \text{ V m}^{-1}$ downwards | ☐ |

(Total 1 mark)

Q5.

Which particle pair has the largest magnitude of $\frac{\text{electrostatic force}}{\text{gravitational force}}$ when separated by the same distance?

- | | |
|--|-----------------------|
| A an electron and a positive pion | ☐ |
| B a helium nucleus and a proton | ☐ |
| C a proton and a positive pion | ☐ |
| D a proton and an electron | ☐ |

(Total 1 mark)

Q6.

Two protons are separated by a distance of $1 \times 10^{-9} \text{ m}$.

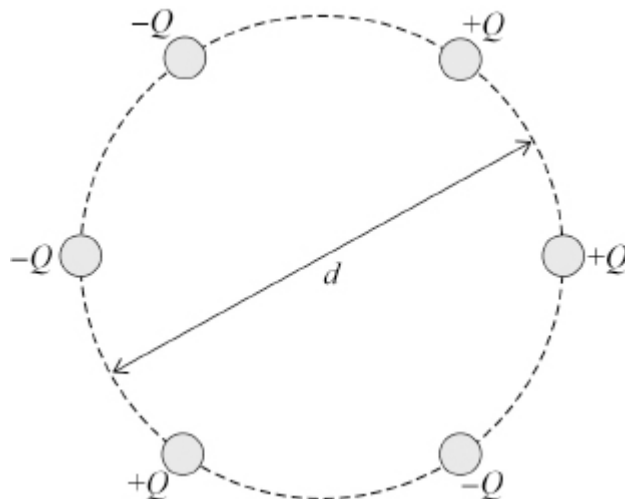
Which is an estimate of $\frac{\text{electric repulsion force}}{\text{gravitational attraction force}}$ for these two protons?

- | | |
|--------------------|-----------------------|
| A 10^{18} | ☐ |
| B 10^{28} | ☐ |
| C 10^{36} | ☐ |
| D 10^{45} | ☐ |

(Total 1 mark)

Q7.

Six metal spheres, each carrying a charge of magnitude Q , are equally spaced around a circle of diameter d .



What is the magnitude of the field strength at the centre of the circle?

A 0
☐
B $\frac{Q}{\pi\epsilon_0 d^2}$
☐
C $\frac{2Q}{\pi\epsilon_0 d^2}$
☐
D $\frac{4Q}{\pi\epsilon_0 d^2}$
☐
(Total 1 mark)**Q8.**

Two point charges are separated by a distance of 200 mm.

The force of attraction between them is 180 μN .

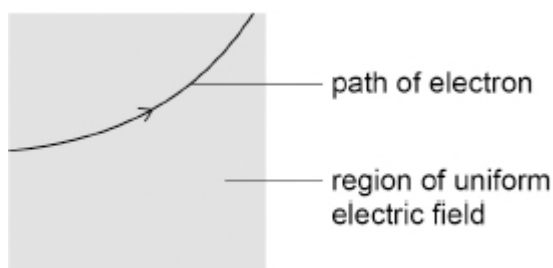
The distance between the point charges is increased by 400 mm.

What is the new force of attraction?

A 20 μN
☐
B 45 μN
☐
C 60 μN
☐
D 90 μN
☐
(Total 1 mark)

Q9.

The diagram shows the path of an electron in a uniform electric field. The electron moves in a vertical plane.



The direction of the electric field is

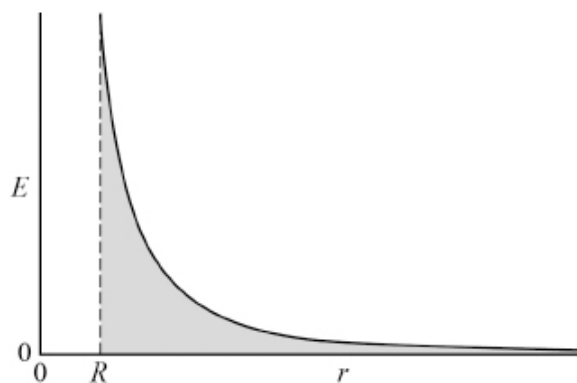
- A** vertically down the plane.
- B** vertically up the plane.
- C** horizontally into the plane.
- D** horizontally out of the plane.

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☐
☐
☐

(Total 1 mark)

Q10.

The graph shows the variation of electric field strength E surrounding a charged sphere of radius R . The distance from the centre of the sphere is r .



The total area under the curve from R to infinity is

- A** the capacitance of the sphere.
- B** the charge held on the sphere.
- C** the electric potential of the sphere.
- D** the energy needed to remove an electron from the sphere.

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☐
☐
☐

(Total 1 mark)

Q11.

An alpha particle is moving towards a stationary gold nucleus. The alpha particle has a kinetic energy of $9.0 \times 10^{-13} \text{ J}$ when it is a large distance from the gold nucleus.

The gold nucleus contains 79 protons.

What is the closest possible distance of approach of the alpha particle to the gold nucleus?

A $2.5 \times 10^{-16} \text{ m}$

☐

B $2.0 \times 10^{-14} \text{ m}$

☐

C $4.0 \times 10^{-14} \text{ m}$

☐

D $2.0 \times 10^{-7} \text{ m}$

☐

(Total 1 mark)

Q12.

A particle of mass m and charge Q is accelerated from rest through a potential difference V . The final velocity of the particle is u .

A second particle of mass $\frac{m}{2}$ and charge $2Q$ is accelerated from rest through a potential difference $2V$.

What is the final velocity of the second particle?

A $\sqrt{2}u$

☐

B $2\sqrt{2}u$

☐

C $4u$

☐

D $8u$

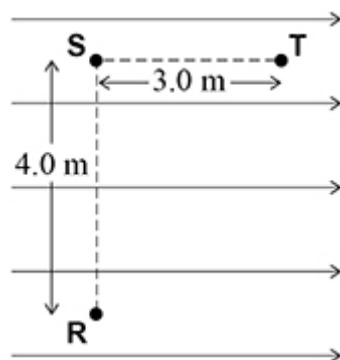
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(Total 1 mark)

Q13.

The diagram shows a uniform electric field of strength 15 V m^{-1} .

The length **RS** is perpendicular to the field and the line **ST** is parallel to the field.



What is the total change in electrical potential energy for a charge of $3.0 \mu\text{C}$ moving from **R** to **T**?

- A** $135 \mu\text{J}$ ☐
- B** $180 \mu\text{J}$ ☐
- C** $225 \mu\text{J}$ ☐
- D** $315 \mu\text{J}$ ☐

(Total 1 mark)