



A-Level Physics

Electric Fields (Multiple Choice)

Question Paper

Time available: 29 minutes

Marks available: 20 marks

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1. 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 $\sqrt{2}u$

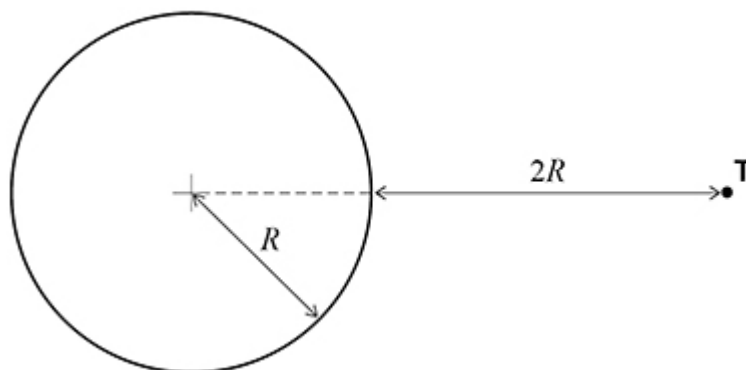
B $2\sqrt{2}u$

C $4u$

D $8u$

(Total 1 mark)

2. An isolated spherical conductor is charged. The conductor has a radius R and an electric potential V . The electric field strength at its surface is E .



Point T is a distance $2R$ from the surface.

What are the electric field strength and electric potential at **T**?

	Electric field strength	Electric potential	
A	$\frac{E}{2}$	$\frac{V}{4}$	<input type="checkbox"/>
B	$\frac{E}{3}$	$\frac{V}{9}$	<input type="checkbox"/>
C	$\frac{E}{4}$	$\frac{V}{2}$	<input type="checkbox"/>
D	$\frac{E}{9}$	$\frac{V}{3}$	<input type="checkbox"/>

(Total 1 mark)

3.

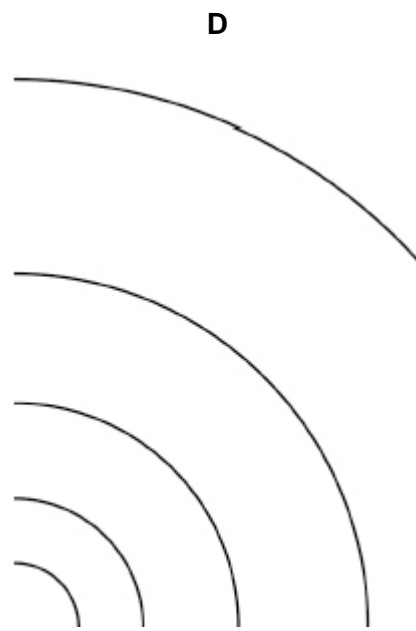
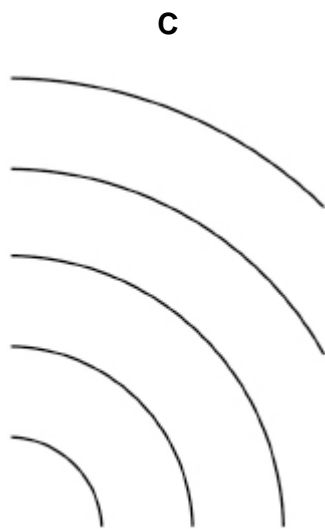
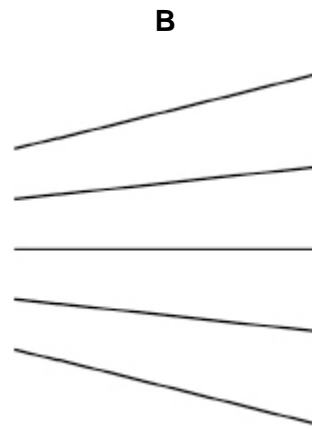
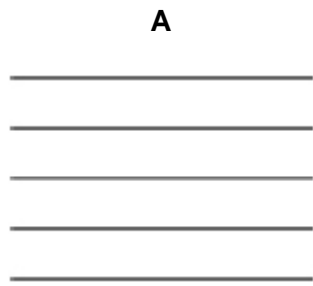
At a distance L from a fixed point charge, the electric field strength is E and the electric potential is V .

What are the electric field strength and the electric potential at a distance $3L$ from the charge?

	Electric field strength	Electric potential	
A	$\frac{E}{3}$	$\frac{V}{9}$	<input type="checkbox"/>
B	$\frac{E}{3}$	$\frac{V}{3}$	<input type="checkbox"/>
C	$\frac{E}{9}$	$\frac{V}{3}$	<input type="checkbox"/>
D	$\frac{E}{9}$	$\frac{V}{9}$	<input type="checkbox"/>

(Total 1 mark)

4. Which diagram shows lines of equipotential in steps of equal potential difference near an isolated point charge?



A

B

C

D

(Total 1 mark)

5.

1.5 mJ of work is done when a charge of 30 μC is moved between two points, **M** and **N**, in an electric field.

What is the potential difference between **M** and **N**?

A 20 mV

B 20 V

C 45 V

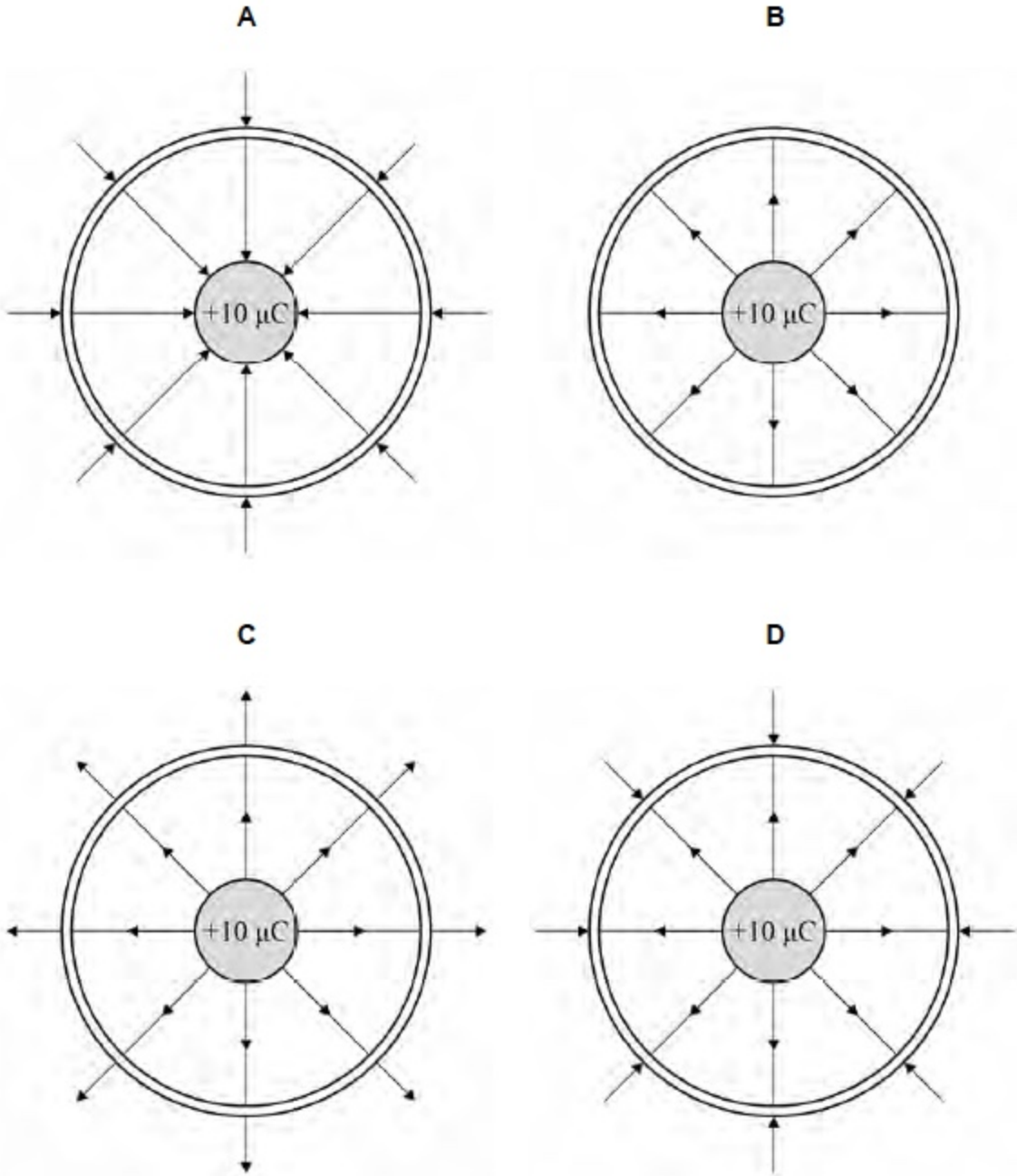
D 50 V

(Total 1 mark)

6.

A conducting sphere holding a charge of $+10 \mu\text{C}$ is placed centrally inside a second uncharged conducting sphere.

Which diagram shows the electric field lines for the system?



- A
- B
- C
- D

(Total 1 mark)

7. A particle of mass m and charge q is accelerated through a potential difference V over a distance d .

What is the average acceleration of the particle?

- A $\frac{qV}{md}$
- B $\frac{mV}{qd}$
- C $\frac{V}{mqd}$
- D $\frac{dV}{mq}$

(Total 1 mark)

8. An electron moves through a distance of 0.10 m parallel to the field lines of a uniform electric field of strength 2.0 kN C^{-1} .

What is the work done on the electron?

- A zero
- B $1.6 \times 10^{-17} \text{ J}$
- C $3.2 \times 10^{-17} \text{ J}$
- D $1.6 \times 10^{-21} \text{ J}$

(Total 1 mark)

9. An electron moving with constant speed enters a uniform electric field at right angles to the direction of the field.

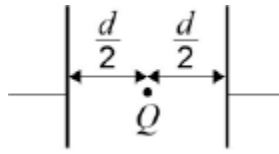
What is true about the force acting on the electron?

- A It is at right angles to the direction of the field.
- B It is in the opposite direction to the direction of the field.
- C It causes the electron to continue in the same direction with its speed increasing steadily.
- D It causes the electron to continue in the same direction with its speed decreasing steadily.

(Total 1 mark)

10.

Two parallel metal plates are separated by a distance d and have a potential difference V across them. Which expression gives the magnitude of the electrostatic force acting on a charge Q placed midway between the plates?



A $\frac{2VQ}{d}$

B $\frac{VQ}{d}$

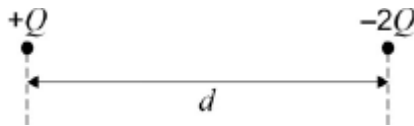
C $\frac{VQ}{2d}$

D $\frac{Qd}{v}$

(Total 1 mark)

11.

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 $\frac{F}{4}$

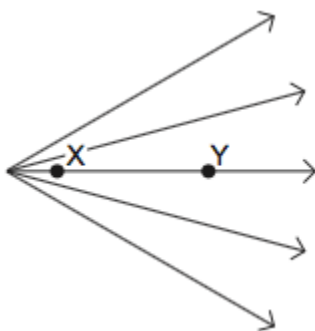
C an attractive force of $\frac{F}{2}$

D a repulsive force of $\frac{F}{2}$

(Total 1 mark)

12.

The diagram shows the field lines in a region of an electric field created by a positive charge.



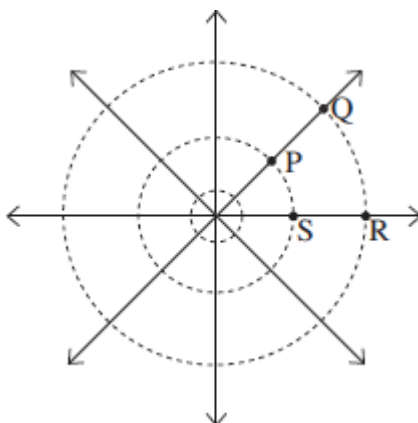
Which one of the following statements is correct?
When moving from X to Y

- A the electric potential is constant.
- B the electric potential increases.
- C the electric potential decreases.
- D the electric potential changes from positive to negative.

(Total 1 mark)

13.

The diagram below shows the field lines and equipotential lines around an isolated positive point charge.



Which one of the following statements concerning the work done when a small charge is moved in the field is **incorrect**?

- A when it is moved from either P to Q or S to R, the work done is the same in each case
- B when it is moved from Q to R no work is done
- C when it is moved around the path PQRS, the overall work done is zero
- D when it is moved around the path PQRS, the overall work done is equal to twice the work done in moving from P to Q

(Total 1 mark)

14.

Two horizontal parallel plate conductors are separated by a distance of 5.0 mm in air. The lower plate is earthed and the potential of the upper plate is +50 V.

Which line, **A** to **D**, in the table gives correctly the electric field strength, E , and the potential, V , at a point midway between the plates?

	electric field strength E / Vm^{-1}	potential V / V
A	1.0×10^4 upwards	25
B	1.0×10^4 downwards	25
C	1.0×10^4 upwards	50
D	1.0×10^4 downwards	50

(Total 1 mark)

15.

When a charge moves between two points in an electric field, or a mass moves between two points in a gravitational field, energy may be transferred.

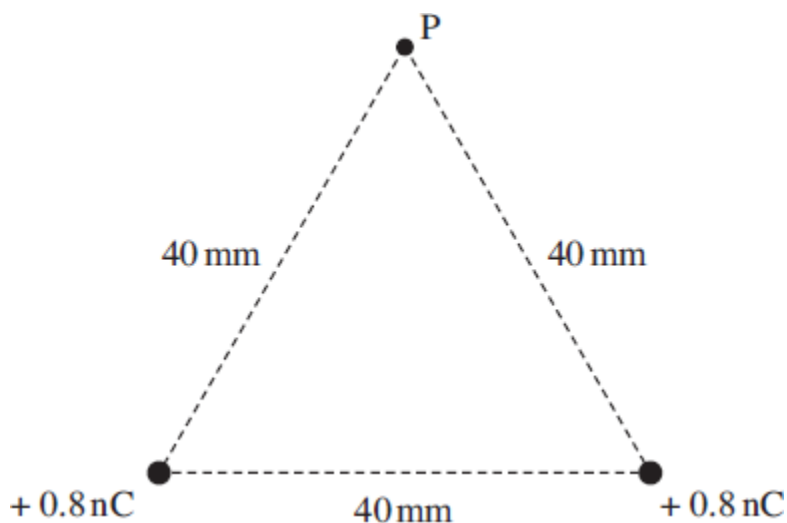
Which one of the following statements is correct?

- A** No energy is transferred when the movement is parallel to the direction of the field.
- B** The energy transferred is independent of the path followed.
- C** The energy transferred is independent of the start and finish points.
- D** Energy is transferred when the movement is perpendicular to the field lines.

(Total 1 mark)

16.

Two charges, each of $+0.8 \text{ nC}$, are 40 mm apart. Point P is 40 mm from each of the charges.



What is the electric potential at P?

- A zero
- B 180 V
- C 360 V
- D 4500 V

(Total 1 mark)

17.

Which line, **A** to **D**, in the table correctly describes the trajectory of charged particles which enter separately, at right angles, a uniform electric field, and a uniform magnetic field?

	uniform electric field	uniform magnetic field
A	parabolic	circular
B	circular	parabolic
C	circular	circular
D	parabolic	parabolic

(Total 1 mark)

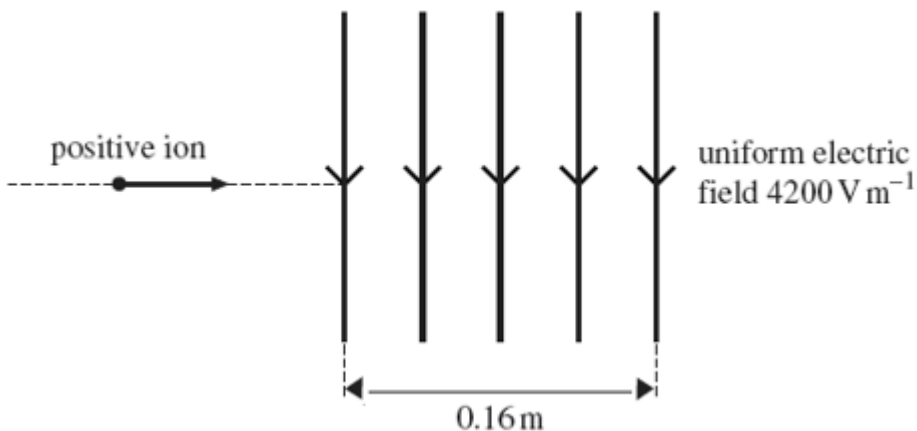
18.

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)

19.



An ion carrying a charge of $+4.8 \times 10^{-19} \text{ C}$ travels horizontally at a speed of $8.0 \times 10^5 \text{ ms}^{-1}$. It enters a uniform vertical electric field of strength 4200 V m^{-1} , which is directed downwards and acts over a horizontal distance of 0.16 m . Which one of the following statements is **not** correct?

- A The ion passes through the field in $2.0 \times 10^{-7} \text{ s}$.
- B The force on the ion acts vertically downwards at all points in the field.
- C The magnitude of the force exerted on the ion by the field is $1.6 \times 10^{-9} \text{ N}$.
- D The horizontal component of the velocity of the ion is unaffected by the electric field.

(Total 1 mark)

20.

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)