# Electric Fields

## TOPIC QUESTIONS (2)

| Level | AS Level |
|---|---|
| Subject | Physics |
| Exam Board | CIE |
| Paper Type | Multiple Choice |

**Time Allowed : 50min**

1. In a uniform electric field, which statement is correct?

   A. All charged particles experience the same force.

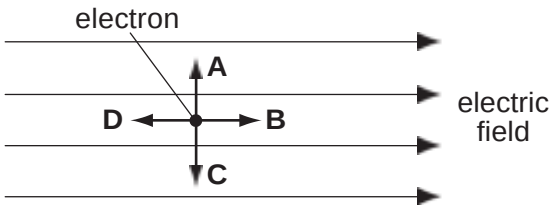
   B. All charged particles move with the same velocity.

   C. All electric field lines are directed towards positive charge

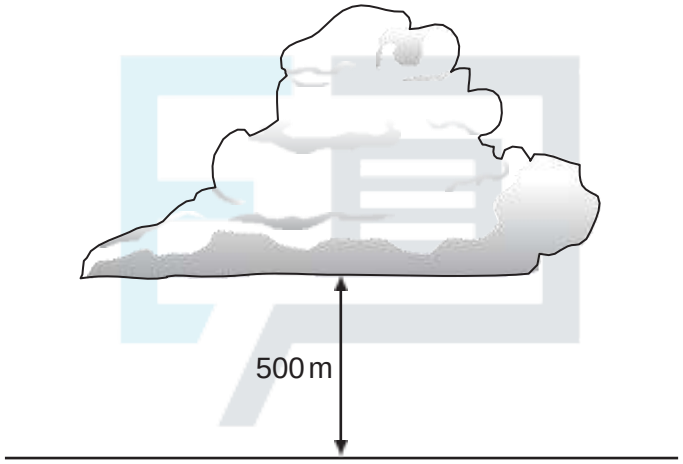
   D. All electric field lines are parallel.

2. The diagram shows an electron in a uniform electric field.

In which direction will the field accelerate the electron?




3. The diagram shows a thundercloud whose base is 500 m above the ground.

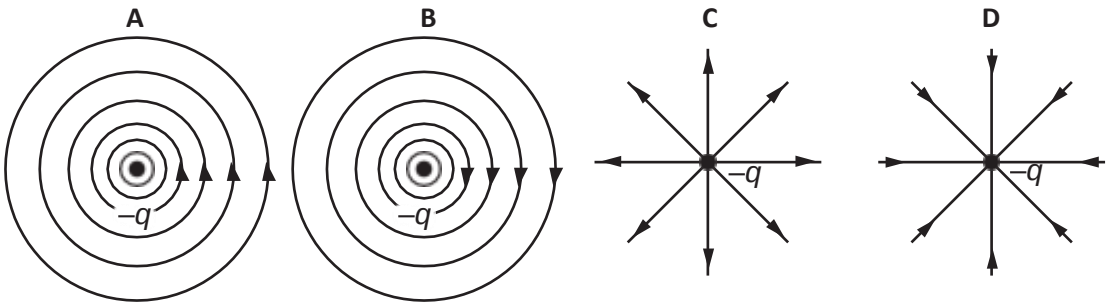



The potential difference between the base of the cloud and the ground is 200 MV. A raindrop with a charge of $4.0 \times 10^{-12}$ C is in the region between the cloud and the ground.

What is the electrical force on the raindrop?

A $1.6 \times 10^{-6}$ N  B $8.0 \times 10^{-4}$ N  C $1.6 \times 10^{-3}$ N  D 0.40 N

4. Which diagram represents the electric field of a negative point charge $-q$?



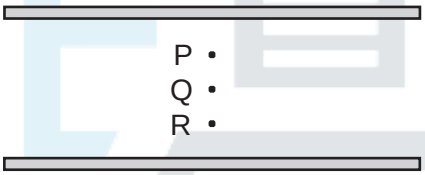
5. A potential difference *V* is applied between two parallel plates a small distance *d* apart, and produces an electric field of strength *E* between the plates.


What is the electric field strength between the plates when both *V* and *d* are doubled?

**A** *E*/4 **B** *E* **C** 2*E* **D** 4*E*

6. The diagram shows two parallel plates.

The plates are charged so that there is an electric field between them. P, Q and R are points which are $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ of the distance from the top plate to the bottom plate.




What is the electric field strength at point P?

A the same as that at point Q

B twice that at point R

C half that at point R

D one third that at point Q

7. A positive charge of $2.6 \times 10^{-8}$ C is in an electric field of constant field strength 300 000 V m$^{-1}$.

   How much work must be done on the charge in order to move it a distance of 4.0 mm in the opposite direction to the direction of the field?

   A $3.1 \times 10^{-5}$ J

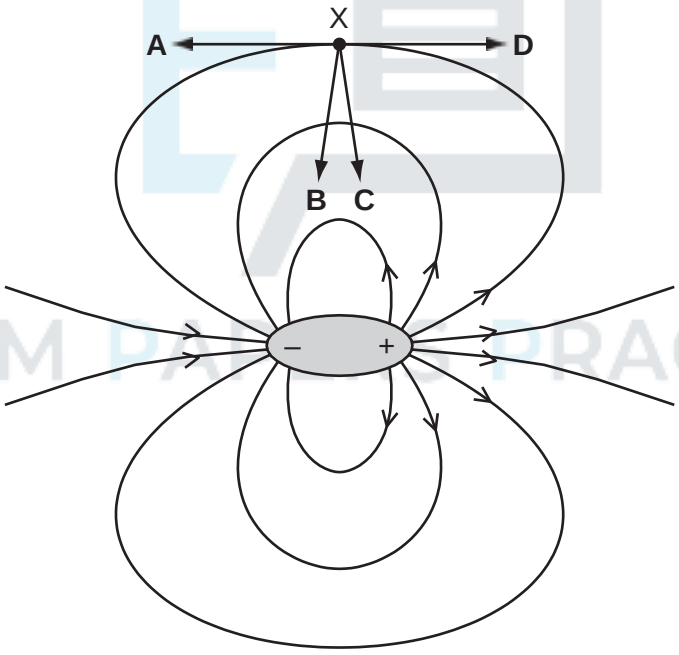
   B $2.0 \times 10^{-3}$ J

   C $3.1 \times 10^{-2}$ J

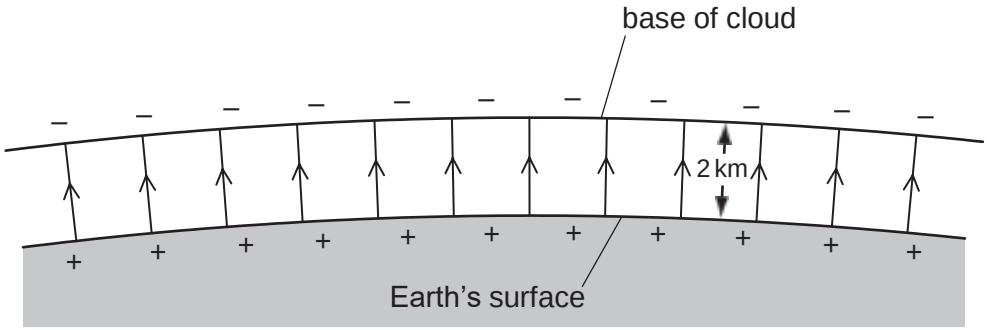
   D 2.0 J

8. A dipole is a pair of one negative charge and one positive charge of equal magnitude. The electric field of a dipole is shown below.

   In which direction does the force act on an electron when at point X?



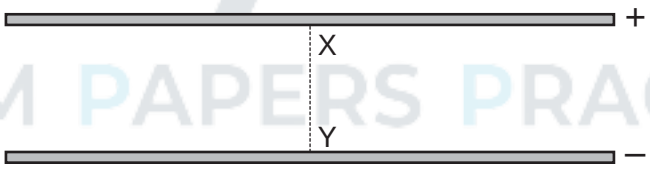
9. Lightning can occur between a charged cloud and the Earth's surface when the electric field strength in the intervening atmosphere reaches 25 kN C$^{-1}$. The diagram shows the electric field between the base of a cloud and the Earth's surface.




What is the minimum potential difference between the Earth and the base of a cloud, 2 km high, for lightning to occur?

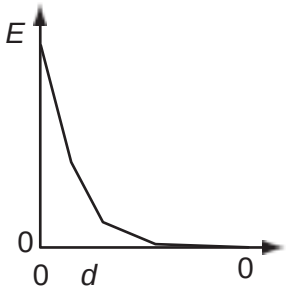
A 12.5 MV B 25 MV C 50 MV D 100 MV

10. An electric field exists in the space between two charged metal plates.

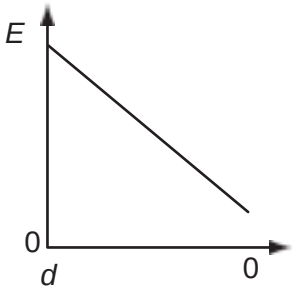



Which graph shows the variation of electric field strength *E* with distance *d* from X along the line XY?

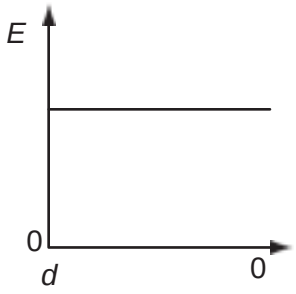
**A**



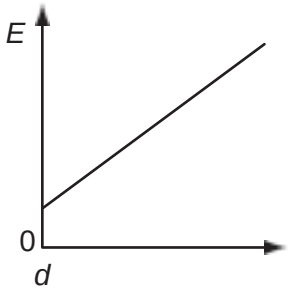

**B**




**C**




**D**



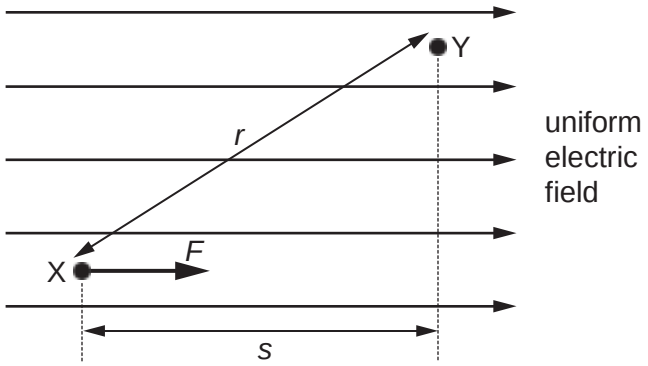
11. What is equivalent to the unit of electric field strength?

A $JCm^{-1}$ B $NsA^{-1}$ C $kgms^{-3}A^{-1}$ D $kgm^{3}s^{-3}A^{-1}$

12. A positive charge experiences a force *F* when placed at point X in a uniform electric field.

The charge is then moved from point X to point Y.

Distances *r* and *s* are shown on the diagram.




What is the change in the potential energy of the charge?

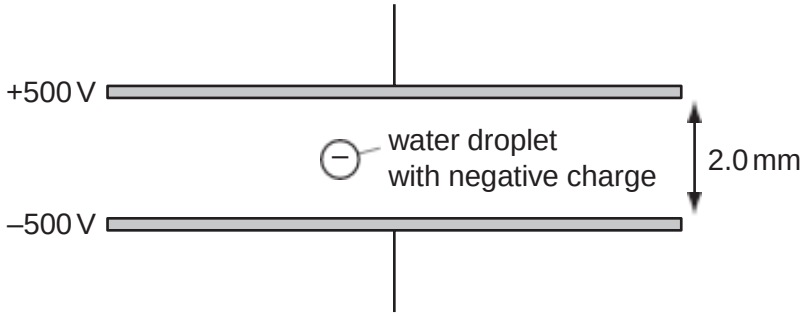
A decreases by *Fs*

B increases by *Fs*

C decreases by *Fr*

D increases by *Fr*

13. A small water droplet of mass 3.0 μg carries a charge of $-6.0 \times 10^{-11}$ C. The droplet is situated in the Earth's gravitational field between two horizontal metal plates. The potential of the upper plate is +500 V and the potential of the lower plate is -500 V.




What is the motion of the droplet?

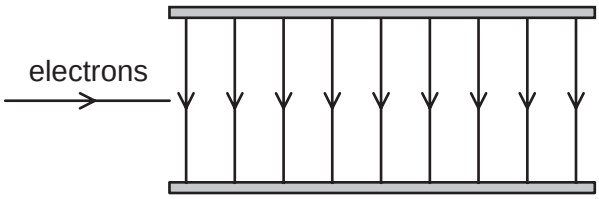
A. It accelerates downwards.

B. It remains stationary.

C. It accelerates upwards.

D. It moves upwards at a constant velocity.

14. Electrons are accelerated and then directed into the uniform electric field between two parallelplates in a vacuum.




What best describes the shape of the path followed by the electrons in the field?

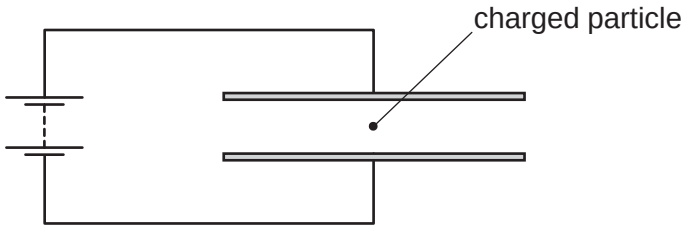
A a downwards curve along a line that is part of a circle

B a downwards curve along a line that is not part of a circle

C an upwards curve along a line that is part of a circle

D an upwards curve along a line that is not part of a circle

15. A charged particle is in the electric field between two horizontal metal plates connected to a source of constant potential difference, as shown. There is a force *F* on the particle due to the electric field.

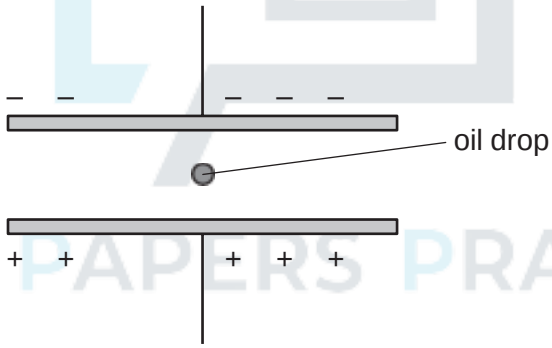



The separation of the plates is doubled.

What will be the new force on the particle?

A $\frac{F}{4}$ B $\frac{F}{2}$ C $F$ D $2F$

16. A very small oil drop of mass *m* carries a charge +*q*.




The potential difference across the plates is *V* and the separation is *d*.

The weight of the drop is balanced by the electric force. (Buoyancy forces may be considered to be negligible.)

Which formula gives the charge on the drop?

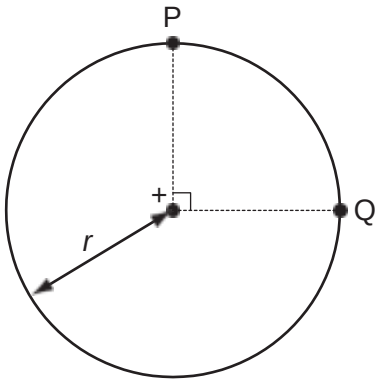
A $q = \frac{mgd}{V}$ B $q = \frac{mgV}{d}$ C $q = \frac{Vd}{mg}$ D $q = \frac{V}{mgd}$

17. Which row describes the circumstances under which forces act on a charged particle in a uniformelectric field?

| | charged particle | direction of force |
|---|---|---|
| A | moving charges only | parallel to the field |
| B | stationary charges only | perpendicular to the field |
| C | stationary and moving charges | parallel to the field |
| D | stationary and moving charges | perpendicular to the field |

18. The diagram shows two points P and Q which lie, 90° apart, on a circle of radius *r*.

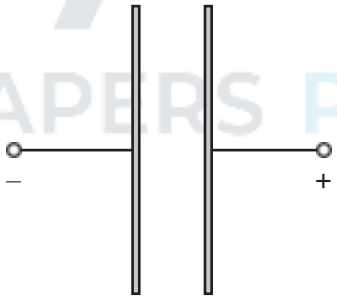
A positive point charge at the centre of the circle creates an electric field of magnitude *E* at both P and Q.




Which expression gives the work done in moving a unit positive charge from P to Q?

A 0 B $E \times r$ C $E \times \frac{\pi r}{2}$ D $E \times (\pi r)$

19. Two oppositely-charged parallel plates are arranged as shown.

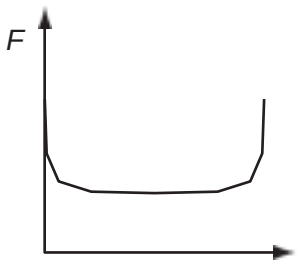



An electron is released from rest from the surface of the negatively-charged plate.

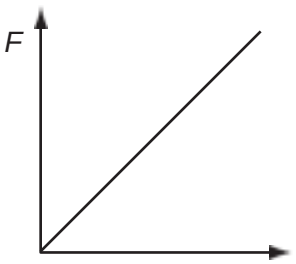
The electron travels from the negatively-charged plate towards the positively-charged plate.

Which graph shows how the force *F* on the electron varies with its distance *x* from the negative plate?

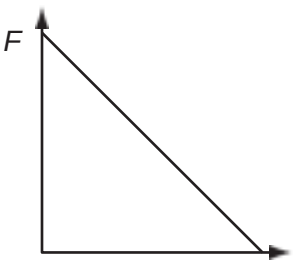
**A**



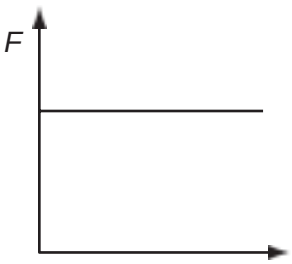

**B**




**C**

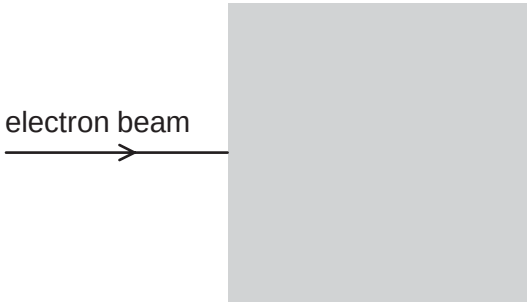



**D**



0 0 x 0 0 x 0 0 x 0 0 x

20. In the diagram, the shaded area represents a uniform electric field directed away from the observer (at right-angles into the plane of the paper).




A horizontal beam of electrons enters the field, travelling from left to right.

In which direction is this beam deflected by the field?

A. upwards (in the plane of the paper)

B. downwards (in the plane of the paper)

C. away from the observer

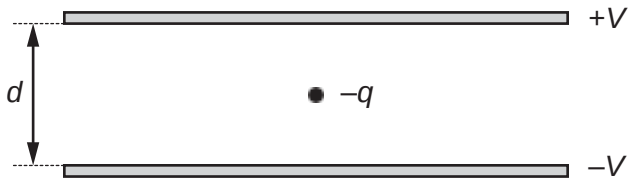
D. towards the observer

21. Two parallel metal plates, a distance of 2 mm apart, have a potential difference of 1000 V acrossthem.

What is the electric field strength between the plates?

A $500\ \text{V m}^{-1}$ B $50\,000\ \text{V m}^{-1}$ C $50\,000\ \text{N C}^{-1}$ D $500\,000\ \text{N C}^{-1}$

22. An oil droplet has charge $-q$ and is situated between two horizontal metal plates as shown in thediagram.



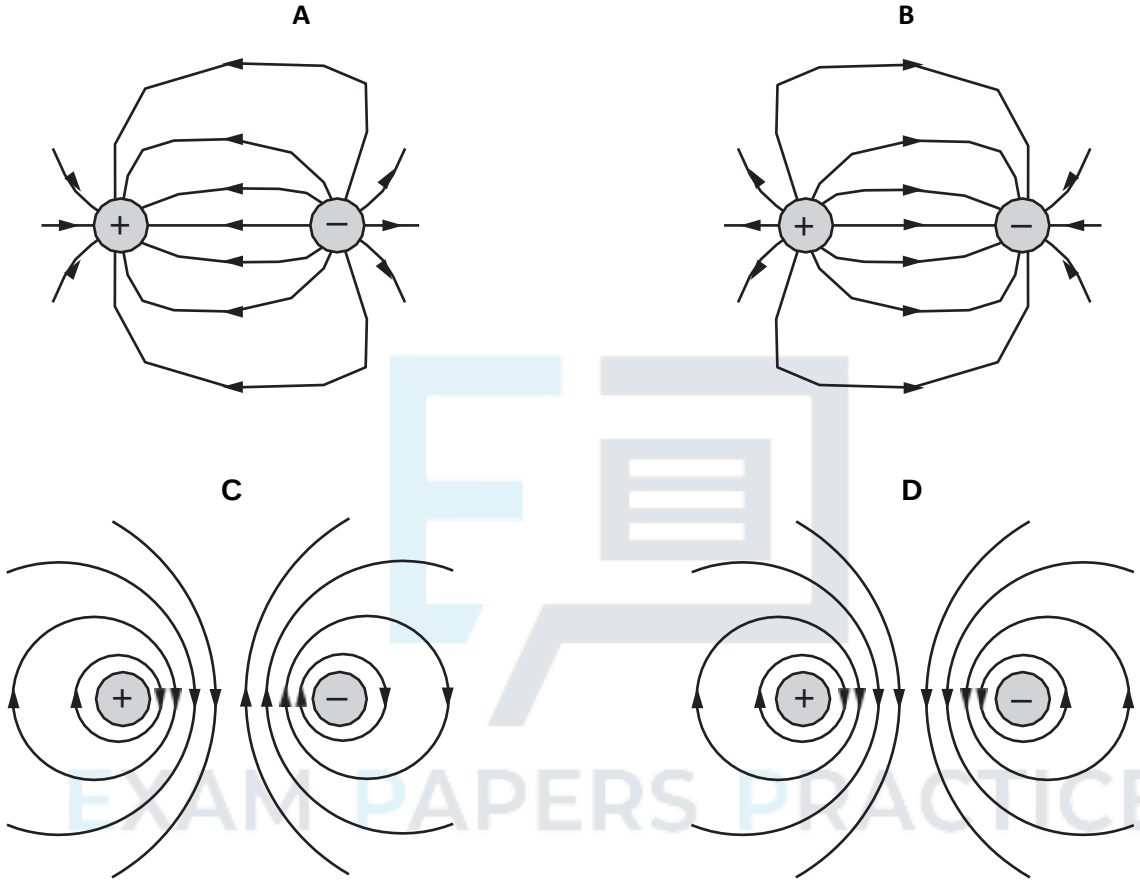

The separation of the plates is $d$. The droplet is observed to be stationary when the upper plate is at potential $+V$ and the lower plate is at potential $-V$.

For this to occur, what is the weight of the droplet?

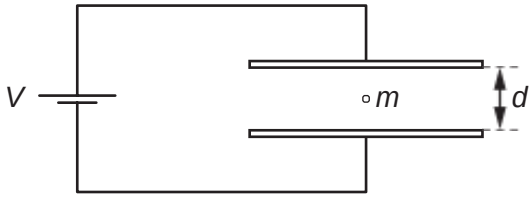
A $\frac{Vq}{d}$ B $\frac{2Vq}{d}$ C $\frac{Vd}{q}$ D $\frac{2Vd}{q}$

23. A positive charge and a negative charge of equal magnitude are placed a short distance apart.

Which diagram best represents the associated electric field?




24. A charged oil drop of mass $m$, with $n$ excess electrons, is held stationary in the uniform electricfield between two horizontal plates separated by a distance $d$.



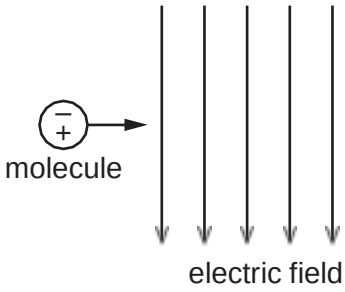

The voltage between the plates is $V$, the elementary charge is $e$ and the acceleration of free fall is $g$.

What is the value of $n$?

A $\frac{eV}{mgd}$ B $\frac{mgd}{eV}$ C $\frac{meV}{gd}$ D $\frac{gd}{meV}$

25. A molecule behaves as an electric dipole consisting of two equal point charges, of opposite sign,

separated by a fixed distance. The molecule moves with constant horizontal velocity as it enters a vertical uniform electric field, as shown.



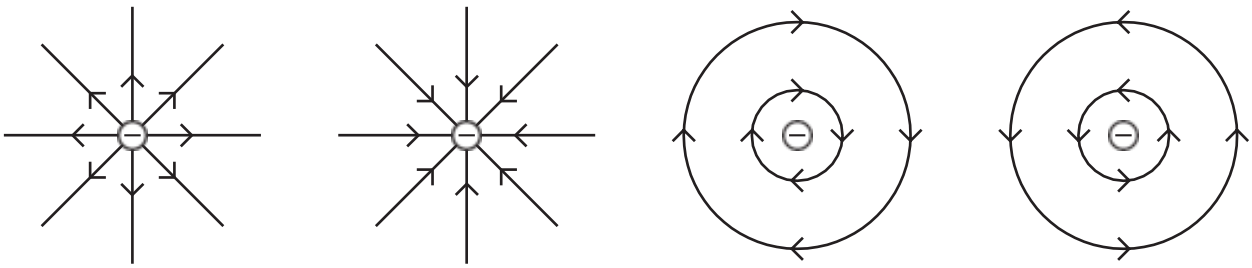

The positive and negative charges of the molecule enter the field at the same time.

Which row describes the velocity of the molecule in the field?

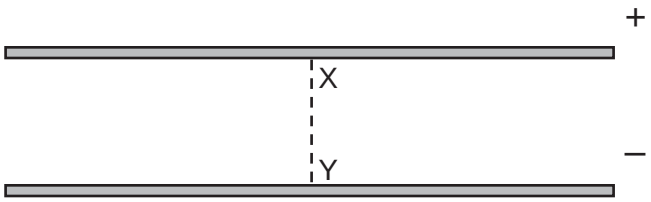
| | horizontal component of velocity | vertical component of velocity |
|---|---|---|
| A | constant | increases |
| B | constant | zero |
| C | increases | increases |
| D | increases | zero |

26. Which diagram shows the electric field pattern of an isolated negative point charge?

A B C D

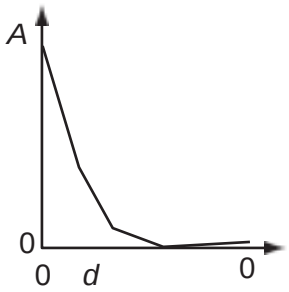


27. An electric field exists in the space between two charged metal plates.

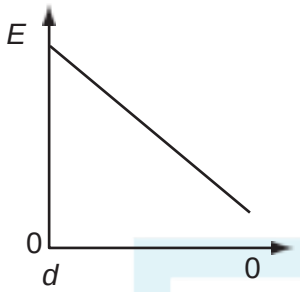



Which graph shows the variation of electric field strength *E* with distance *d* from X along the line XY?

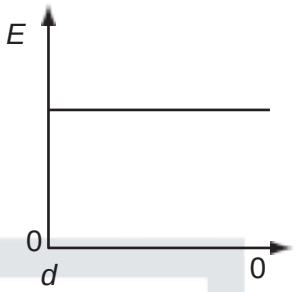
**A**



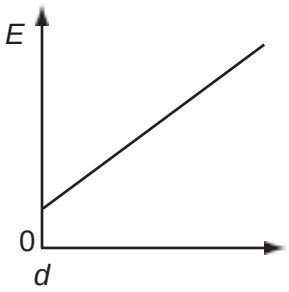

**B**




**C**

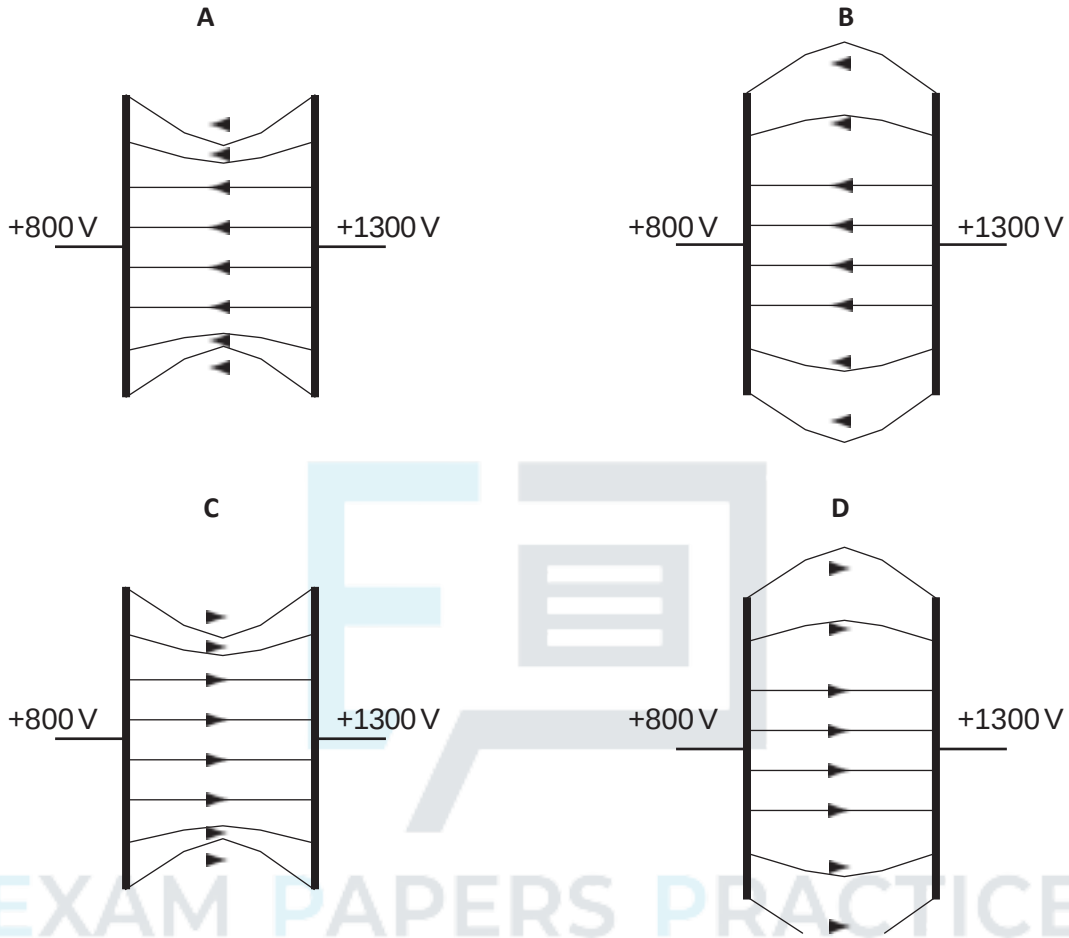



**D**



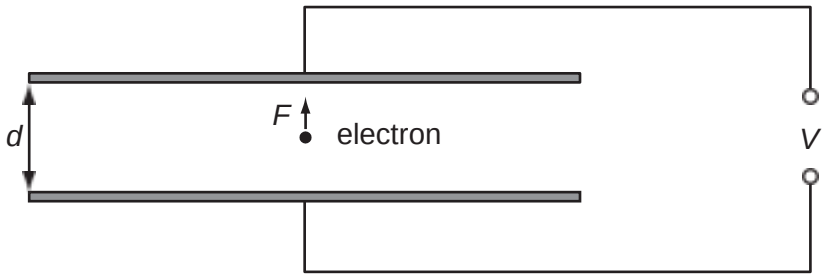
28. Two parallel metal plates are at potentials of +800 V and +1300 V.

Which diagram best shows the electric field between the metal plates?




29. An electron of charge *e* is introduced between two metal plates a distance *d* apart.

A potential difference *V* is applied to the plates as shown in the diagram.




Which expression gives the electric force *F* on the electron?

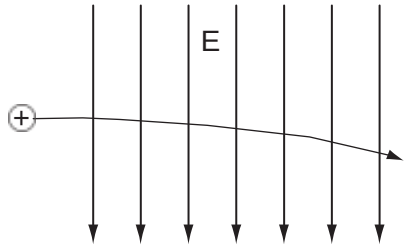
A $\frac{eV}{d}$ B $eVd$ C $\frac{V}{ed}$ D $\frac{dV}{e}$

30. A positively charged particle is projected into a region of uniform electric field E.

Which diagram represents the motion of the particle in the electric field?

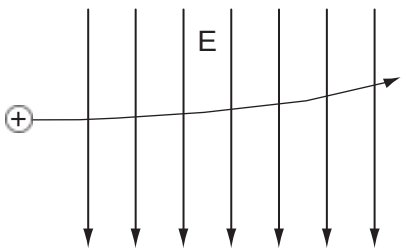
**A**

electric field in plane of the paper



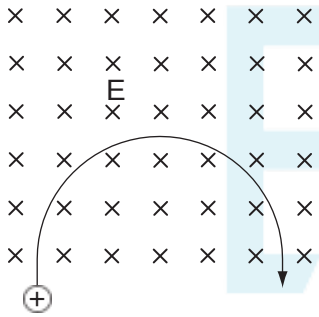

**B**

electric field in plane of the paper



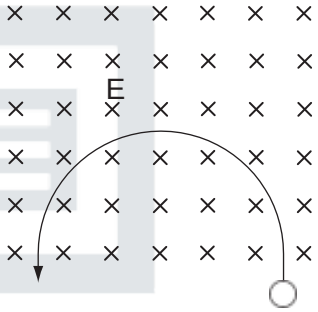

**C**

electric field into paper

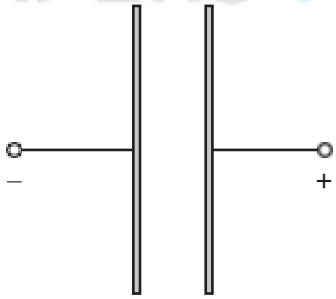



**D**

electric field into paper



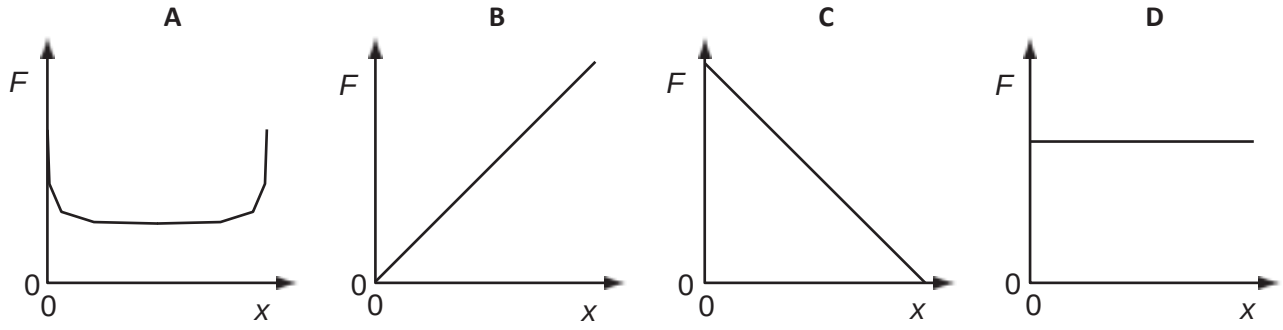

31. Two oppositely-charged parallel plates are arranged as shown.




An electron is released from rest from the surface of the negatively-charged plate.

The electron travels from the negatively-charged plate towards the positively-charged plate.

Which graph shows how the force *F* on the electron varies with its distance *x* from the negative plate?




32. Two conducting layers of a liquid crystal display of a calculator are 8 μm apart. A 1.5 V cell is connected across the conducting layers when the calculator is switched on.

What is the electric field strength between the layers?

A $1.2 \times 10^{-5}\,V\,m^{-1}$

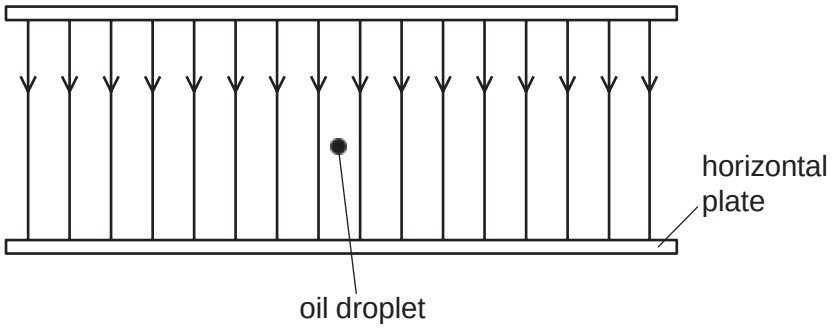
B $0.19\,V\,m^{-1}$

C $12\,V\,m^{-1}$

D $1.9 \times 10^{5}\,V\,m^{-1}$

33. A tiny oil droplet with mass $6.9 \times 10^{-13}$ kg is at rest in an electric field of electric field strength

$\times 10^{7}$ N C$^{-1}$, as shown.




The weight of the droplet is exactly balanced by the electrical force on the droplet.

What is the charge on the droplet?

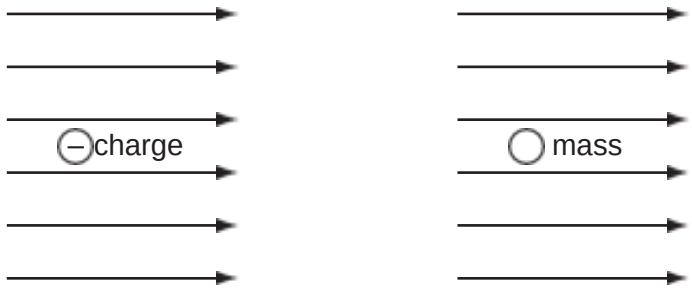
A $3.3 \times 10^{-20}$ C

B $-3.3 \times 10^{-20}$ C

C $3.2 \times 10^{-19}$ C

D $-3.2 \times 10^{-19}$ C

34. The diagrams show a negative electric charge situated in a uniform electric field and a mass situated in a uniform gravitational field.

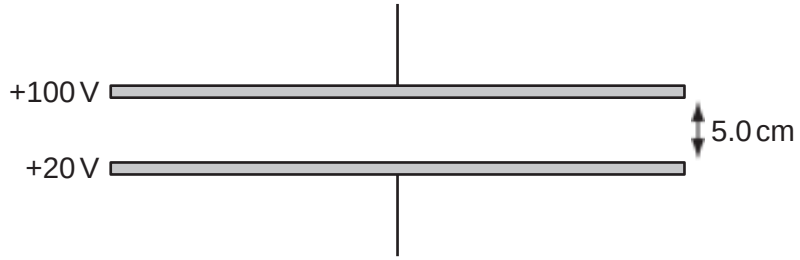



uniform electric field  uniform gravitational field

Which row shows the directions of the forces acting on the charge and on the mass?

| | charge | mass |
|---|---|---|
| **A** | ⊖→ | ○→ |
| **B** | ←⊖ | ○→ |
| **C** | ⊖→ | ○↓ |
| **D** | ←⊖ | ○↓ |

35. Two metal plates are held horizontal and parallel, 5.0 cm apart. The plates are at potentials of +100 V and +20 V.




What is the force experienced by an electron in the electric field between the plates?

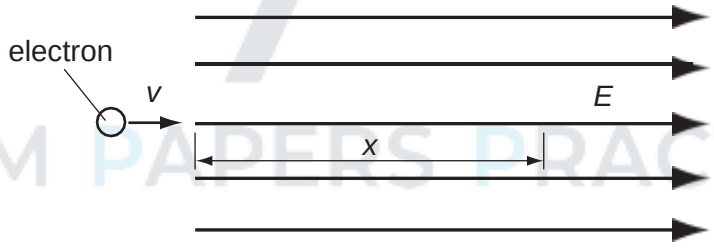
A $2.6 \times 10^{-18}$ N

B $3.8 \times 10^{-18}$ N

C $2.6 \times 10^{-16}$ N

D $3.8 \times 10^{-16}$ N

36. The diagram shows an electron, with charge *e*, mass *m*, and velocity *v*, entering a uniform electric field of strength *E*.

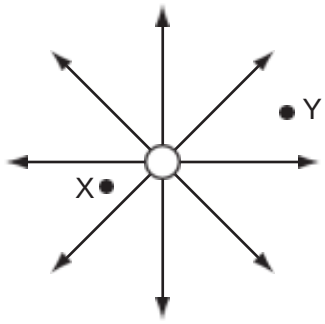



The direction of the field and the electron's motion are both horizontal and to the right.

Which expression gives the distance *x* through which the electron travels before it stops momentarily?

A $x = \frac{mv}{E}$ B $x = \frac{mv}{Ee}$ C $x = \frac{mv^2}{2E}$ D $x = \frac{mv^2}{2Ee}$

37. The diagram shows the electric field near a point charge and two electrons X and Y.



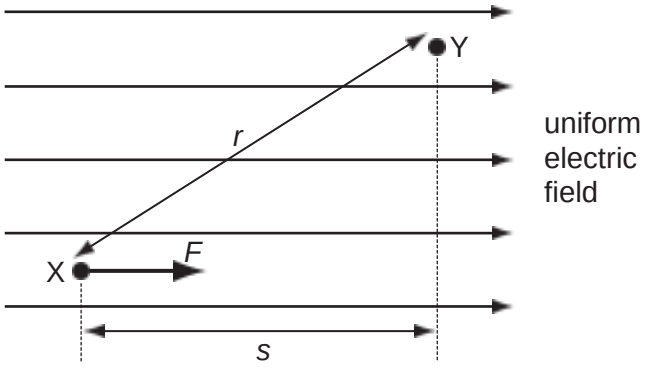

Which row describes the forces acting on X and Y?

| | direction of force | magnitude of force on X |
|---|---|---|
| A | radially inwards | less than force on Y |
| B | radially inwards | greater than force on Y |
| C | radially outwards | less than force on Y |
| D | radially outwards | greater than force on Y |

38. A positive charge experiences a force *F* when placed at point X in a uniform electric field.

The charge is then moved from point X to point Y.

Distances *r* and *s* are shown on the diagram.




What is the change in the potential energy of the charge?

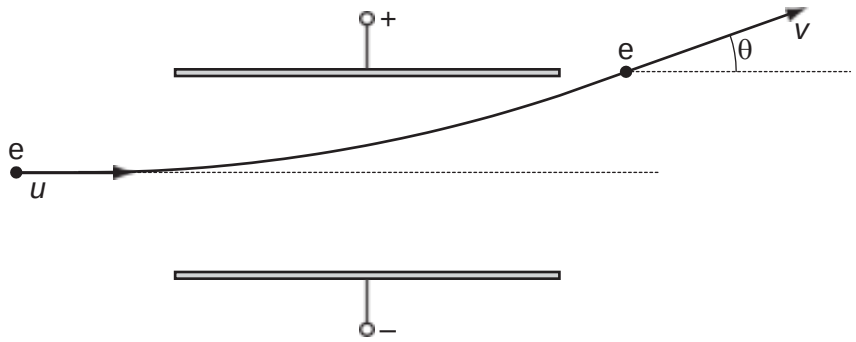
A decreases by *Fs*

B increases by *Fs*

C decreases by *Fr*

D increases by *Fr*

39. An electron enters the space between two parallel charged plates with an initial velocity *u*.

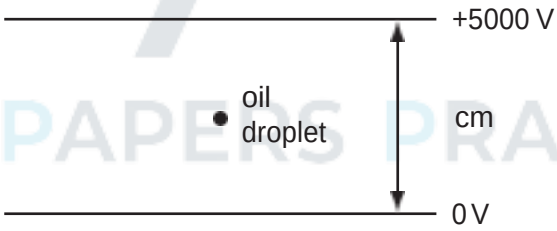



While in the electric field, its direction changes by θ and it emerges with a velocity *v*.

What is the relation between *v* and *u*?

A $v = \frac{u}{\cos\theta}$ B $v = u\cos\theta$ C $v = \frac{u}{\sin\theta}$ D $v = u\sin\theta$

40. The diagram shows an oil droplet that has become charged by gaining five electrons. The droplet remains stationary between charged plates.




What is the magnitude and direction of the electrostatic force on the oil droplet?

A $5.0 \times 10^{-15}$ N upwards

B $5.0 \times 10^{-15}$ N downwards

C $5.0 \times 10^{-13}$ N upwards

D $5.0 \times 10^{-13}$ N downwards