1)

Which one of the following statements is correct?

The force between two charged particles

A is always attractive.

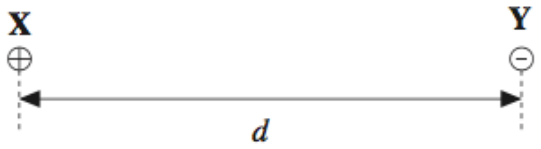
B can be measured in $C^2 F^{-1} m^{-1}$.

C is directly proportional to the distance between them.

D is independent of the magnitude of the charges.

2)

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 $0.5F$.

What is the distance d?

A 7 mm

B 14 mm

C 15 mm

D 28 mm

3)

A positive ion has a charge-to-mass ratio of 2.40×10^7 C kg^{-1}. It is held stationary in a vertical electric field.
Which line, **A** to **D**, in the table shows correctly both the strength and the direction of the electric field?

	Electric field strength / V m^{-1}	**Direction**
A	4.09×10^{-7}	upwards
B	4.09×10^{-7}	downwards
C	2.45×10^{6}	upwards
D	2.45×10^{6}	downwards

4)

In the equation $X = \frac{ab}{r^n}$, X represents a physical variable in an electric or a gravitational field, a is a constant, b is either mass or charge and n is a number.

Which line, **A** to **D**, in the table provides a consistent representation of X, a and b according to the value of n?

The symbols E, g, V and r have their usual meanings.

	n	X	a	b
A	1	E	$\frac{1}{4\pi\varepsilon_0}$	charge
B	1	V	$\frac{1}{4\pi\varepsilon_0}$	mass
C	2	g	G	mass
D	2	V	G	charge

5)

Which one of the following statements is correct?

When a negative ion is projected into an electric field

A the field can change the magnitude of the velocity but not its direction.

B the field can change the direction of the velocity but not its magnitude.

C the field can change both the magnitude and the direction of the velocity.

D the ion will accelerate in the direction of the field.

6)

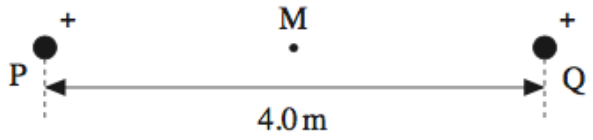
Two horizontal parallel plate conductors are separated by a distance of 5.0 mm in air. The lower plate is earthed and the potential of the upper plate is +50 V.

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/V m^{-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

7)

Two identical positive point charges, P and Q, are separated by a distance of 4.0 m. The resultant electric potential at point M, which is mid-way between the charges, is 25.0 V.



What would be the resultant electrical potential at a point 1.0 m closer to P?

A 8.3 V

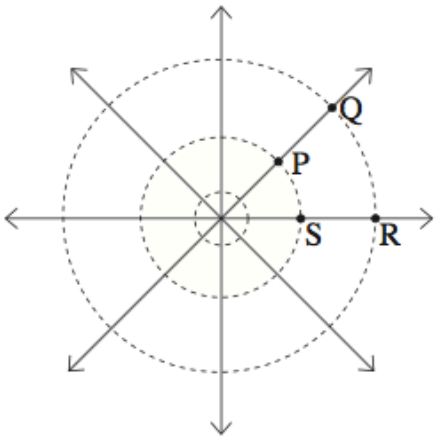
B 12.5 V

C 33.3 V

D 37.5 V

8)

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.

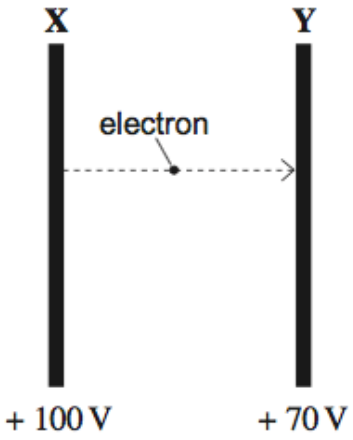
B When it is moved from Q to R no work is done.

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.

9)

Two fixed parallel metal plates **X** and **Y** are at constant potentials of + 100 V and + 70 V respectively. An electron travelling from **X** to **Y** experiences a change of potential energy ΔE_p



Which line, **A** to **D**, in the table shows correctly the direction of the electrostatic force F on the electron and the value of ΔE_p?

	Direction of F	ΔE_p
A	towards **X**	+ 30 eV
B	towards **Y**	– 30 eV
C	away from **X**	+ 30 eV
D	away from **Y**	– 30 eV

10)

Two identical positive point charges, P and Q, separated by a distance r, repel each other with a force F. If r is decreased so that the electrical potential energy of Q is doubled, what is the force of repulsion?

A $0.5F$

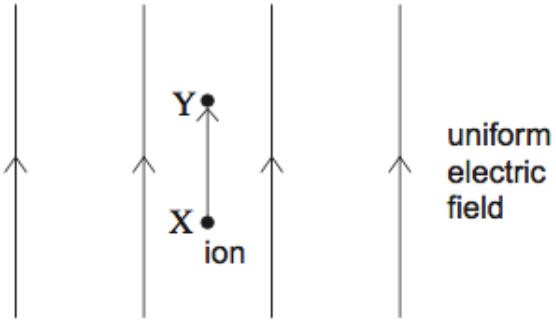
B F

C $2F$

D $4F$

11)

A uniform electric field of electric field strength E is aligned so it is vertical. An ion moves vertically through a small distance Δd from point X to point Y in the field. There is a uniform gravitational field of field strength g throughout the region.



Which line, **A** to **D**, in the table correctly gives the gravitational potential difference, and the electric potential difference, between X and Y?

	Gravitational potential difference	Electric potential difference
A	$g\Delta d$	$E\Delta d$
B	$g\Delta d$	$\frac{E}{\Delta d}$
C	$\frac{g}{\Delta d}$	$E\Delta d$
D	$\frac{g}{\Delta d}$	$\frac{E}{\Delta d}$

12)

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 $\frac{F}{3r}$

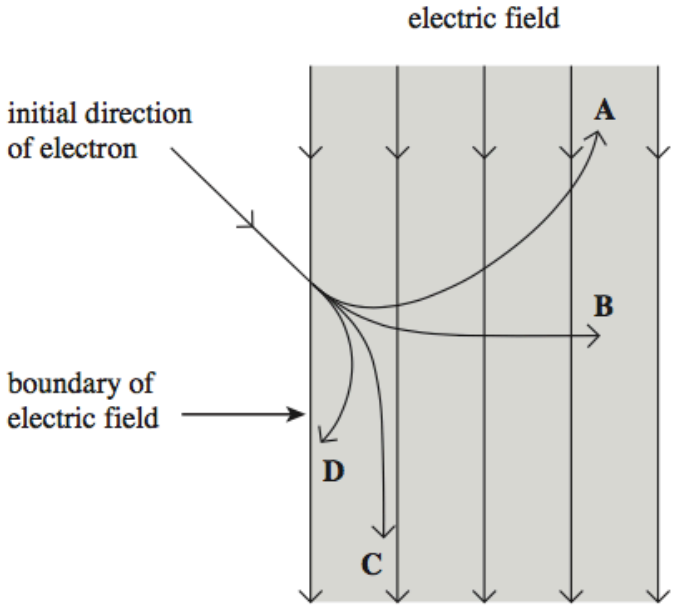
B $\frac{F}{9r}$

C $\frac{F}{3}$

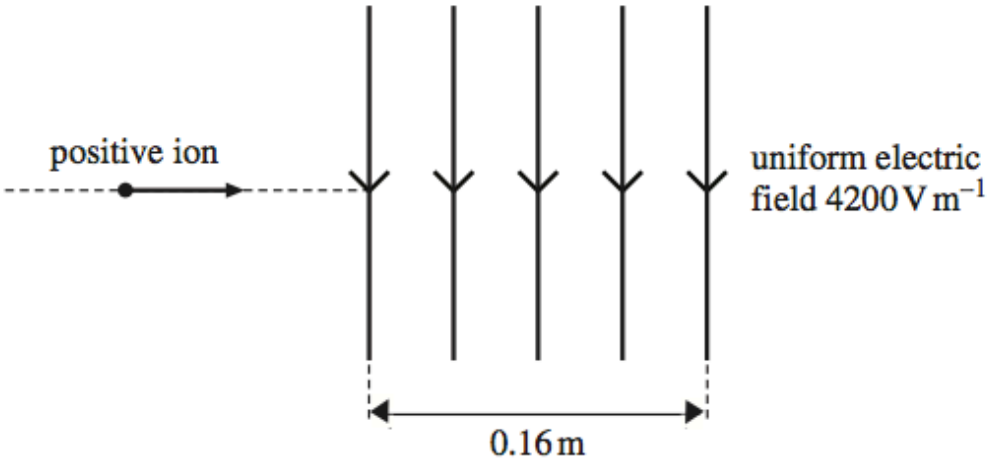
D $\frac{F}{9}$

13)

Which path, **A** to **D**, shows how an electron moves in the uniform electric field represented in the diagram?



14)

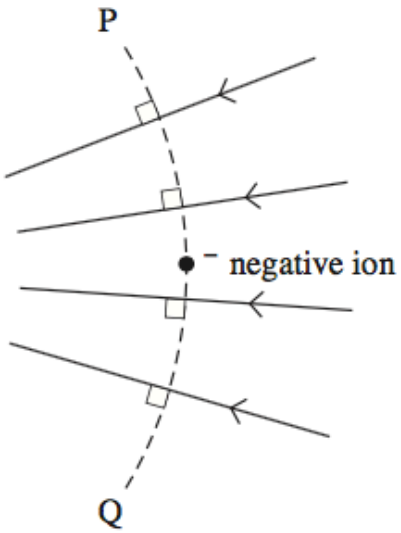


An ion carrying a charge of $+4.8 \times 10^{-19}$C travels horizontally at a speed of 8.0×10^{5}m s^{-1}. It enters a uniform vertical electric field of strength 4200 V m^{-1}, which is directed downwards and acts over a horizontal distance of 0.16m.
Which one of the following statements is **not**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

A The ion passes through the field in 2.0×10^{-7}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 1.6×10^{-9} N.
D The horizontal component of the velocity of the ion is unaffected by the electric field.

15)

The diagram shows a negative ion at a point in an electric field, which is represented by the arrowed field lines.



Which one of the following statements correctly describes what happens when the ion is displaced?

When the negative ion is displaced

A to the left the magnitude of the electric force on it decreases.

B to the right its potential energy increases.

C along the line PQ towards Q its potential energy decreases.

D along the line PQ towards P the magnitude of the electric force on it is unchanged.

16)

An electron and a proton are 1.0×10^{-10} m apart. In the absence of any other charges, what is the electric potential energy of the electron?

A $+2.3 \times 10^{-18}$ J

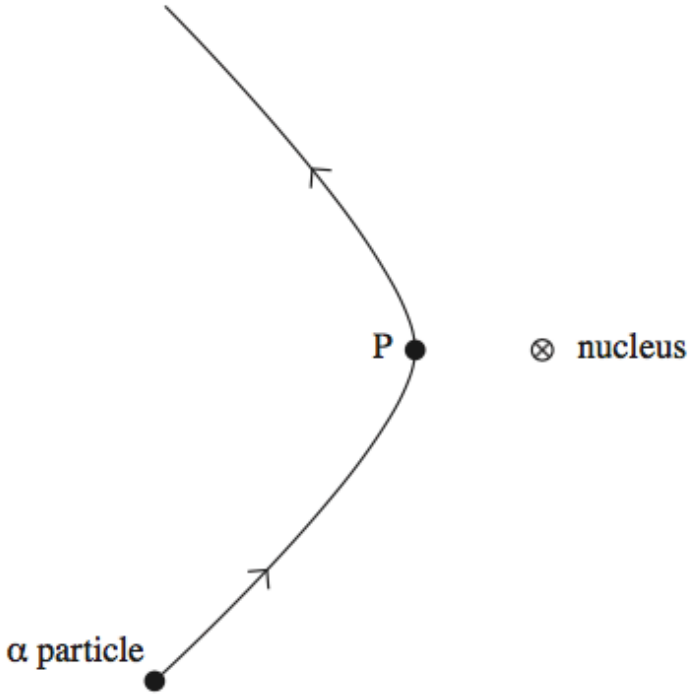
B -2.3×10^{-18} J

C $+2.3 \times 10^{-8}$ J

D -2.3×10^{-8} J

17)

The diagram shows the path of an α particle deflected by the nucleus of an atom. Point P on the path is the point of closest approach of the α particle to the nucleus.



Which one of the following statements about the α particle on this path is correct?

A Its acceleration is zero at P.

B Its kinetic energy is greatest at P.

C Its speed is least at P.

D Its potential energy is least at P.

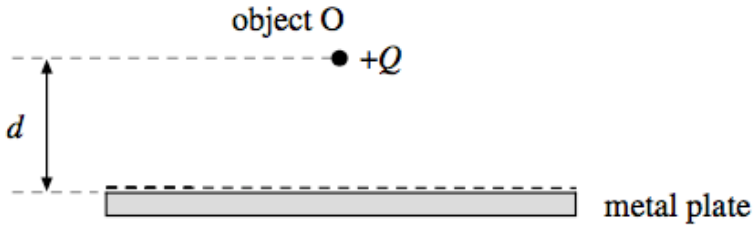
18)

The electric potential at a distance *r* from a positive point charge is 45 V. The potential increases to 50 V when the distance from the charge decreases by 1.5 m. What is the value of *r*?

A 1.3 m
B 1.5 m
C 7.9 m
D 15 m

19)

A small object O carrying a charge $+Q$ is placed at a distance d from a metal plate that has an equal and opposite charge. The object is acted on by an electrostatic force F.



Which one of the following expressions has the same unit as F?

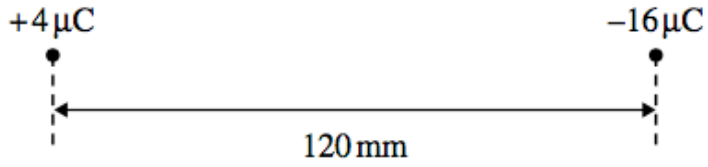
A $\frac{\varepsilon_0 Q^2}{d}$

B $\frac{\varepsilon_0 Q^2}{d^2}$

C $\frac{Q^2}{\varepsilon_0 d}$

D $\frac{Q^2}{\varepsilon_0 d^2}$

20)

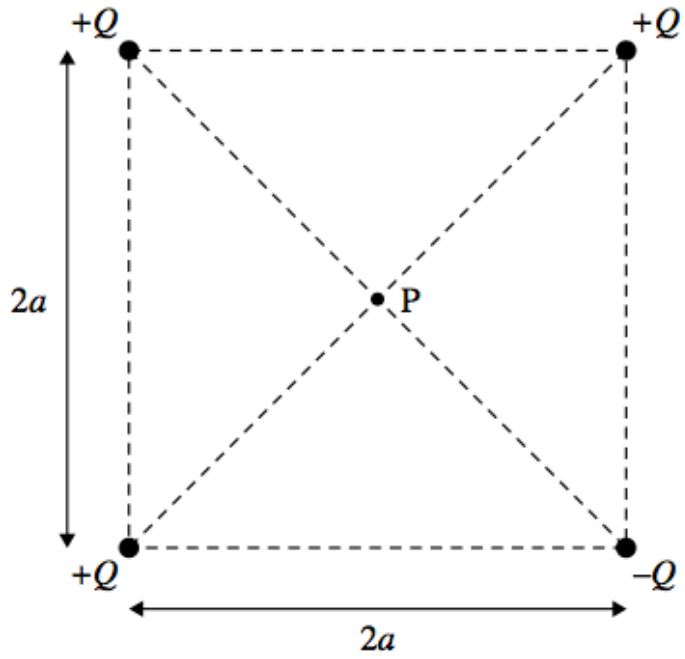


The diagram shows two charges, +4 μC and −16 μC, 120 mm apart. What is the distance from the +4 μC charge to the point between the two charges where the resultant electric potential is zero?

A 24 mm
B 40 mm
C 80 mm
D 96 mm

21)

The diagram shows four point charges at the corners of a square of side $2a$. What is the electric potential at P, the centre of the square?



A $\dfrac{Q}{2\sqrt{2}\pi\varepsilon_0 a}$

B $\dfrac{Q}{\sqrt{2}\pi\varepsilon_0 a}$

C $\dfrac{Q}{2\pi\varepsilon_0 a}$

D $\dfrac{Q}{4\pi\varepsilon_0 a}$