Q1.A satellite orbiting the Earth moves to an orbit which is closer to the Earth.

Which line, **A** to **D**, in the table shows correctly what happens to the speed of the satellite and to the time it takes for one orbit of the Earth?

	Speed of satellite	**Time For One Orbit Of Earth**
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

(Total 1 mark)

Q2.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

(Total 1 mark)

Q3. 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

(Total 1 mark)

Q4. Which one of the following statements is correct?

An electron follows a circular path when it is moving at right angles to

A a uniform magnetic field.

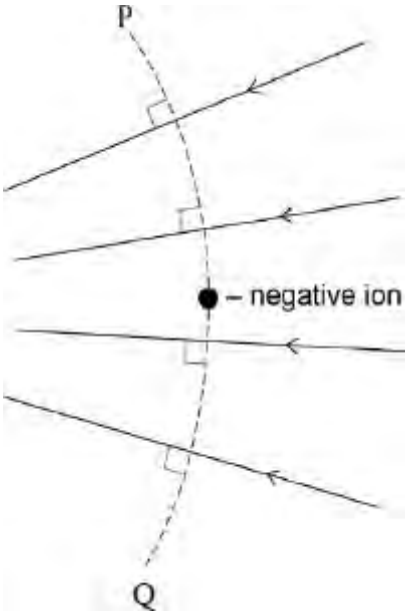
B a uniform electric field.

C uniform electric and magnetic fields which are perpendicular.

D uniform electric and magnetic fields which are in opposite directions.

(Total 1 mark)

Q5. The diagram shows a small negative charge at a point in an electric field, which is represented by the arrowed field lines.



Which of the following statements, about what happens when the charge is displaced, is correct?

When the negative charge is displaced

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

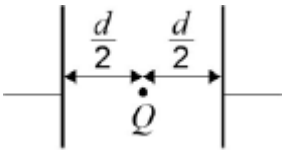
B to the right its potential energy increases. ⬭

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. ⬭

(Total 1 mark)

Q6. 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 $\frac{2VQ}{d}$ ⬭

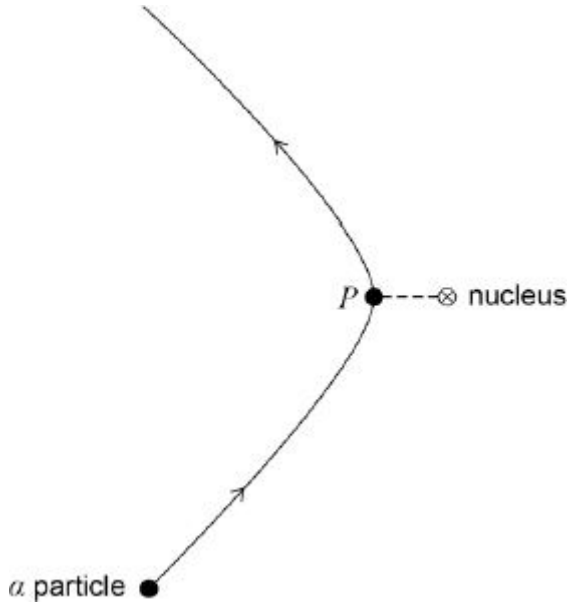
B $\frac{VQ}{d}$ ⬭

C $\frac{VQ}{2d}$ ⬭

D $\frac{Qd}{v}$ ⬭

(Total 1 mark)

Q7. 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 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 potential energy is least at P. ⬭

D Its speed is least at P. ⬭

(Total 1 mark)

Q8. 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 point 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 15m ⬭

(Total 1 mark)

Q9. 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)

Q10. Which of the following statements about a parallel plate capacitor is **incorrect**?

A The capacitance of the capacitor is the amount of charge stored by the capacitor when the pd across the plates is 1 V. ⬭

B A uniform electric field exists between the plates of the capacitor. ⬭

C The charge stored on the capacitor is inversely proportional to the pd across the plates. ⬭

D The energy stored when the capacitor is fully charged is proportional to the square of the pd across the plates. ⬭

(Total 1 mark)

Q11. Which one of the following statements is correct?

The force between two charged particles

A is always attractive

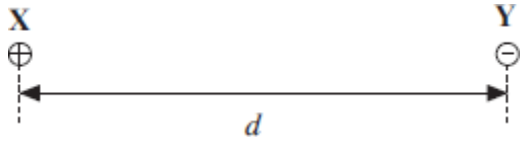
B can be measured in $C^2\ F^{-1}\ m^{-1}$

C is directly proportional to the distance between them

D is independent of the magnitude of the charges

(Total 1 mark)

Q12. 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)

Q13. 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

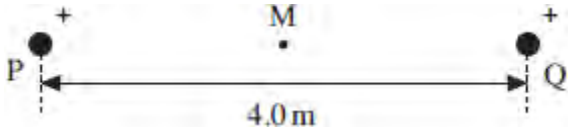
B the field can change the direction of the velocity but not its magnitude

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

(Total 1 mark)

Q14. 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

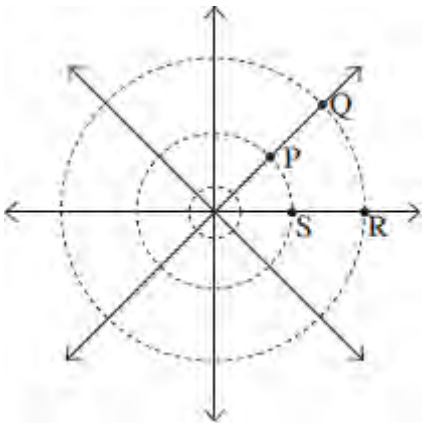
B 12.5 V

C 33.3 V

D 37.5 V

(Total 1 mark)

Q15. 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

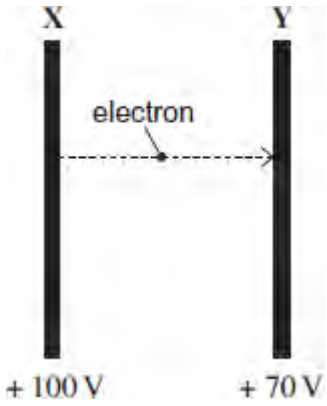
B when it is moved from Q to R no work is done

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)

Q16. 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.

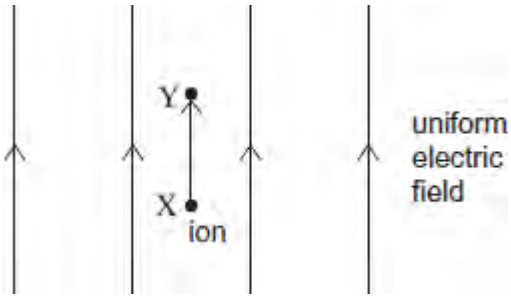


Which line, **A** to **D**, in the table shows correctly the direction of the electrostatic force F on the electron and the value of ΔE_p?

	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

(Total 1 mark)

Q17. 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	$\frac{g}{\Delta d}$	$\frac{E}{\Delta d}$

(Total 1 mark)

Q18. 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)

Q19. 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 0.5 *F*

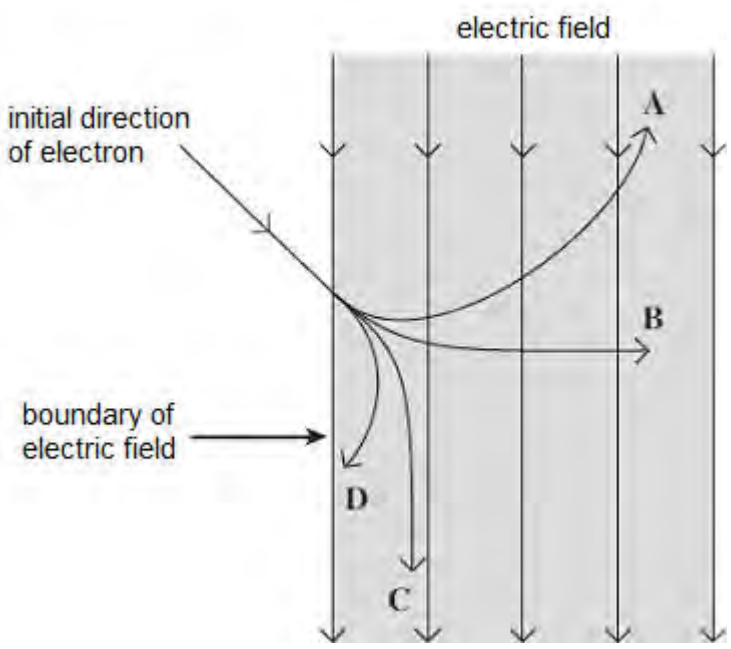
B *F*

C 2*F*

D 4*F*

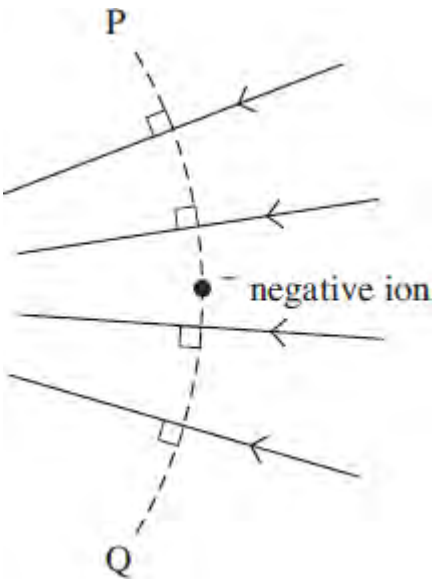
(Total 1 mark)

Q20. Which path, **A** to **D**, shows how an electron moves in the uniform electric field represented in the diagram?



(Total 1 mark)

Q21. 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.

(Total 1 mark)

Q22. 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.

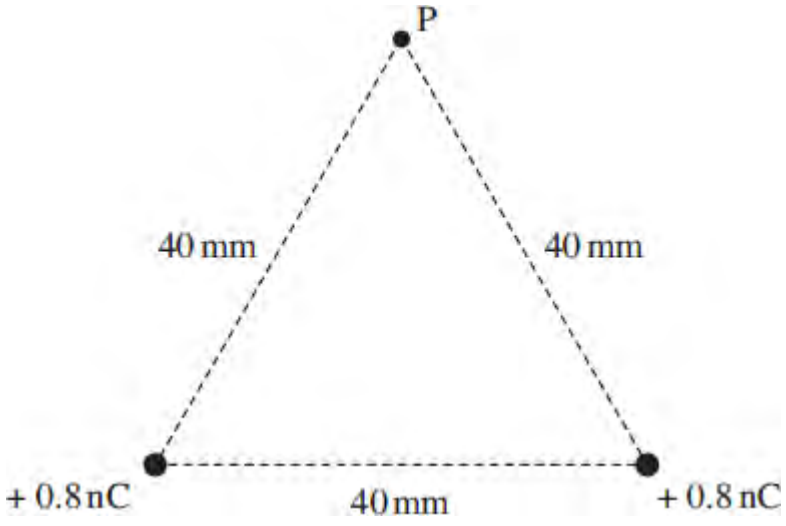
B The energy transferred is independent of the path followed.

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)

Q23. Two charges, each of + 0.8 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)

Q24. Which one of the following statements about a parallel plate capacitor is **incorrect**?

A The capacitance of the capacitor is the amount of charge stored by the capacitor when the pd across the plates is 1V.

B A uniform electric field exists between the plates of the capacitor.

C The charge stored on the capacitor is inversely proportional to the pd across the plates.

D The energy stored when the capacitor is fully charged is proportional to the square of the pd across the plates.

(Total 1 mark)

Q25. 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)

Q26. The force between two point charges is *F* when they are separated by a distance *r*. If the separation is increased to 3*r*, what is the force between the charges?

A $\frac{F}{3r}$

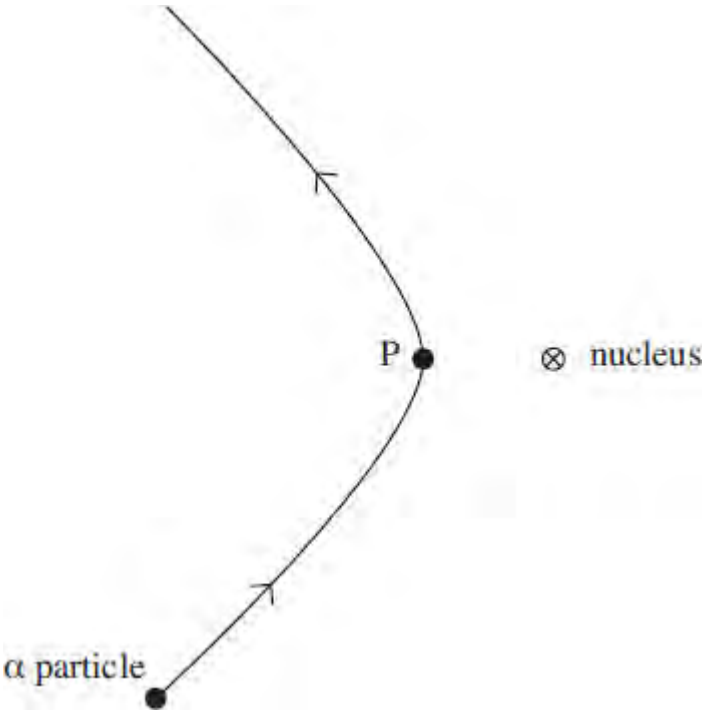
B $\frac{F}{9r}$

C $\frac{F}{3}$

D $\frac{F}{9}$

(Total 1 mark)

Q27. 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.

(Total 1 mark)

Q28. 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*

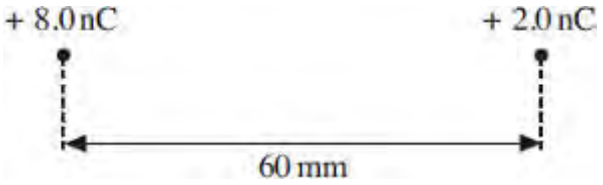
B 2*F*

C 4*F*

D 16*F*

(Total 1 mark)

Q29. The distance between two point charges of + 8.0 nC and + 2.0 nC is 60 mm.



At a point between the charges, on the line joining them, the resultant electric field strength is zero. How far is this point from the + 8.0 nC charge?

A 20 mm

B 25 mm

C 40 mm

D 45 mm

(Total 1 mark)

Q30. Which one of the following **cannot** be used as a unit for electric field strength?

A $J\ m^{-1}\ C^{-1}$

B $J\ A^{-1}\ s^{-1} m^{-1}$

C $N\ A^{-1}\ s^{-1}$

D $J\ C\ m^{-1}$

(Total 1 mark)

Q31. 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

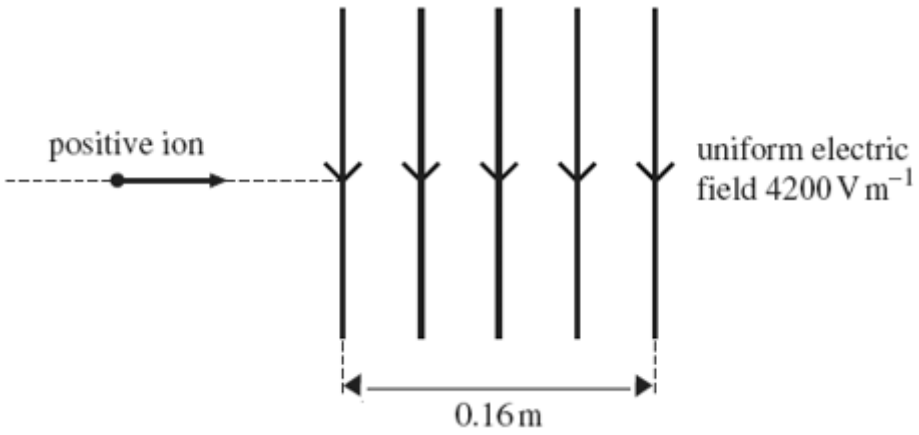
B -2.3×10^{-18}J

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

D -2.3×10^{-8}J

(Total 1 mark)

Q32.



An ion carrying a charge of +4.8 × 10^{-19}C travels horizontally at a speed of 8.0 × 10^{5}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 0.16m. 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.

(Total 1 mark)

Q33. 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

(Total 1 mark)

Q34. 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)

Q35. What is the acceleration of an electron at a point in an electric field where the field strength is 1.5×10^5 V m^{-1}?

A 1.2×10^6 m s^{-2}

B 1.4×10^{13} m s^{-2}

C 2.7×10^{15} m s^{-2}

D 2.6×10^{16} m s^{-2}

(Total 1 mark)

Q36. Two protons are 1.0×10^{-14} m apart. Approximately how many times is the electrostatic force between them greater than the gravitational force between them?
(Use the Data and Formulae booklet)

A 10^{23}

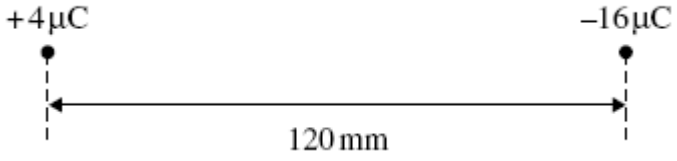
B 10^{30}

C 10^{36}

D 10^{42}

(Total 1 mark)

Q37.



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

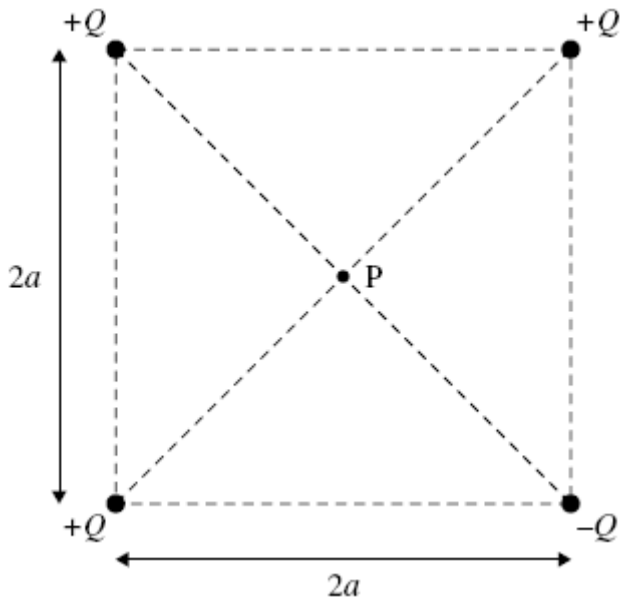
B 40 mm

C 80 mm

D 96 mm

(Total 1 mark)

Q38. The diagram shows four point charges at the corners of a square of side 2*a*. What is the electric potential at P, the centre of the square?



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

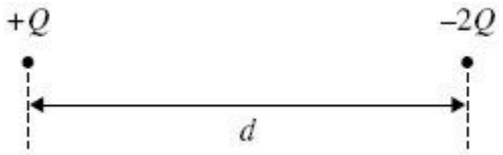
B $\frac{Q}{\sqrt{2}\pi\varepsilon_0 a}$

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

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

(Total 1 mark)

Q39.



The diagram shows two particles at a distance *d* apart. One particle has charge +*Q* and the other –2*Q*. 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 2*d*.
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)

Q40. Which one of the following statements about a charged particle in an electric field is correct?

A No work is done when a charged particle moves along a field line.

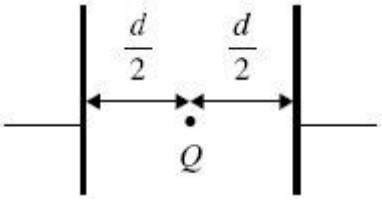
B No force acts on a charged particle when it moves along a field line.

C No work is done when a charged particle moves along a line of constant potential.

D No force acts on a charged particle when it moves along a line of constant potential.

(Total 1 mark)

Q41. Two parallel metal plates separated by a distance *d* have a potential difference *V* across them.
What is 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)

Q42. Which one of the following statements about *electric field strength* and *electric potential* is **incorrect**?

A Electric potential is a scalar quantity.

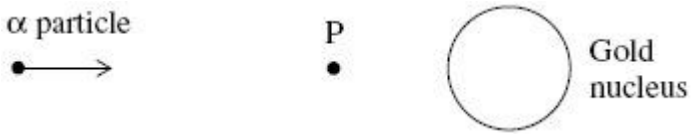
B Electric field strength is a vector quantity.

C Electric potential is zero whenever the electric field strength is zero.

D The potential gradient is proportional to the electric field strength.

(Total 1 mark)

Q43.



An α particle travels towards a gold nucleus and at P reverses its direction.
Which one of the following statements is **incorrect**?

A The electric potential energy of the α particle is a maximum at P.

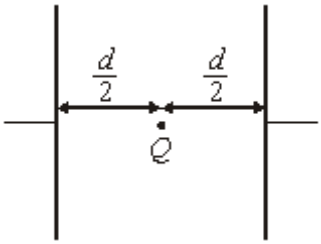
B The kinetic energy of the α particle is a minimum at P.

C The total energy of the α particle is zero.

D The total energy of the α particle has a constant positive value.

(Total 1 mark)

Q44. Two parallel metal plates separated by a distance *d* have a potential difference V across them. What is the magnitude of the electrostatic force acting on a charge Q placed midway between the plates?



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

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

C $\frac{VQ}{d}$

D $\frac{Qd}{V}$

(Total 1 mark)

Q45. Two protons, each of mass *m* and charge *e*, are a distance *d* apart. Which one of the following expressions correctly gives the ratio $\left(\frac{\text{electrostatic force}}{\text{gravitational force}}\right)$ for the forces acting between them?

A $\frac{4\pi\varepsilon_0 e^2}{Gm^2}$

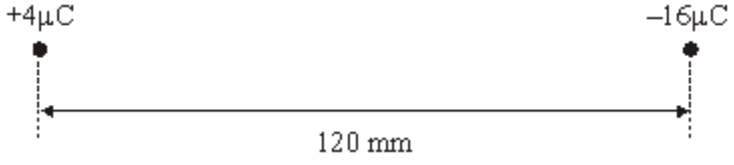
B $\frac{Ge^2}{4\pi\varepsilon_0 m^2}$

C $\frac{e^2 m^2}{4\pi\varepsilon_0 G}$

D $\frac{e^2}{4\pi\varepsilon_0 Gm^2}$

(Total 1 mark)

Q46.



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

(Total 1 mark)

Q47. An electron travelling at constant speed enters a uniform electric field at right angles to the field. While the electron is in the field it accelerates in a direction which is

A in the same direction as the electric field.

B in the opposite direction to the electric field.

C in the same direction as the motion of the electron.

D in the opposite direction to the motion of the electron.

(Total 1 mark)

Q48. 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

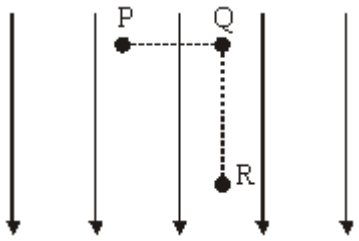
B 20 μN

C 10 μN

D 5 μN

(Total 1 mark)

Q49.



The diagram shows a uniform electric field of strength 10 V m^{-1}

A charge of 4 μC is moved from P to Q and then from Q to R. If the distance PQ is 2 m and QR is 3 m, what is the change in potential energy of the charge when it is moved from P to R?

A 40 μJ

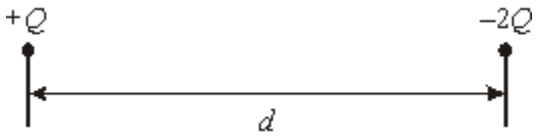
B 50 μJ

C 120 μJ

D 200 μJ

(Total 1 mark)

Q50.



The diagram shows two particles at a distance *d* apart. One particle has charge +*Q* and the other –2*Q*. 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 2*d*. 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)

Q51. The electrical field strength, *E*, and the electrical potential, *V*, at the surface of a sphere of radius *r* carrying a charge *Q* are given by the equations

$$E = \frac{Q}{4\pi\varepsilon_0 r^2} \text{ and } V = \frac{Q}{4\pi\varepsilon_0 r}$$

A school van de Graaff generator has a dome of radius 100 mm. Charge begins to leak into the air from the dome when the electric field strength at its surface is approximately 3×10^6 V m^{-1}. What, approximately, is the maximum potential to which the dome can be raised without leakage?

A 3×10^4 V

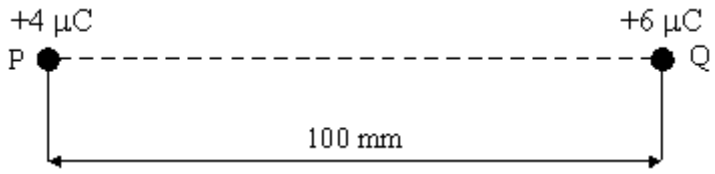
B 3×10^5 V

C 3×10^6 V

D 3×10^7 V

(Total 1 mark)

Q52. Two charges, P and Q, are 100 mm apart.



X is a point on the line between P and Q. If the potential at X is 0 V, what is the distance from P to X?

A 40 mm

B 45 mm

C 50 mm

D 60 mm

(Total 1 mark)