Multiple Choice Electric Fields Paper Questions
Jan 2002—Jan 2010 (old spec)

9 If the potential difference between a pair of identical, parallel, conducting plates is known, what is the only additional knowledge required to determine the electric field strength between the plates?

Jan 2002

A the permittivity of the medium between the plates

B the separation and area of the plates

C the separation and area of the plates and the permittivity of the medium between the plates

D the separation of the plates

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

A Electric potential is a scalar quantity.

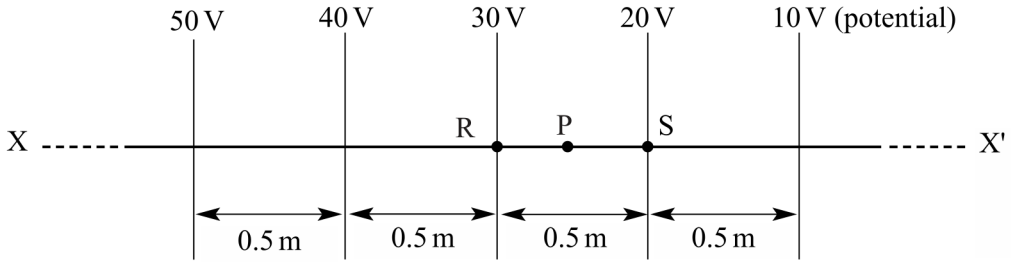
B Electric field strength is a vector quantity.

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

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

12

Jun 2002



The diagram shows how the electric potential varies along a line XX' in an electric field. What will be the electric field strength at a point P on XX' which is mid-way between R and S?

A $5.0\ \text{V m}^{-1}$

B $10\ \text{V m}^{-1}$

C $20\ \text{V m}^{-1}$

D $30\ \text{V m}^{-1}$

13 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 place is + 50 V.

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

Jan 2003

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

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 $\frac{F}{3r}$

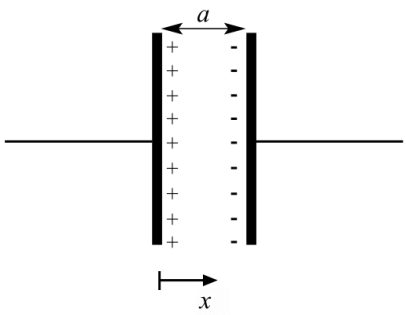
B $\frac{F}{9r}$

C $\frac{F}{3}$

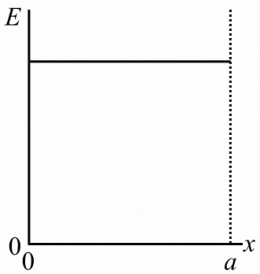
D $\frac{F}{9}$

Jun 2003

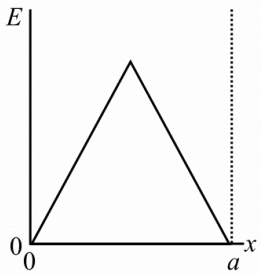
13



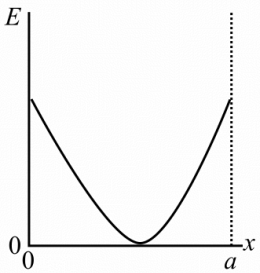
Two parallel metal plates of separation a carry equal and opposite charges. Which one of the following graphs, **A** to **D**, best represents how the electric field strength E varies with the distance x in the space between the plates?



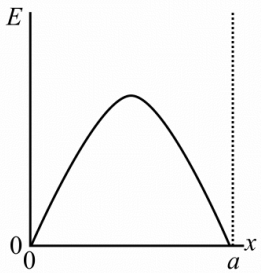
A



B



C



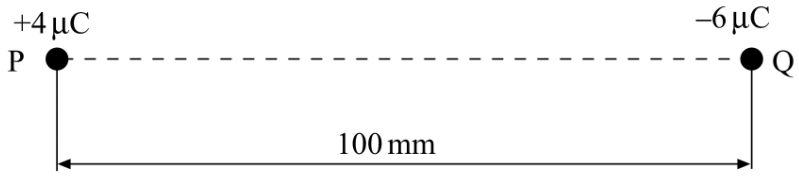
D

10 At a distance R from a fixed charge, the electric field strength is E and the electric potential is V. Which line, **A** to **D**, gives the electric field strength and electric potential at a distance $2R$ from the charge?

Jan 2004

	electric field strength	electric potential
A	$\frac{E}{2}$	$\frac{V}{4}$
B	$\frac{E}{2}$	$\frac{V}{2}$
C	$\frac{E}{4}$	$\frac{V}{2}$
D	$\frac{E}{4}$	$\frac{V}{4}$

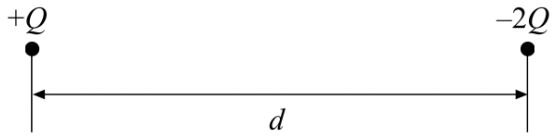
11 Two charges, P and Q, are 100 mm apart.



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

10



Jun 2004

The diagram shows two particles at a 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 a distance of $2d$. 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 $\frac{F}{2}$

11 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 $3 \times 10^6\,\text{V m}^{-1}$.
What, approximately, is the maximum potential to which the dome can be raised without leakage?

A $3 \times 10^4\,\text{V}$
B $3 \times 10^5\,\text{V}$
C $3 \times 10^6\,\text{V}$
D $3 \times 10^7\,\text{V}$

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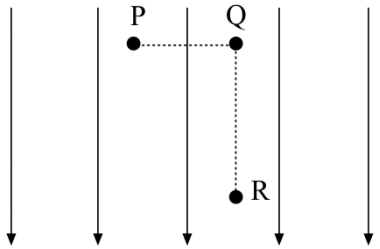
10 Two isolated point charges are separated by 0.04 m and attract each other with a force of 20 μN. If the distance between them is increased by 0.04 m, what is the new force of attraction?

Jan 2005

A 40 μN
B 20 μN
C 10 μN
D 5 μN

11



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

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

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9 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?

Jun 2005

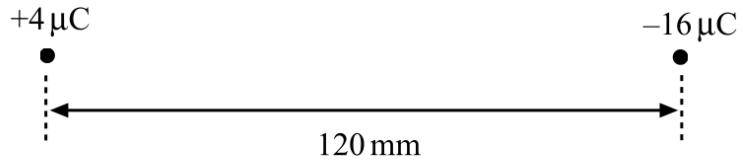
A $\frac{4\pi\varepsilon_0 e^2}{Gm^2}$

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

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

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

11



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

12 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.

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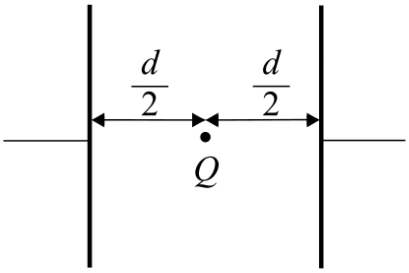
11 Two parallel metal plates separated by a distance d have a potential difference V across them. What is the magnitude of the electrostatic force acting on a charge Q placed midway between the plates?

Jan 2006



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

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

C $\frac{VQ}{d}$

D $\frac{Qd}{V}$

12 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?

Jun 2006

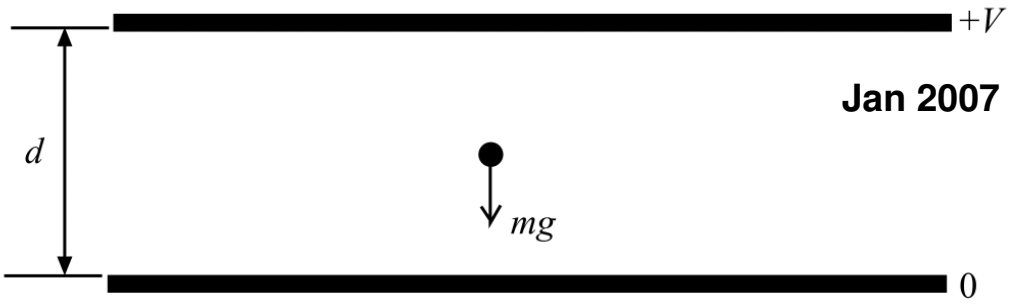
A 10^{23}

B 10^{30}

C 10^{36}

D 10^{42}

11



Jan 2007

The diagram shows a charged oil drop of weight mg, which is stationary in the electric field between two parallel plates. If the potential difference between the plates is V and the separation of the plates is d, what is the charge on the oil drop?

A $-\dfrac{Vd}{mg}$

B $-\dfrac{V}{mgd}$

C $-mgVd$

D $-\dfrac{mgd}{V}$

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12 When two point charges, each $+Q$, are distance r apart, the force between them is F. What is the force between point charges of $+Q$ and $+2Q$ when they are distance $\dfrac{r}{2}$ apart?

Jan 2008

A F

B $2F$

C $8F$

D $16F$

13 Variables x and y are defined by

$$x = \frac{\alpha z}{r} \quad \text{and} \quad y = \frac{\beta z}{r^2},$$

where r is a distance, z is either a mass or a charge, and α and β are constants.

Which line, **A** to **D**, in the table shows correctly the meaning of the symbols when used in this way?

	gravitational field	**electric field**
A	$\alpha = G$	y = potential
B	$\beta = \frac{1}{G}$	x = potential
C	x = field strength	$\beta = 4\pi\varepsilon_0$
D	y = field strength	$\alpha = \frac{1}{4\pi\varepsilon_0}$

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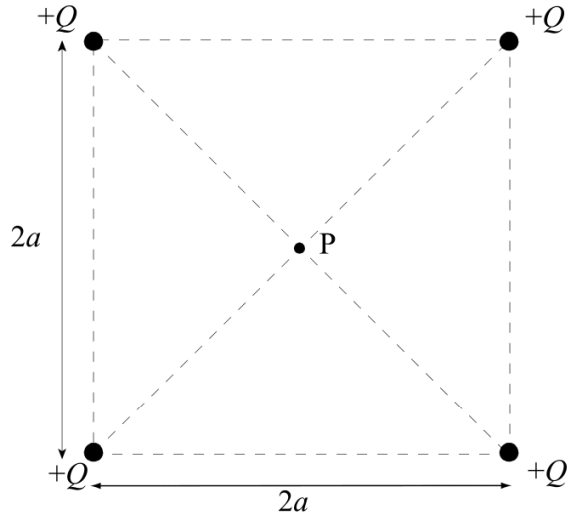
10 A charged particle of mass 4.80×10^{-13} kg and charge 8.00×10^{-19} C is stationary in a vertical electric field. What is the value of the electric field?
(Assume that the gravitational field strength is $10.0\,\text{N kg}^{-1}$) **Jun 2008**

A $6.00 \times 10^{5}\,\text{V m}^{-1}$
B $1.67 \times 10^{6}\,\text{V m}^{-1}$
C $6.00 \times 10^{6}\,\text{V m}^{-1}$
D $1.67 \times 10^{7}\,\text{V m}^{-1}$

11 The diagram shows four point charges, each $+Q$, at the corners of a square of side $2a$. What is the electric field strength at P, the centre of the square?



A zero

B $\frac{Q}{4\pi\varepsilon_0 a^2}$

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

D $\frac{Q}{\pi\varepsilon_0 a^2}$

9 Which one of the following is a quantity that can be resolved into different directions?

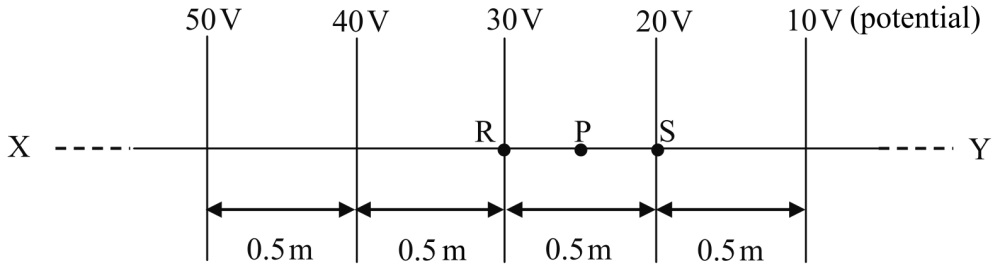
Jan 2009

A electrical potential
B gravitational potential
C electric field strength
D induced emf

11 A positive ion, with a charge/mass ratio of $2.40 \times 10^{7}\,\text{C kg}^{-1}$, is 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

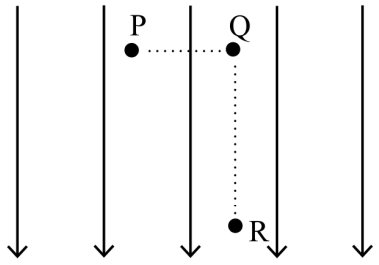
12



The diagram shows how the electric potential varies along a line XY in an electric field. What will be the electric field strength at a point P on XY, which is mid-way between R and S?

A $5.0\,\text{V m}^{-1}$
B $10\,\text{V m}^{-1}$
C $20\,\text{V m}^{-1}$
D $30\,\text{V m}^{-1}$

10



Jun 2009

The diagram shows a uniform electric field of strength $10\,\text{V m}^{-1}$.

A charge of $4.0\,\mu\text{C}$ is moved from P to Q and then from Q to R. If the distance PQ is 2.0 m and QR is 3.0 m, what is the change in potential energy of the charge when it is moved from P to R?

A $40\,\mu\text{J}$
B $50\,\mu\text{J}$
C $120\,\mu\text{J}$
D $200\,\mu\text{J}$