

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?

A the permittivity of the medium between the plates

Jan 2002

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.

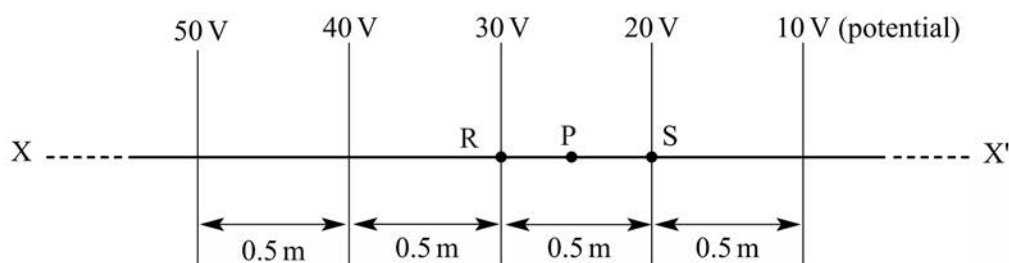
B Electric field strength is a vector quantity.

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 V m^{-1}

B 10 V m^{-1}

C 20 V m^{-1}

D 30 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 plate 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

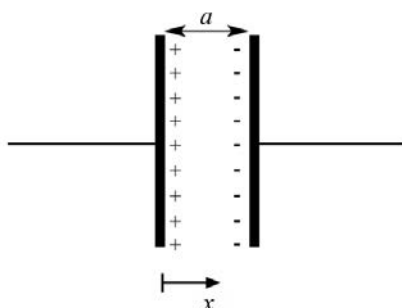
	<i>electric field strength $E/\text{N m}^{-1}$</i>	<i>potential V/V</i>
A	1×10^4 upwards	25
B	1×10^4 downwards	25
C	1×10^4 upwards	50
D	1×10^4 downwards	50

- 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?

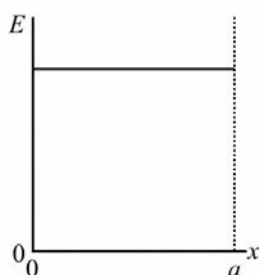
- A** $\frac{F}{3r}$
B $\frac{F}{9r}$
C $\frac{F}{3}$
D $\frac{F}{9}$

Jun 2003

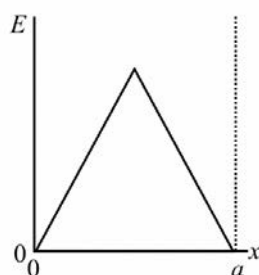
13



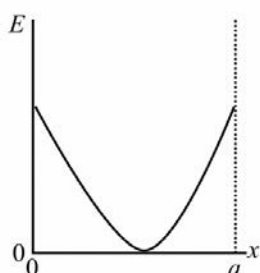
Two parallel metal plates of separation a carry equal and opposite charges. Which one of the following graphs, **A** to **D**, best represents how the electric field strength E varies with the distance x in the space between the plates?



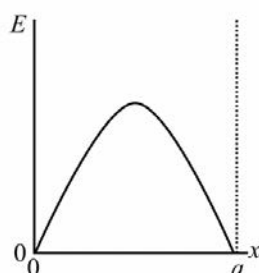
A



B



C



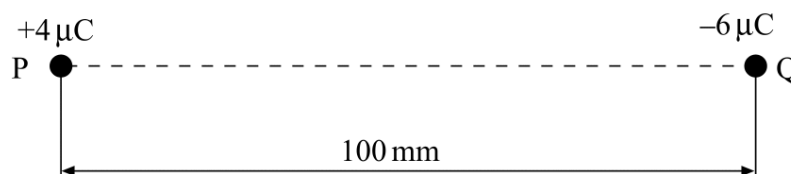
D

- 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	$\frac{E}{4}$	$\frac{V}{4}$

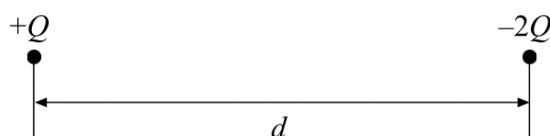
- 11 Two charges, P and Q, are 100 mm apart.



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

$$E = \frac{Q}{4\pi\epsilon_0 r^2} \text{ and } V = \frac{Q}{4\pi\epsilon_0 r}.$$

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?

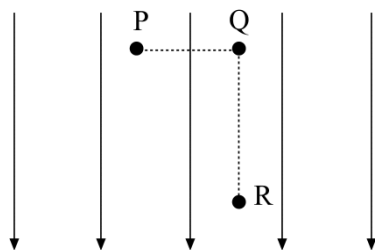
- A $3 \times 10^4 \text{ V}$
 B $3 \times 10^5 \text{ V}$
 C $3 \times 10^6 \text{ V}$
 D $3 \times 10^7 \text{ V}$

- 10 Two isolated point charges are separated by 0.04 m and attract each other with a force of $20 \mu\text{N}$. If the distance between them is increased by 0.04 m, what is the new force of attraction?

Jan 2005

- A $40 \mu\text{N}$
 B $20 \mu\text{N}$
 C $10 \mu\text{N}$
 D $5 \mu\text{N}$

11



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

A charge of $4 \mu\text{C}$ 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?

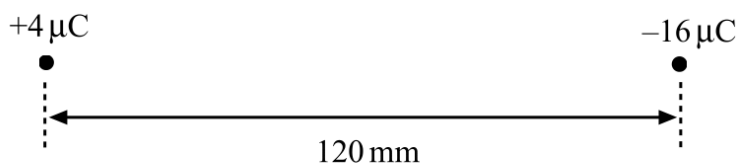
- A $40 \mu\text{J}$
 B $50 \mu\text{J}$
 C $120 \mu\text{J}$
 D $200 \mu\text{J}$

- 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 $\frac{4\pi\epsilon_0 e^2}{Gm^2}$
 B $\frac{Ge^2}{4\pi\epsilon_0 m^2}$
 C $\frac{e^2 m^2}{4\pi\epsilon_0 G}$
 D $\frac{e^2}{4\pi\epsilon_0 Gm^2}$

11

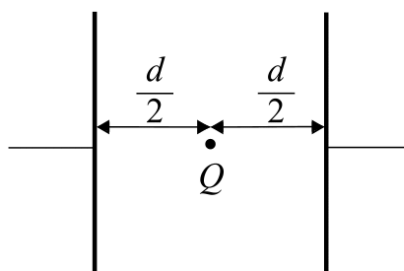


The diagram shows two charges, $+4\ \mu\text{C}$ and $-16\ \mu\text{C}$, 120 mm apart. What is the distance from the $+4\ \mu\text{C}$ charge to the point between the two charges, where the resultant electric potential is zero?

- 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.

-
- 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?

A 10^{23}

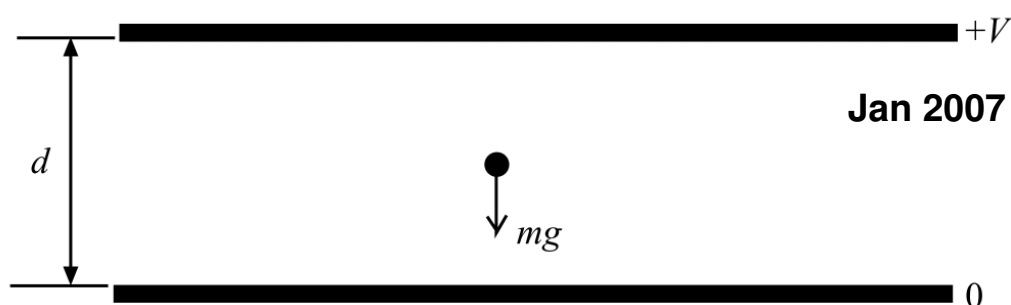
Jun 2006

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 $-\frac{Vd}{mg}$

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

C $-mgVd$

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

- 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 $\frac{r}{2}$ apart?

A F

B $2F$

C $8F$

D $16F$

Jan 2008

- 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?

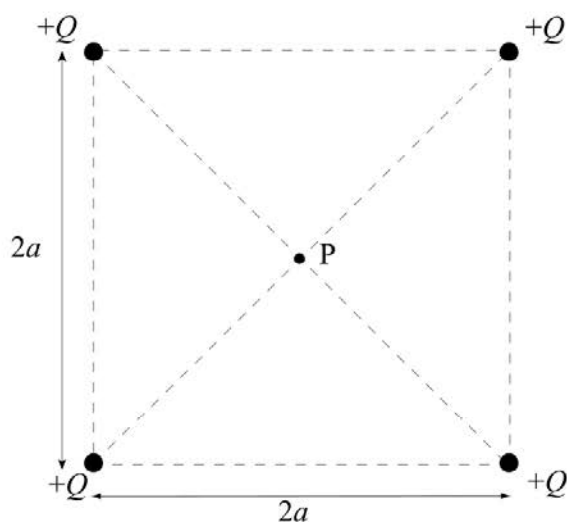
	gravitational field	electric field
A	$\alpha = G$	$y = \text{potential}$
B	$\beta = \frac{1}{G}$	$x = \text{potential}$
C	$x = \text{field strength}$	$\beta = 4\pi\epsilon_0$
D	$y = \text{field strength}$	$\alpha = \frac{1}{4\pi\epsilon_0}$

- 10 A charged particle of mass $4.80 \times 10^{-13} \text{ kg}$ and charge $8.00 \times 10^{-19} \text{ C}$ is stationary in a vertical electric field. What is the value of the electric field?
(Assume that the gravitational field strength is 10.0 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 $\frac{Q}{4\pi\epsilon_0 a^2}$
C $\frac{Q}{2\pi\epsilon_0 a^2}$
D $\frac{Q}{\pi\epsilon_0 a^2}$

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

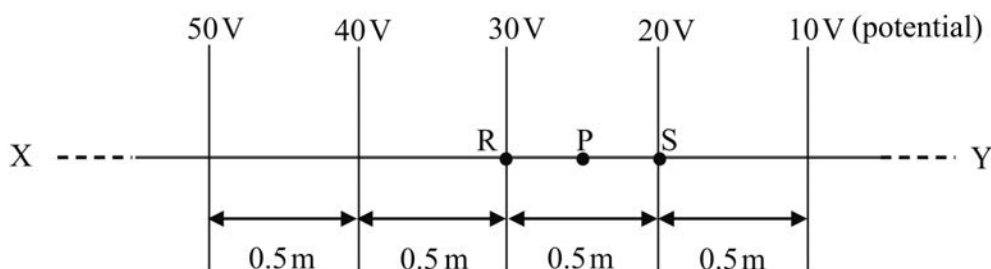
- A electrical potential
- B gravitational potential
- C electric field strength
- D induced emf

Jan 2009

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

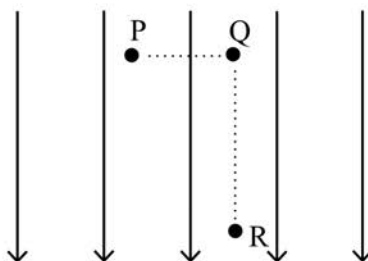
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The diagram shows how the electric potential varies along a line XY in an electric field. What will be the electric field strength at a point P on XY, which is mid-way between R and S?

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- B 10 V m^{-1}
- C 20 V m^{-1}
- D 30 V m^{-1}

10



Jun 2009

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