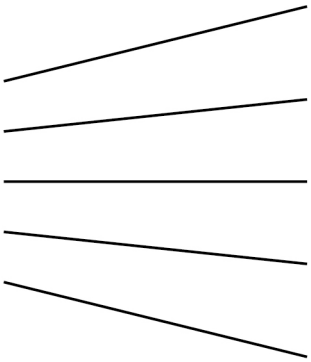
Do not write outside the box

1 6 Which diagram shows lines of equipotential in steps of equal potential difference near an isolated point charge?

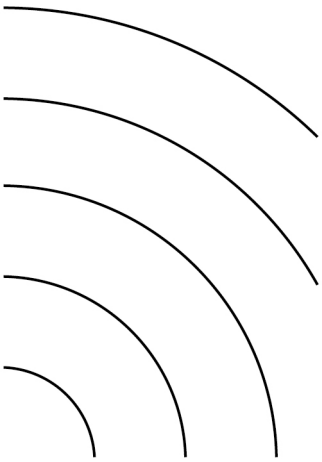
[1 mark]

A

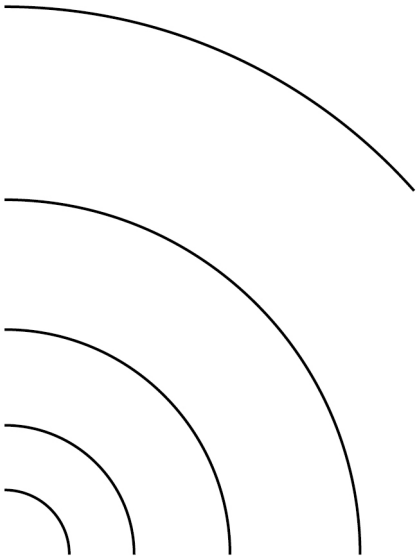
B



C



D



A ⬭

B ⬭

C ⬭

D ⬭

Do not write outside the box

1 7 A positive charge of 2.0×10^{-4} C is placed in an electric field at a point where the potential is +500 V.

What is the potential energy of the system? **[1 mark]**

EPE = V × Q

Q is in Joules

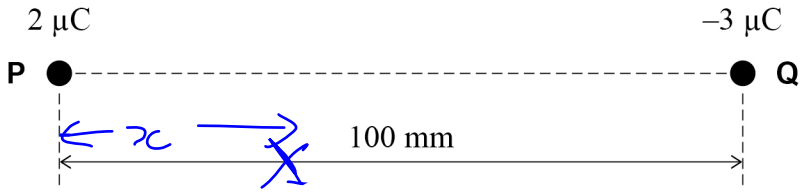
A 1.0×10^{-1} J ○

B 1.0×10^{-1} J C^{-1} ○

C 4.0×10^{-7} J ○

D 4.0×10^{-7} J C^{-1} ○

1 8 Two charges **P** and **Q** are 100 mm apart.
X is a point on the line between **P** and **Q** where the electric potential is 0 V.



What is the distance from **P** to **X**? **[1 mark]**

x is at the point where the potentials are equal and opposite

A 33 mm ○

B 40 mm ○

C 60 mm ○

D 67 mm ○

$k = \frac{1}{4\pi\varepsilon_0}$

$V_P = \frac{kQ}{r} = \frac{k \times 2 \times 10^{-6}}{x}$

$V_Q = \frac{k(-3\mu C)}{100 - x}$

$\frac{2 \times 10^{-6} k}{x} = \frac{3 \times 10^{-6} k}{100 - x}$

$\Rightarrow \frac{2}{x} = \frac{3}{100 - x}$

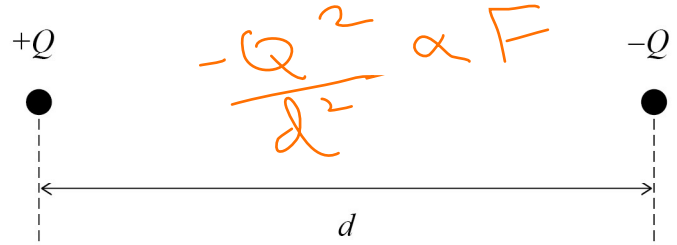
$\Rightarrow 2(100 - x) = 3x$

$\Rightarrow 200 - 2x = 3x$

$\Rightarrow x = \frac{200}{5} \Rightarrow x = 40$ mm

Do not write outside the box

1 4 The diagram shows a particle with charge $+Q$ and a particle with charge $-Q$ separated by a distance d.
The particles exert a force F on each other.



$\frac{-Q^2}{d^2} \propto F$

An additional charge of $+2Q$ is then given to each particle and their separation is increased to $2d$.

What is the force that now acts between the particles?

[1 mark]

A an attractive force of $\frac{9}{2}F$ ○

B an attractive force of $\frac{9}{4}F$ ○

C a repulsive force of $\frac{3}{2}F$ ○

D a repulsive force of $\frac{3}{4}F$ ○

$F \propto \frac{3Q \times 1Q}{(2d)^2}$

$F \propto \frac{3Q^2}{4d^2}$

so $F \propto \frac{3}{4}F$ and repulsive

1 5 Two protons are separated by distance r.
The electrostatic force between the two protons is **X** times the gravitational force between them.

What is the best estimate for **X**?

[1 mark]

A 10^{20} ○

B 10^{28} ○

C 10^{36} ○

D 10^{42} ○

I know this because I have done the calculation so many times....

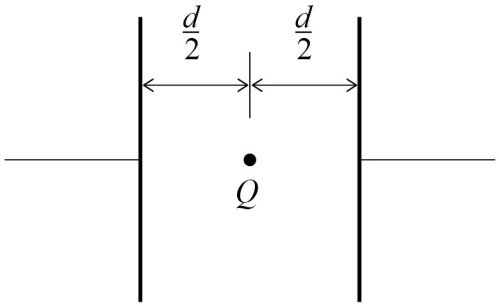
$\frac{F_G}{F_e} = \frac{\left(\frac{GMm}{r^2}\right)}{\left(\frac{kQQ}{r^2}\right)}$

r^2 will cancel. Bung in the numbers. K is a shorthand for that constant 1/(4PixE0)

$k = \frac{1}{4\pi\varepsilon_0}$

Do not write outside the box

1 6 Two parallel metal plates separated by a distance d have a potential difference V across them. A particle with charge Q is placed midway between the plates.



$F = \frac{QV}{d}$

What is the magnitude of the electrostatic force acting on the particle?

[1 mark]

force on Q is the same at any point between the plates...

A zero ○

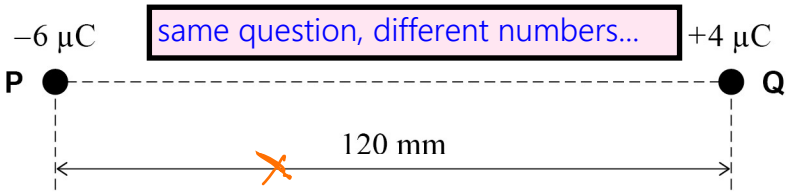
B $\frac{QV}{2d}$ ○

C $\frac{QV}{d}$ ⊗

D $\frac{2QV}{d}$ ○

1 7 Two charged particles **P** and **Q** are separated by a distance of 120 mm.
X is a point on the line between **P** and **Q** where the electric potential is zero.

same question, different numbers...



$k = \frac{1}{4\pi\varepsilon_0}$

What is the distance from **P** to **X**?

x is where the two potentials are opposite sign, equal size. we can drop the - therefore.f

[1 mark]

$V_P = \frac{k(+6\mu C)}{x} = \frac{k(4\mu C)}{(120-x)}$

$6(120-x) = 4x \Rightarrow x = 72$

A 40 mm ○

B 48 mm ○

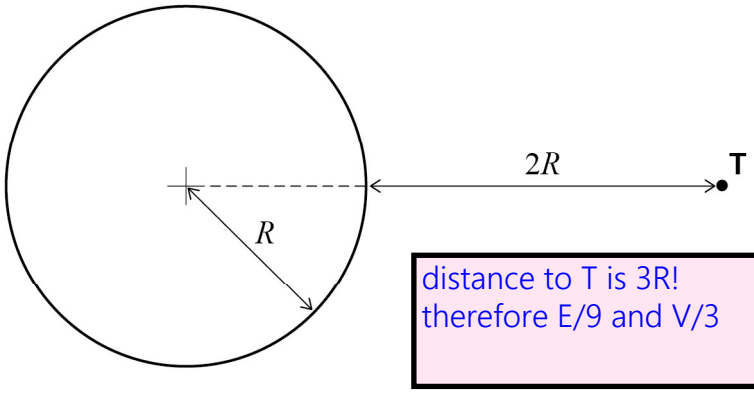
C 60 mm ○

D 72 mm ○

Turn over ►

Do not write outside the box

1 8 An isolated spherical conductor is charged.
The conductor has a radius R and an electric potential V. The electric field strength at its surface is E.



distance to T is 3R!
therefore E/9 and V/3

Point **T** is a distance $2R$ from the surface.

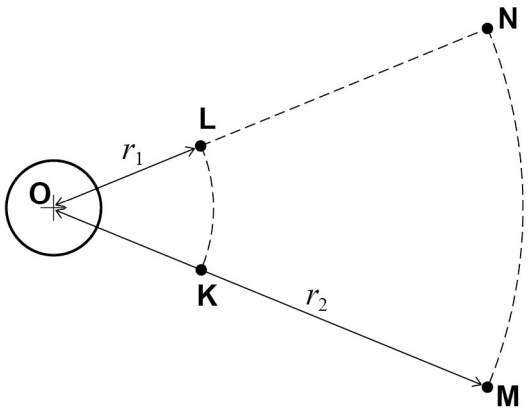
What are the electric field strength and electric potential at **T**?

[1 mark]

	Electric field strength	Electric potential	
A	$\frac{E}{2}$	$\frac{V}{4}$	○
B	$\frac{E}{3}$	$\frac{V}{9}$	○
C	$\frac{E}{4}$	$\frac{V}{2}$	○
D	$\frac{E}{9}$	$\frac{V}{3}$	⊗

Do not write outside the box

1 9 **O** is the centre of a negatively charged sphere.



K and **L** are two points at a distance r_1 from **O**.
M and **N** are two points at a distance r_2 from **O**.

Which statement is true?

[1 mark]

A The work done moving an electron from **M** to **K** is the same as that done moving an electron from **K** to **L**. ⬭

B The work done moving a positron from **K** to **M** is the same as that done moving an electron from **K** to **M**. ⬭

C No work is done moving an electron from **M** to **N**. ⊠

D No work is done moving a positron from **L** to **N**. ⬭

Turn over for the next question