AQA – Capacitance – A2 Physics P2

1. June/2021/Paper_7408_2/No.01

0 1 A capacitor of capacitance $63\ \text{pF}$ is made from two parallel metal plates separated by an air gap.
The capacitor is charged so that it stores a charge of $7.6 \times 10^{-10}\ \text{C}$; it is then isolated.

A sheet of mica of dielectric constant 6.0 is inserted between the plates so that it completely fills the space between them. The mica does not discharge the capacitor and does not change the separation of the plates.

0 1 . 1 Explain what is meant by a dielectric constant of 6.0

[1 mark]

0 1 . 2 Mica is made up of polar molecules. As the mica is inserted, the capacitance of the capacitor changes.

Explain how the polar molecules cause this change in capacitance.

[3 marks]

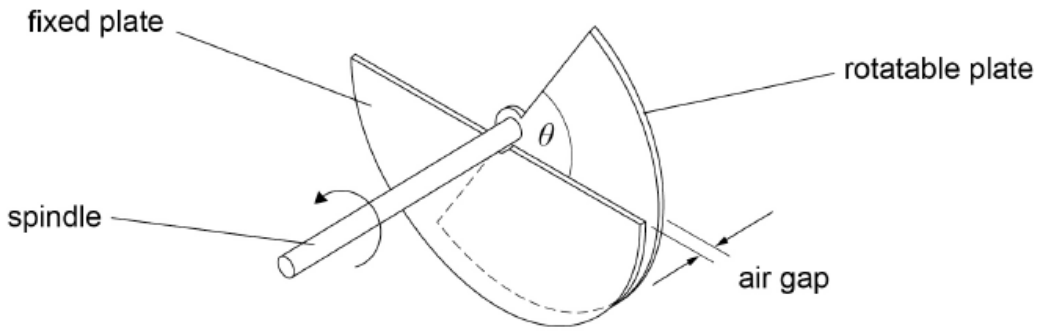
0 1 . 3 Calculate the difference between the initial energy stored by the capacitor and the energy stored when the mica has been fully inserted.

[3 marks

energy difference = _____ J

Figure 1 shows the structure of a variable capacitor used for measuring angular movement. The capacitor consists of two semicircular metal plates. These plates are parallel and are separated by an air gap.

Figure 1

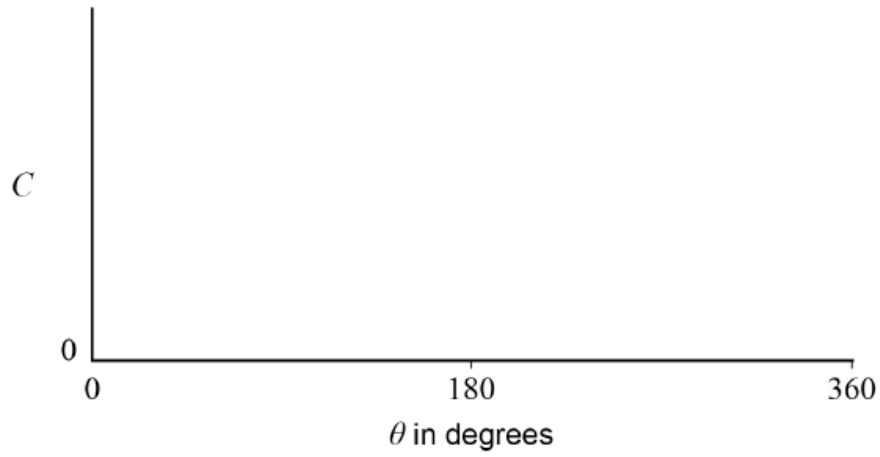


To vary the capacitance, one of the plates is rotated through an angle θ using the spindle. The other plate remains fixed.

0 1 . 4 Sketch a graph on **Figure 2** to show how the capacitance C varies with θ as the spindle is turned through $360°$.
When θ is $0°$, the plates completely overlap.

[2 marks]

Figure 2



0 1 . 5 In one situation, the variable capacitor is too large for the available space.

The same maximum capacitance is required using plates that have half the diameter of the original capacitor.

Explain, with numerical detail, **two** ways in which this can be achieved.

[3 marks]

1 _____

_____

_____

_____

2 _____

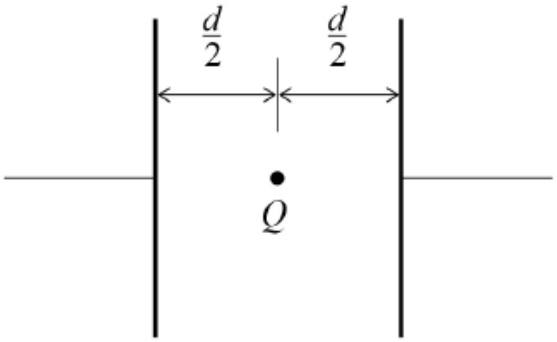
_____

_____

_____

2. June/2021/Paper_7408_2/No.16

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.



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

[1 mark]

A zero ⬭

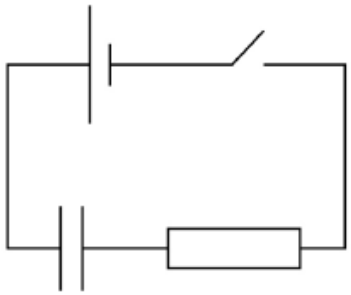
B $\frac{QV}{2d}$ ⬭

C $\frac{QV}{d}$ ⬭

D $\frac{2QV}{d}$ ⬭

3. June/2021/Paper_7408_2/No.20

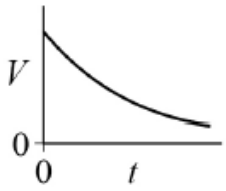
The capacitor in the circuit is initially uncharged.
The switch is closed at time $t = 0$

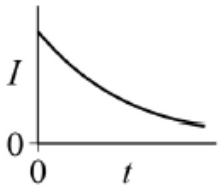


Which pair of graphs shows how the potential difference V across the capacitor and the current I in the circuit change with time t?

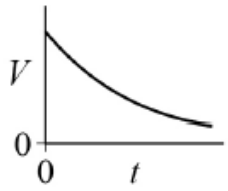
[1 mark]

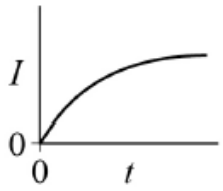
A



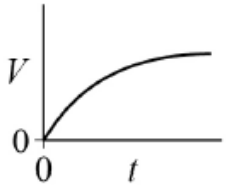


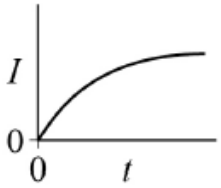
B



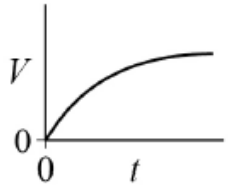


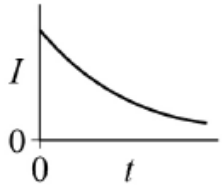
C





D





A ⬭

B ⬭

C ⬭

D ⬭

4. June/2020/Paper_7408_2/No.19

An uncharged capacitor is connected to a power supply which supplies a constant current of $10\ \mu A$.

After $100\ ms$, the potential difference across the capacitor is $5.0\ kV$.

What is the capacitance of the capacitor?

[1 mark]

A $2.0 \times 10^{-10}\ F$ ⬭

B $4.0 \times 10^{-10}\ F$ ⬭

C $2.5 \times 10^{9}\ F$ ⬭

D $5.0 \times 10^{9}\ F$ ⬭

5. June/2020/Paper_7408_2/No.20

When a parallel-plate capacitor is connected across a battery, the energy stored in the capacitor is W.

The battery remains connected as the distance between the capacitor plates is halved.

What is the energy now stored in the capacitor?

[1 mark]

A $0.5W$ ⬭

B W ⬭

C $2W$ ⬭

D $4W$ ⬭

6. June/2020/Paper_7408_2/No.21

A parallel-plate capacitor is made using a sheet of dielectric material between, and in contact with, two plates.
The properties of four sheets of dielectric material are shown.

Which sheet will produce the maximum capacitance?

[1 mark]

Sheet	Relative permittivity	Thickness / mm	
A	2	0.40	⬭
B	3	0.90	⬭
C	4	1.0	⬭
D	6	1.6	⬭

7. June/2020/Paper_7408_2/No.22

A 10 μF capacitor stores 4.5 mJ of energy.
It then discharges through a 25 Ω resistor.

What is the maximum current during the discharge of the capacitor?

[1 mark]

A 1.2 A ⬭

B 18 A ⬭

C 30 A ⬭

D 36 A ⬭