Capacitor Charge & Discharge

TOPIC QUESTIONS

Level	AS Level
Subject	Physics
Exam Board	AQA
Paper Type	Multiple Choice

Time Allowed : 30min

1. A parallel-plate capacitor has square plates of length l separated by distance d and is filled with a dielectric.

A second capacitor has square plates of length $2l$ separated by distance $2d$ and has air as its dielectric.

Both capacitors have the same capacitance.

What is the relative permittivity of the dielectric in the first capacitor?

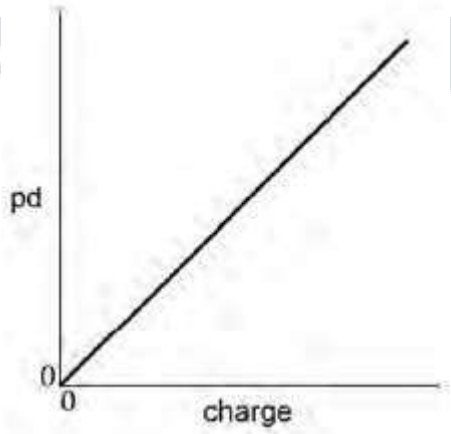
A $\frac{1}{2}$

B 1

C 2

D 8

2. The graph shows the variation of potential difference (pd) with charge for a capacitor while it ischarging.



Which statement can be deduced from the graph?

A The charging current is constant.

B The energy stored in the capacitor increases uniformly with time.

C The capacitance of the capacitor is constant.

D The power supply used to charge the capacitor had a constant terminal pd.

3. A capacitor of capacitance 120 μF is charged and then discharged through a 20 kΩ resistor.

What fraction of the original charge remains on the capacitor 4.8 s after the discharge begins?

A 0.14

B 0.37

C 0.63

D 0.86

4. A capacitor consists of two parallel square plates of side l separated by distance d.The capacitance of the arrangement is C.

What is the capacitance of a capacitor with square plates of side $2l$ separated by a distance $\frac{d}{2}$?

A C

B $2C$

C $4C$

D $8C$

5. A capacitor of capacitance C has a charge of Q stored on the plates. The potential differencebetween the plates is doubled.

What is the change in the energy stored by the capacitor?

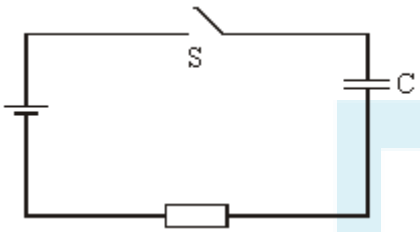
A $\frac{Q^2}{2C}$

B $\frac{Q^2}{C}$

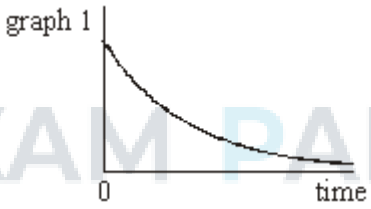
C $\frac{3Q^2}{2C}$

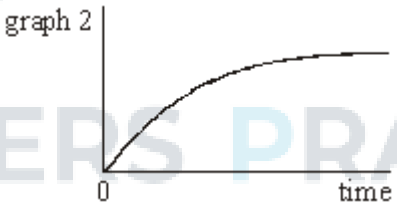
D $\frac{2Q^2}{C}$

6. In the circuit shown, the capacitor C is charged to a potential difference *V* when the switch S is closed.



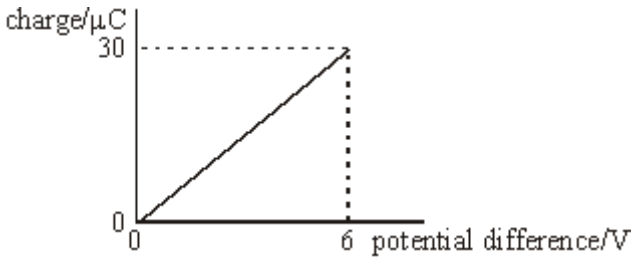
Which line, **A** to **D**, in the table gives a correct pair of graphs showing how the charge and current change with time after S is closed?





	charge	current
A	graph 1	graph 1
B	graph 1	graph 2
C	graph 2	graph 2
D	graph 2	graph 1

7. The graph shows how the charge stored by a capacitor varies with the potential difference across it as it is charged from a 6 V battery.



Which one of the following statements is **not** correct?

A The capacitance of the capacitor is 5.0 μF.

B When the potential difference is 2 V the charge stored is 10 μC.

C When the potential difference is 2 V the energy stored is 10 μJ.

D When the potential difference is 6 V the energy stored is 180 μJ.

8. A capacitor of capacitance *C* discharges through a resistor of resistance *R*.
Which one of the following statements is **not** true?

A The time constant will increase if *R* is increased.

B The time constant will decrease if *C* increased.

C After charging to the same voltage, the initial discharge current will increase if *R* is decreased.

D After charging to the same voltage, the initial discharge current will be unaffected if *C* is increased.

9. A 10 mF capacitor is charged to 10 V and then discharged completely through a small motor. During this process, the motor lifts a weight of mass 0.10 kg. If 10% of the energy stored in the capacitor is used to lift the weight, through what approximate height will the weight be lifted?

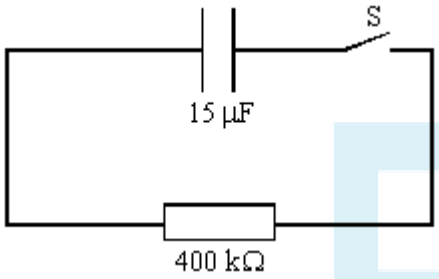
A 0.05 m

B 0.10 m

C 0.50 m

D 1.00m

10. A capacitor of capacitance 15 μF is fully charged and the potential difference across its platesis 8.0 V. It is then connected into the circuit as shown.



The switch S is closed at time $t = 0$. Which one of the following statements is correct?

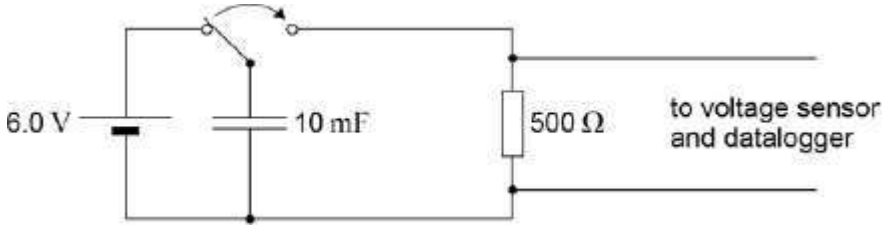
A The time constant of the circuit is 6.0 ms.

B The initial charge on the capacitor is 12 μC.

C After a time equal to twice the time constant, the charge remaining on the capacitor is Q_0e^2, where Q_0 is the charge at time $t = 0$.

D After a time equal to the time constant, the potential difference across the capacitor is 2.9 V.

11. A voltage sensor and a datalogger are used to record the discharge of a 10 mF capacitor in series with a 500 Ω resistor from an initial pd of 6.0 V. The datalogger is capable of recording 1000 readings in 10 s.



After a time equal to the time constant of the discharge circuit, which one of the rows gives the pdand the number of readings made?

	Potential difference / V	Number of readings
A	2.2	50

B	3.8	50
C	3.8	500
D	2.2	500

12. Initially a charged capacitor stores 1600 μJ of energy. When the pd across it decreases by 2.0 V, the energy stored by it becomes 400 μJ.

What is the capacitance of this capacitor?

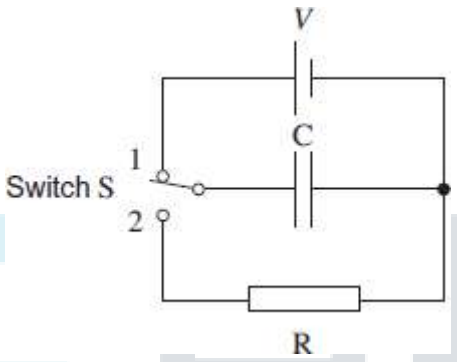
A 100 μF

B 200 μF

C 400 μF

D 600 μF

13. Switch S in the circuit is held in position 1, so that the capacitor C becomes fully charged to a pd V and stores energy E.



The switch is then moved quickly to position 2, allowing C to discharge through the fixed resistor R. It takes 36 ms for the pd across C to fall to $\frac{V}{16}$. What period of time must elapse, after theswitch has moved to position 2, before the energy stored by C has fallen to $\frac{E}{16}$?

A 51 ms

B 72 ms

C 432 ms

D 576 ms

14. A nuclear fusion device is required to deliver at least 1 MJ of energy using capacitors. If the largestworkable potential difference is 10 kV, what is the minimum capacitance of the capacitors that should be used?

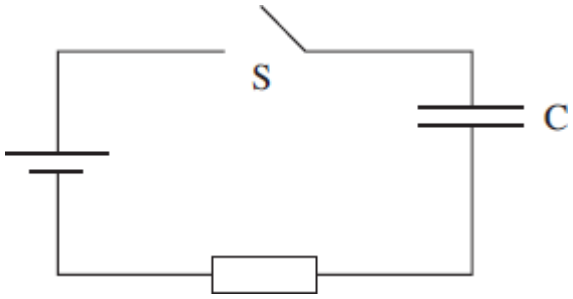
A 0.01 F

B 0.02 F

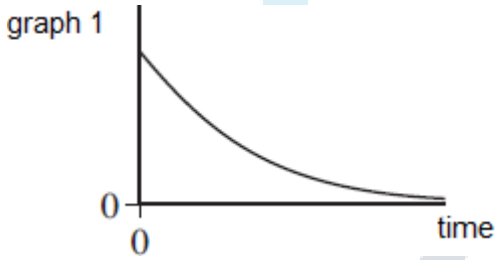
C 2 F

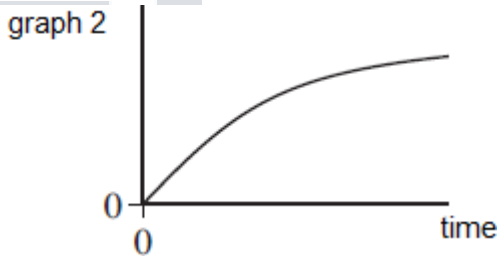
D 100F

15. In the circuit shown the capacitor C charges when switch S is closed.



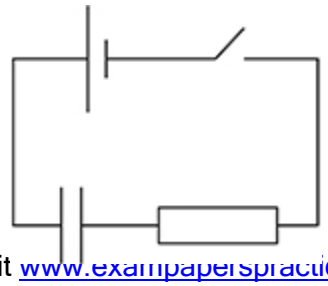
Which line, **A** to **D**, in the table gives a correct pair of graphs showing how the charge on thecapacitor and the current in the circuit change with time after S is closed?





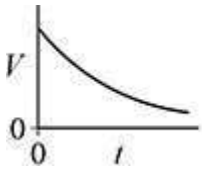
	charge	current
A	graph 1	graph 1
B	graph 1	graph 2
C	graph 2	graph 2
D	graph 2	graph 1

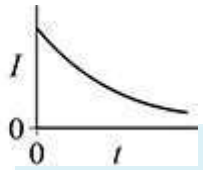
16. The capacitor in the circuit is initially uncharged.
The switch is closed at time $t = 0$



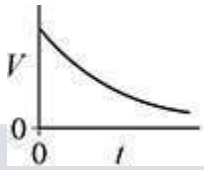
Which pair of graphs shows how the potential difference V across the capacitor and the current I in the circuit change with time t?

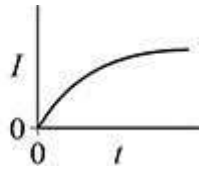
A



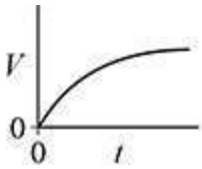


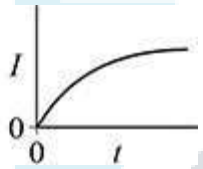
B



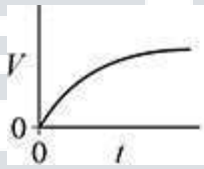


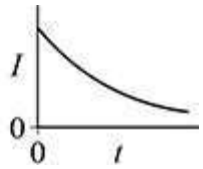
C





D





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

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

is the energy now stored in the capacitor?

A $0.5W$

B **W**

C $2W$

D $4W$

18. An uncharged capacitor is connected to a power supply which supplies a constant current of 10 μA.

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

is the capacitance of the capacitor?

A 2.0×10^{-10} F

B 4.0×10^{-10} F

C 2.5×10^{9} F

D 5.0×10^{9} F

19. A parallel-plate capacitor is made using a sheet of dielectric material between, and in contactwith, two plates.

The properties of four sheets of dielectric material

are shown.Which sheet will produce the maximum

capacitance?

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

20. A parallel-plate capacitor is made by inserting a sheet of dielectric material between two plates.Both plates are in contact with the sheet.

Which relative permittivity and sheet thickness give the greatest capacitance?

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