A Level · OCR · Physics

7 mins 7 questions

Multiple Choice Questions

Charging & Discharging Capacitors

Capacitor Charge & Discharge / Capacitor Charge & Discharge Equations / Modelling Capacitor Discharge

Medium (6 questions)	/6
Hard (1 question)	/1
Total Marks	**/7**

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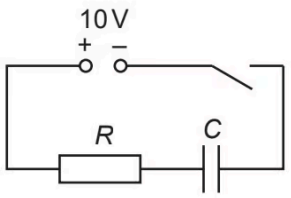
Medium Questions

1 The diagram below shows a circuit used to charge a capacitor.



The power supply has electromotive force (e.m.f.) 10 V and negligible internal resistance. The capacitor has capacitance *C* and the resistor has resistance *R*. The switch is closed at time $t = 0$. The table below shows potential difference *V* across the resistor at various values of time *t*.

***V* / V**	10	6.3	5.0	3.7
***t* / s**	0	2.8	4.2	6.0

What is the product $C \times R$ for this circuit?

A. 0 s

B. 2.8 s

C. 4.2 s

D. 6.0 s

(1 mark)

2 A capacitor discharges through a resistor. At time $t = 0$ the potential difference V across the capacitor is V_0. At time $t = 2.0$ s, $V = 0.90\ V_0$.

Which statement is **not** correct?

A. At $t = 4.0$ s, $V = 0.81\ V_0$.

B. The capacitor is fully discharged after $t = 10$ s.

C. The potential difference across the resistor is the same as that for the capacitor when the capacitor has potential difference $0.5V_0$.

D. The potential difference V decreases exponentially with time t.

(1 mark)

3 A student is modelling the decay of charge for a capacitor discharging through a resistor using the equation $\frac{\Delta Q}{\Delta t} = -0.2Q$.

The student decides to use $\Delta t = 0.5$ s. The initial charge on the capacitor is 1000 μC.

Part of the modelling spreadsheet from the student is shown below.

***t* / s**	**Charge *Q* left on capacitor at time *t* / μC**	**Charge Δ*Q* decaying in the next 0.5 s / μC**
0	1000	100
0.5	900	
1.0		
1.5		

What is the value of Q in μC at $t = 1.5$ s?

A. 700

B. 720

C. 729

D. 800

(1 mark)

4 A capacitor discharges through a resistor. At time $t = 0$, the charge stored by the capacitor is 600 μC. The capacitor loses 5.0% of its charge every second.

What is the charge **left** on the capacitor at time $t = 4.0$ s?

A. 111 μC

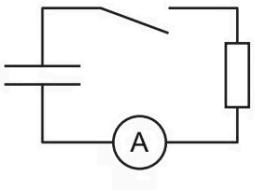
B. 120 μC

C. 480 μC

D. 489 μC

(1 mark)

5 A capacitor is discharged through a resistor.



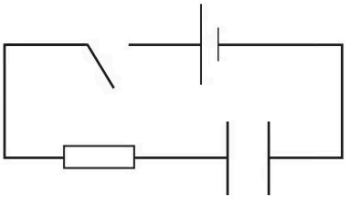
The capacitor is fully charged at time $t = 0$. The time constant of the circuit is 10 s. The switch is closed at time $t = 0$. The current in the resistor is I.

Which row is correct?

	Current I at $t = 0$	Current I at $t = 10$ s
A	maximum	0
B	maximum	37% of the current at $t = 0$
C	0	63% of the current at $t = \infty$
D	0	37% of the current at $t = \infty$

(1 mark)

6 A capacitor is charged through a resistor.



The cell has e.m.f. 1.50 V and negligible internal resistance. The capacitor is initially uncharged. The time constant of the circuit is 100 s. The switch is closed at time $t = 0$. What is the potential difference across the capacitor at time $t = 200$ s?

A. 0.20 V

B. 0.55 V

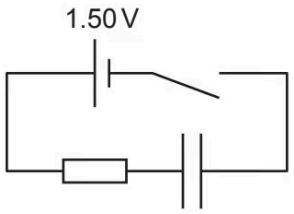
C. 0.95 V

D. 1.30 V

(1 mark)

Hard Questions

1 A capacitor is charged through a resistor.



The cell has electromotive force (e.m.f.) 1.50 V and negligible internal resistance. The time constant of the circuit is 10 s. The switch is closed at time $t = 0$. At time t, the potential difference across the resistor is 0.60 V.

Which expression is correct?

A. $0.60 = 1.50e^{-0.10t}$

B. $0.90 = 1.50(e^{-10t} - 1)$

C. $0.60 = 1.50e^{-10t}$

D. $0.60 = 1.50(1-e^{-0.10t})$

(1 mark)