Exercise 13 - Capacitance

Past Paper Homework Questions

1. The unit for capacitance can be written as

A $V C^{-1}$

B $C V^{-1}$

C $J s^{-1}$

D $C J^{-1}$

E $J C^{-1}$.

2. Which of the following statements about capacitors is/are true?

I Capacitors are used to block a.c. signals.

II Capacitors are used to block d.c. signals.

III Capacitors can store energy.

IV Capacitors can store electric charge.

A I only

B I and III only

C II and III only

D II, III and IV only

E III and IV only

3. A student makes the following statements about capacitors.

I Capacitors block a.c. signals.

II Capacitors store energy.

III Capacitors store charge.

Which of these statements is/are true?

A I only

B I and II only

C I and III only

D II and III only

E I, II and III

4. A $25{\cdot}0\,\mu F$ capacitor is charged until the potential difference across it is 500 V.

The charge stored in the capacitor is

A $5{\cdot}00 \times 10^{-8}\,C$

B $2{\cdot}00 \times 10^{-5}\,C$

C $1{\cdot}25 \times 10^{-2}\,C$

D $1{\cdot}25 \times 10^{4}\,C$

E $2{\cdot}00 \times 10^{7}\,C$.

5. In an experiment to find the capacitance of a capacitor, a student makes the following measurements.

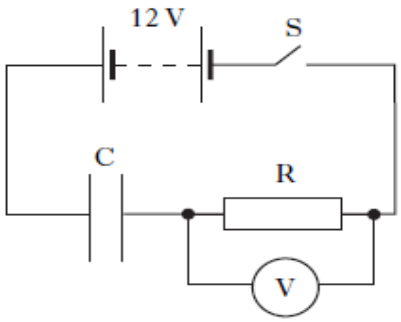
potential difference across capacitor $= (10{\cdot}0 \pm 0{\cdot}1)\,V$

charge stored by capacitor $= (500 \pm 25)\,\mu C$

Which row in the table gives the capacitance of the capacitor and the percentage uncertainty in the capacitance?

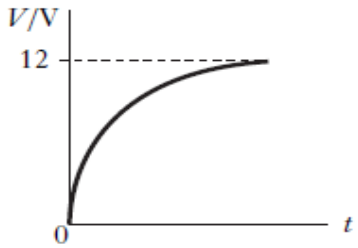
	Capacitance/μF	*Percentage uncertainty*
A	0·02	1
B	0·02	5
C	50	1
D	50	5
E	5000	6

6. A circuit is set up as shown.



The capacitor is initially uncharged. Switch S is now closed. Which graph shows how the potential difference, V, across R, varies with time, t?

A



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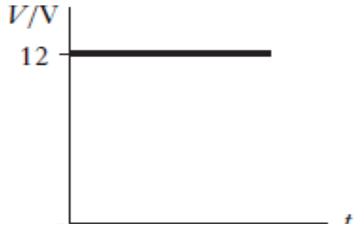
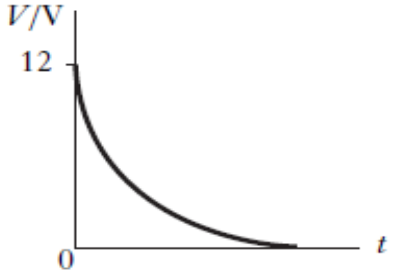


C



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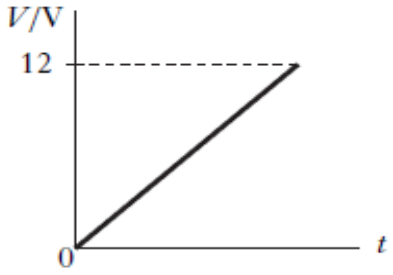
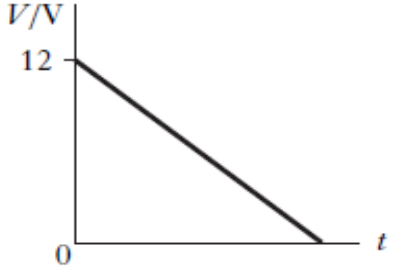


E



7. A student carries out an experiment to find the capacitance of a capacitor. The charge on the capacitor is measured for different values of p.d. across the capacitor. The results are shown.

charge on capacitor/μC	*p.d. across capacitor*/V
1·9	1·0
4·6	2·0
9·6	4·0

The best estimate of the capacitance is

A 1·9 μF

B 2·2 μF

C 2·3 μF

D 2·4 μF

E 2·6 μF.

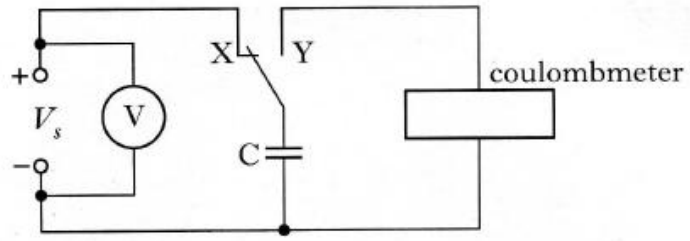
8. The capacitance of a capacitor is 1000 μF. The potential difference (p.d.) across the capacitor is 100 V. The charge stored by the capacitor is 0·10 C.

The charge on the capacitor is now reduced to half its original value.

Which row in the table shows the capacitance of the capacitor and the p.d. across the capacitor, for this new value of charge?

	Capacitance/μF	*p.d.*/V
A	1000	200
B	500	100
C	1000	100
D	500	50
E	1000	50

9. (*a*) In an experiment to measure the capacitance of a capacitor, a student sets up the following circuit.



When the switch is in position X, the capacitor charges up to the supply voltage, V_s. When the switch is in position Y, the coulombmeter indicates the charge stored by the capacitor.

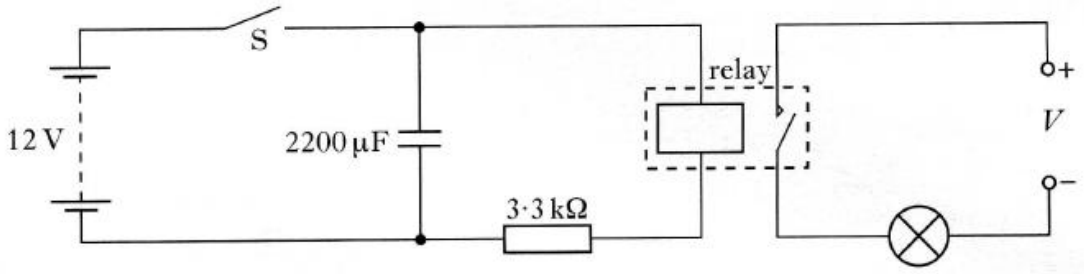
The student records the following measurements and uncertainties.

Reading on voltmeter = $(2{\cdot}56 \pm 0{\cdot}01)$ V
Reading on coulombmeter = $(32 \pm 1)\,\mu$C

Calculate the value of the capacitance and the percentage uncertainty in this value. You must give the answer in the form

value ± percentage uncertainty. **3**

(*b*) The student designs the circuit shown below to switch off a lamp after a certain time.



The 12 V battery has negligible internal resistance.

The relay contacts are normally open. When there is a current in the relay coil the contacts close and complete the lamp circuit.

Switch S is initially closed and the lamp is on.

(i) What is the maximum energy stored in the capacitor?

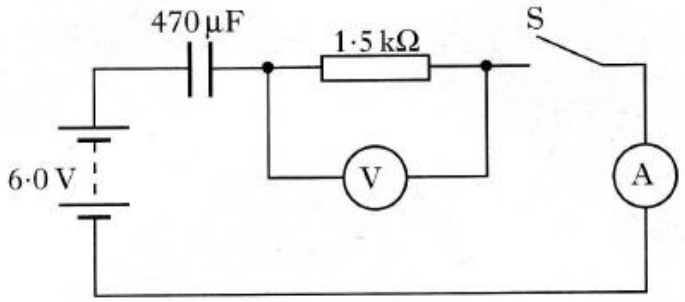
(ii) (A) Switch S is now opened. Explain why the lamp stays lit for a few seconds.

(B) The 2200 μF capacitor is replaced with a 1000 μF capacitor.

Describe and explain the effect of this change on the operation of the circuit. **6**

(9)

10. (*a*) The following diagram shows a circuit that is used to investigate the charging of a capacitor.



The capacitor is initially uncharged.

The capacitor has a capacitance of 470 μF and the resistor has a resistance of 1·5 kΩ.

The battery has an e.m.f. of 6·0 V and negligible internal resistance.

(i) Switch S is now closed. What is the initial current in the circuit?

(ii) How much energy is stored in the capacitor when it is fully charged?

(iii) What change could be made to this circuit to ensure that the **same** capacitor stores **more** energy? **5**

(*b*) A capacitor is used to provide the energy for an electronic flash in a camera.

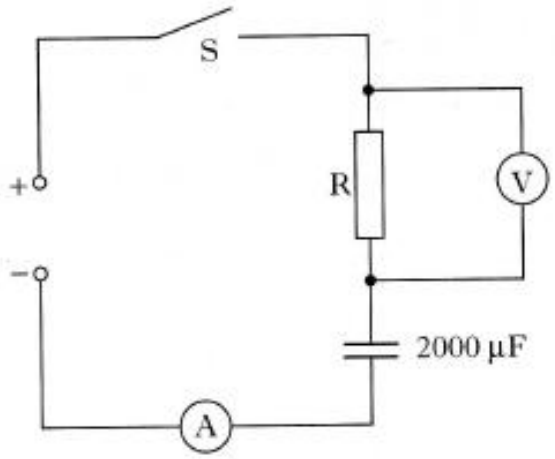
When the flash is fired, $6{\cdot}35 \times 10^{-3}$ J of the stored energy is emitted as light.

The mean value of the frequency of photons of light from the flash is $5{\cdot}80 \times 10^{14}$ Hz.

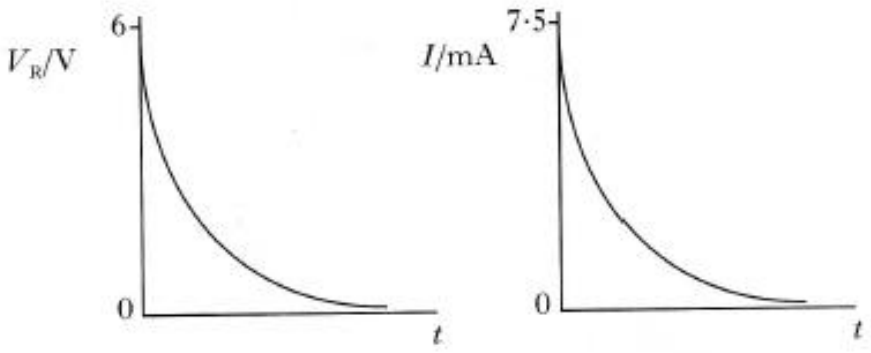
Calculate the number of photons emitted in each flash of light. **3**

(8)

11. (*a*) The circuit below is used to investigate the charging of a 2000 μF capacitor. The d.c. supply has negligible internal resistance.



The graphs below show how the potential difference V_R across the **resistor** and the current I in the circuit vary with time from the instant switch S is closed.



(i) What is the potential difference across the capacitor when it is fully charged?

(ii) Calculate the energy stored in the capacitor when it is fully charged.

(iii) Calculate the resistance of R in the circuit above. **5**

30 marks