Q1. A 400 μF capacitor is charged so that the voltage across its plates rises at a constant rate from 0 V to 4.0 V in 20 s. What current is being used to charge the capacitor?

A 5 μA

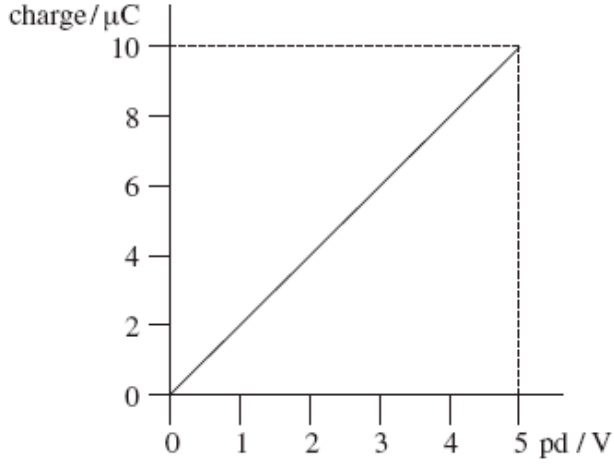
B 20 μA

C 40 μA

D 80 μA

(Total 1 mark)

Q2. The graph shows how the charge stored by a capacitor varies with the pd applied across it.



Which line, **A** to **D**, in the table gives the capacitance and the energy stored when the potential difference is 5.0 V?

	capacitance/μF	**energy stored/μJ**
A	2.0	25
B	2.0	50
C	10.0	25
D	10.0	50

(Total 1 mark)

Q3. In experiments to pass a very high current through a gas, a bank of capacitors of total capacitance 50 μF is charged to 30 kV. If the bank of capacitors could be discharged completely in 5.0 ms, what would be the mean power delivered?

A 22 kW

B 110 kW

C 4.5 MW

D 9.0 MW

(Total 1 mark)

Q4. A 10 mF capacitor is charged to 10 V and then discharged completely through a small motor. During the 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 1.00 m

(Total 1 mark)

Q5. A capacitor of capacitance *C* stores an amount of energy *E* when the pd across it is *V*. Which line, **A** to **D**, in the table gives the correct stored energy and pd when the charge is increased by 50%?

	energy	**pd**
A	1.5 *E*	1.5 *V*
B	1.5 *E*	2.25 *V*
C	2.25 *E*	1.5 *V*
D	2.25 *E*	2.25 *V*

(Total 1 mark)

Q6. 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 decrease if *C* is increased.

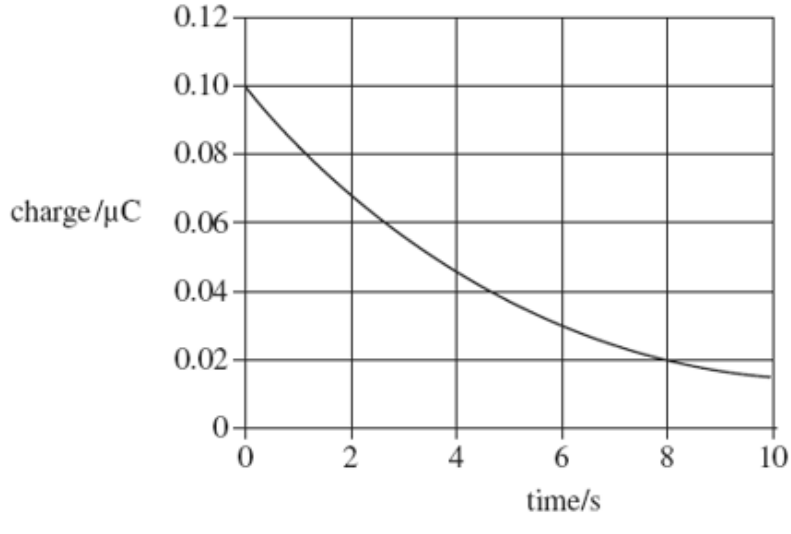
B The time constant will increase if *R* is increased.

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.

(Total 1 mark)

Q7. The graph shows how the charge on a capacitor varies with time as it is discharged through a resistor.



What is the time constant for the circuit?

A 3.0 s

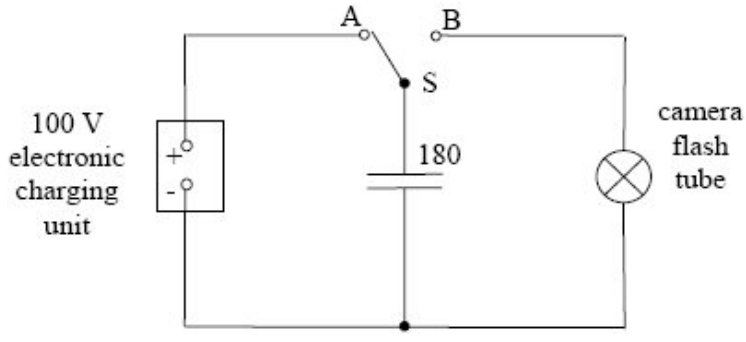
B 4.0 s

C 5.0 s

D 8.0 s

(Total 1 mark)

Q8. The flash tube in a camera produces a flash of light when a 180 μF capacitor is discharged across the tube.



(a) The capacitor is charged to a pd of 100 V from an electronic charging unit in the camera, as shown in the diagram above.
Calculate,

(i) the energy stored in the capacitor,

.....

.....

.....

(ii) the work done by the battery.

.....

.....

(2)

(b) When a photograph is taken, switch S in the diagram above is automatically moved from A to B and the capacitor is discharged across the flash tube. The discharge circuit has a resistance of 1.5 Ω. Emission of light from the flash tube ceases when the pd falls below 30 V.

(i) Calculate the duration of the light flash.

.....

.....

.....

.....

.....

(ii) The capacitor in the circuit in the diagram above is replaced by a capacitor of greater capacitance. Discuss the effect of this change on the photograph image of a moving object.

.....

.....

.....

.....

.....

(4)
(Total 6 marks)

Q9. A capacitor of capacitance 330 μF is charged to a potential difference of 9.0 V. It is then discharged through a resistor of resistance 470 kΩ.

Calculate

(a) the energy stored by the capacitor when it is fully charged,

.....

.....

.....

.....

(2)

(b) the time constant of the discharging circuit,

.....

.....

(1)

(c) the p.d. across the capacitor 60 s after the discharge has begun.

.....

.....

.....

.....

.....

.....

(3)
(Total 6 marks)

Q10. A 680 μF capacitor is charged fully from a 12 V battery. At time t = 0 the capacitor begins to discharge through a resistor. When t = 25 s the energy remaining in the capacitor is one quarter of the energy it stored at 12 V.

(a) Determine the pd across the capacitor when t = 25s.

.....

.....

.....

.....

(2)

(b) (i) Show that the time constant of the discharge circuit is 36 s.

.....

.....

.....

.....

.....

(ii) Calculate the resistance of the resistor.

.....

.....

(4)
(Total 6 marks)

Q11. Capacitors and rechargeable batteries are examples of electrical devices that can be used repeatedly to store energy.

(a) (i) A capacitor of capacitance 70 F is used to provide the emergency back-up in a low voltage power supply.

Calculate the energy stored by this capacitor when fully charged to its maximum operating voltage of 1.2 V. Express your answer to an appropriate number of significant figures.

answer = ...J

(3)

(ii) A rechargeable 1.2 V cell used in a cordless telephone can supply a steady current of 55 mA for 10 hours. Show that this cell, when fully charged, stores almost 50 times more energy than the capacitor in part (a)(i).

(2)

(b) Give **two** reasons why a capacitor is **not** a suitable source for powering a cordless telephone.

Reason 1.....

.....

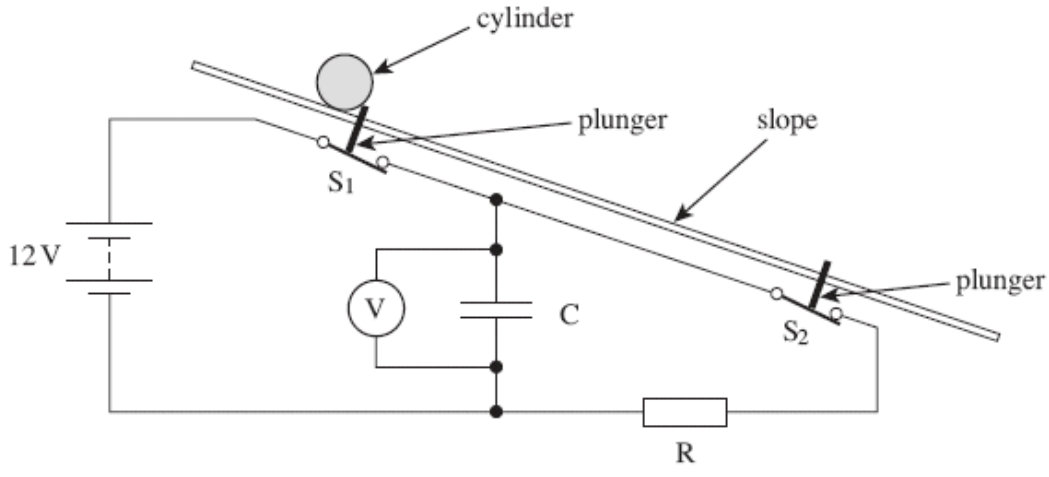
Reason 2.....

.....

(2)

(Total 7 marks)

Q12. A student was required to design an experiment to measure the acceleration of a heavy cylinder as it rolled down an inclined slope of constant gradient. He suggested an arrangement that would make use of a capacitor-resistor discharge circuit to measure the time taken for the cylinder to travel between two points on the slope. The principle of this arrangement is shown in the figure below.



S_1 and S_2 are two switches that would be opened in turn by plungers as the cylinder passed over them. Once opened, the switches would remain open. The cylinder would be released from rest as it opened S_1. The pd across the capacitator would be measured by the voltmeter.

(a) Describe the procedure the student should follow, including the measurements he should make, when using this arrangement. Explain how he should use the measurements taken to calculate the acceleration of the cylinder down the slope.

The quality of your written communication will be assessed in this question.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6)

(b) When the student set up his experiment using the arrangement shown in the figure above, he used a 22 μF capacitor, C, and a 200 kΩ resistor, R. In one of his results, the initial pd was 12.0 V and the final pd was 5.8 V. The distance between the plungers was 2.5 m.

(i) From the student's result, calculate the time taken for the cylinder to reach the second plunger.

answer = ... s

(3)

(ii) What value does this result give for the acceleration of the cylinder down the slope, assuming the acceleration is constant?

answer = ...m s^{-2}

(2)

(Total 11 marks)