Physics Higher Level
Electricity and Electronics
Practice Unit Assessment

Time 45 minutes

Read Carefully

1 All questions should be attempted.

2 Enter the question number clearly beside the answer to each question.

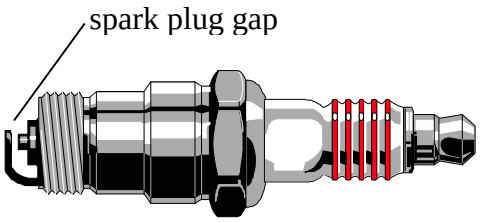
3 Care should be taken to give an appropriate number of significant figures in the final answers to calculations.

4 The following data should be used when required.

Speed of light in vacuum c	$3{\cdot}00 \times 10^{8}$ m s^{-1}	Planck's constant h	$6{\cdot}63 \times 10^{-34}$ J s
Magnitude of the charge on electron e	$1{\cdot}60 \times 10^{-19}$ C	Mass of electron m_e	$9{\cdot}11 \times 10^{-31}$ kg
Acceleration due to gravity g	$9{\cdot}8$ m s^{-2}	Mass of proton m_p	$1{\cdot}67 \times 10^{-27}$ kg

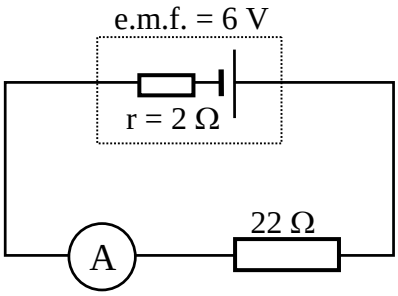
NOTE: This is a **trial paper** and contains questions **of the type** that will be encountered in the actual unit assessment. The threshold of attainment of the unit assessment (pass mark) is 18 marks.

1. A spark crosses the gap between the electrodes at the end of a spark plug. The voltage across the gap is 600 V. Calculate the electrical energy transferred by the spark if the spark transfers a charge of 1×10^{-5} C.



(2)

2. A 22 Ω resistor is connected in series with a cell of e.m.f. 6 V and with an internal resistance of 2 Ω.



(*a*) (i) Find the current flowing through the ammeter. **2**

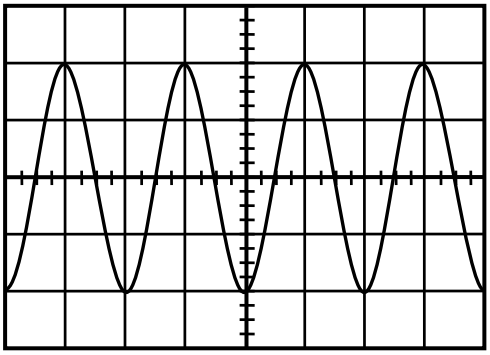
(ii) What will be the voltage across the terminals of the cell? **2**

(iii) What is the value of the lost volts in the circuit? **1**

(*b*) The 22 Ω resistor is replaced by a resistor with only 18 Ω resistance. State the effect this change will have on the value of the lost volts in the circuit. Explain your answer. **2**

(7)

3. An oscilloscope is used to find the frequency of an a.c. power supply.
The oscilloscope screen is divided into 1 cm squares and these are shown below.
Each 1 cm square represents 2 ms.

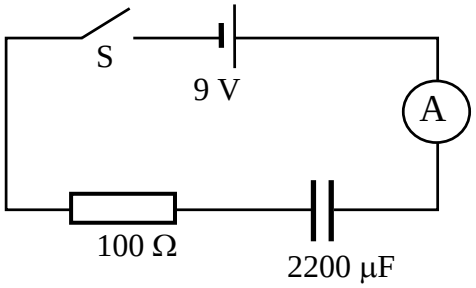


(*a*) Use the trace shown above to calculate the frequency of the power supply. **2**

(*b*) The root mean square (r.m.s.) output voltage from the power supply is 12 V. What is the peak output voltage from the power supply? **2**

(4)

4. A circuit is set up which consists of a resistor and capacitor in series connected to a 9 V cell with negligible internal resistance. The capacitor has a capacitance of 2200 μF.



(*a*) The capacitor is initially uncharged. The switch, S, is closed and the capacitor allowed to charge. What will be the initial charging current recorded on the ammeter? **2**

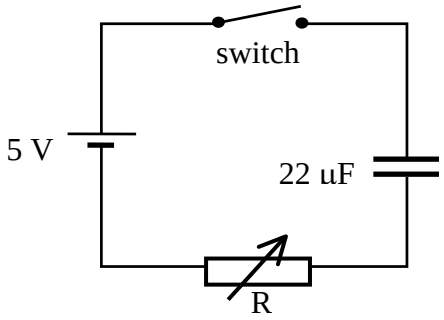
(*b*) The capacitor begins to charge. What will be the voltage across the capacitor at the instant the voltage across the resistor is 6 V? **1**

(*c*) (i) Calculate the charge *Q*, on the capacitor when fully charged? **2**

(ii) How much energy can the capacitor store when fully charged? **2**

(7)

5. A capacitor is connected in series with a resistor as shown below.



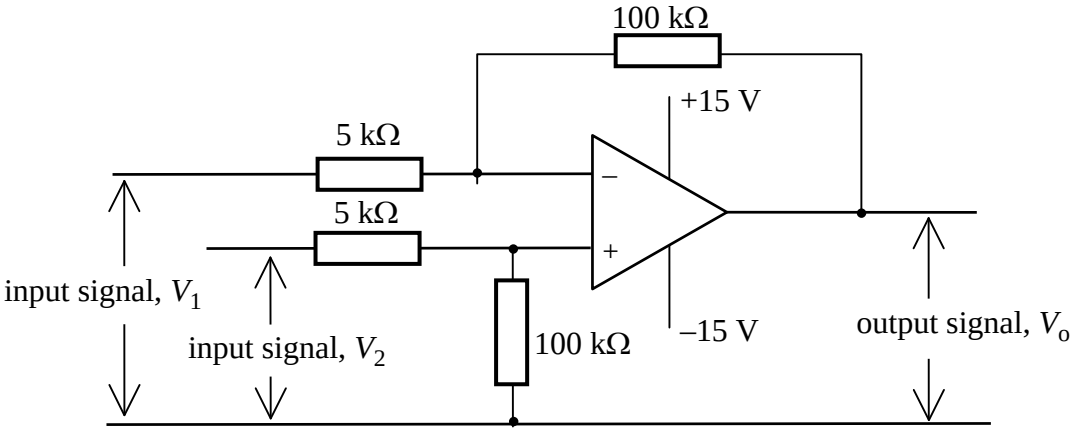
The switch is closed so that the capacitor charges through resistor R.

(*a*) Sketch a graph of voltage against time for the charging capacitor. **1**

(*b*) The value of the variable resistor is now decreased. State the effect this will have on the time it takes for the capacitor to charge. **1**

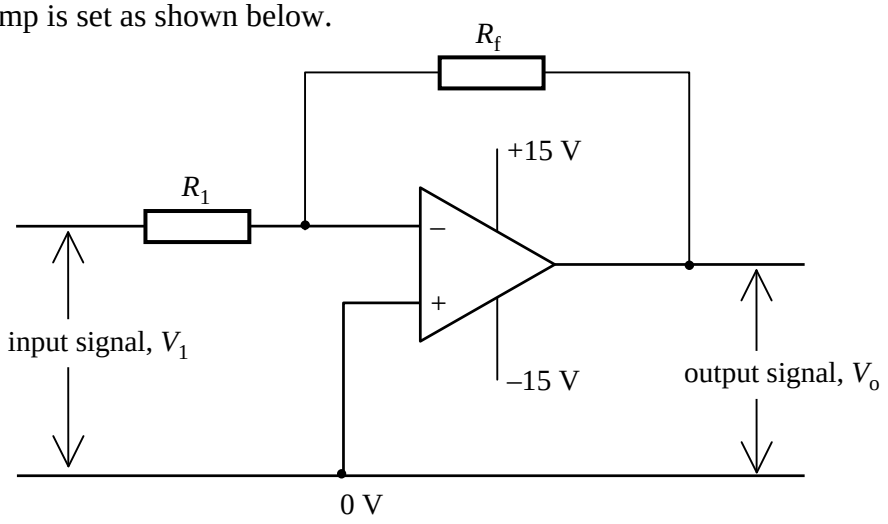
(2)

6. An op-amp is set up as shown in the circuit diagram below.



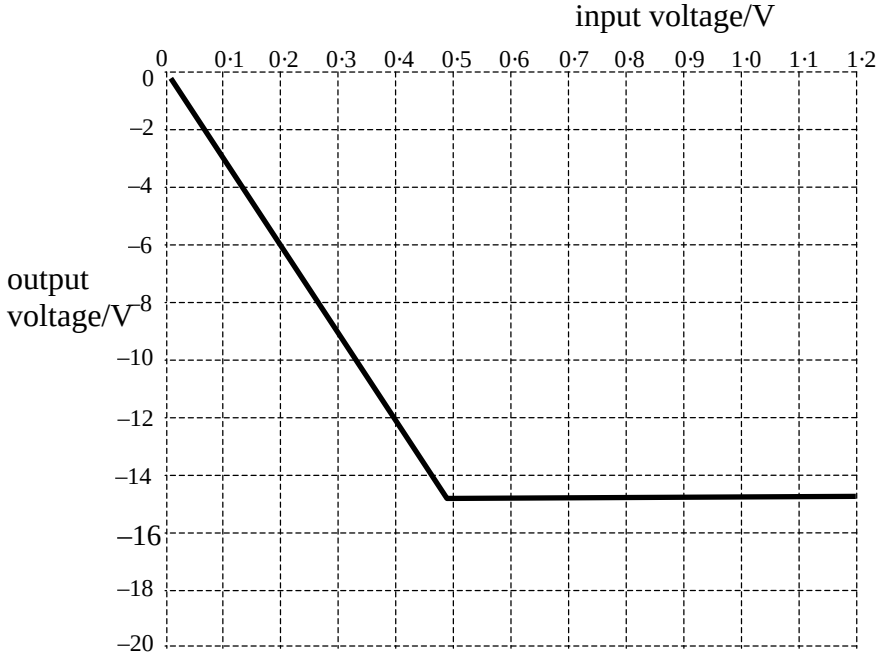
The op-amp has two inputs, V_1 and V_2. The voltage applied to V_1 is 0·4 V and the voltage applied to V_2 is 0·5 V. Calculate the output from this op-amp. **(2)**

7. An op-amp is set as shown below.



(*a*) In what mode is this op-amp operating? **1**

(*b*) The output voltage from the op-amp is plotted against the input voltage to produce the graph shown below.



(i) Use the graph to find the gain of the op-amp. **2**

(ii) If the input resistor has a value of 10 kΩ, find the value of the feedback resistor to provide the gain calculated in (*b*) (i). **2**

(iii) Explain why the output voltage does not exceed 15 V. **1**

(6)