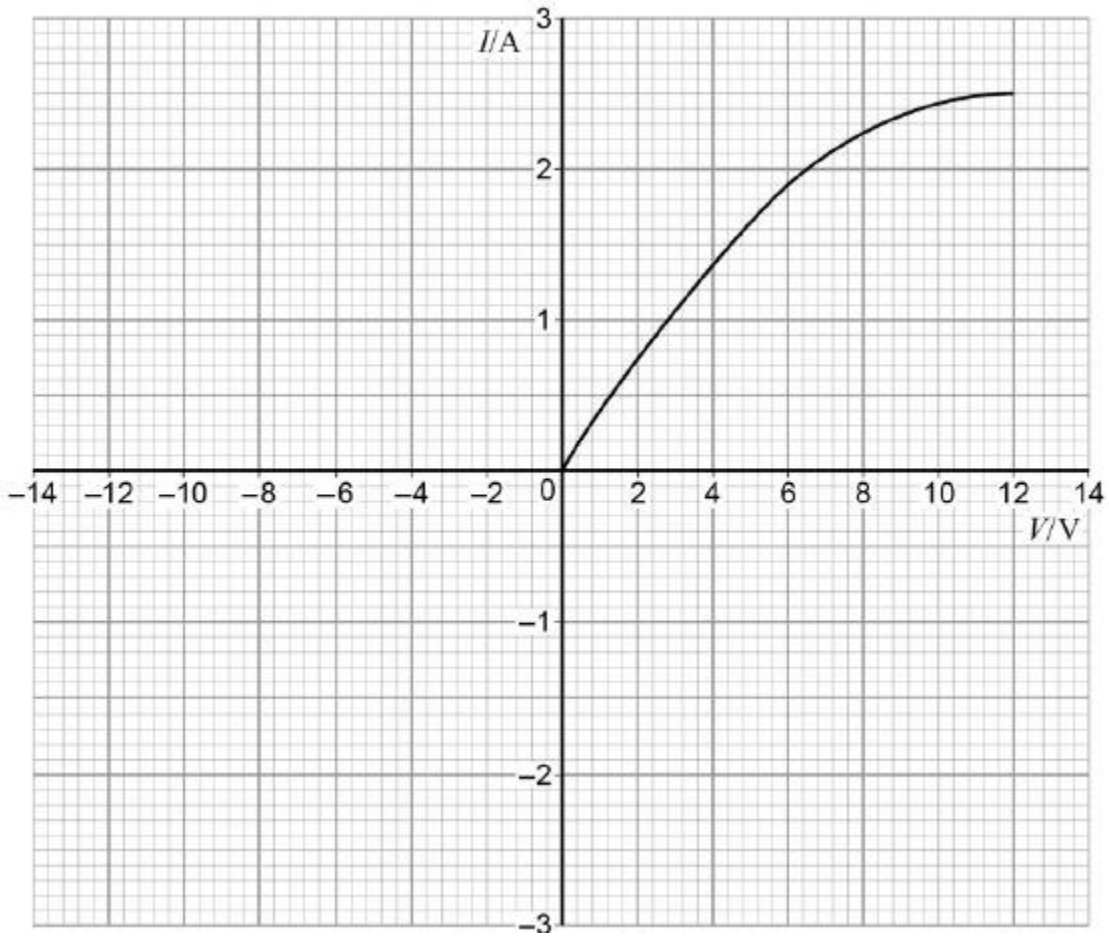
Name of the Student:_____
Max. Marks : 24 Marks **Time :** 24 **Minutes**

Q1.

Figure 1 shows the current–voltage (I–V) characteristic of the lamp used in a car headlight up to its working voltage.

Figure 1



(a) Draw on **Figure 1** the characteristic that would be obtained with the connections to the supply reversed.

(2)

(b) Lamps are marked with their working voltage and the power used at this voltage.
For example, a lamp for use in a torch may be marked 2.5 V 0.3 W.

Deduce the marking on the lamp for the car headlight.

lamp marking =_____ V _____ W

(2)

(c) Determine the resistance of the lamp when the potential difference (pd) across it is half the working voltage.

resistance _____ Ω

(1)

(d) Explain, without further calculation, how the resistance of the lamp varies as the voltage across it is increased from zero to its working voltage.

_____

_____

_____

_____

_____

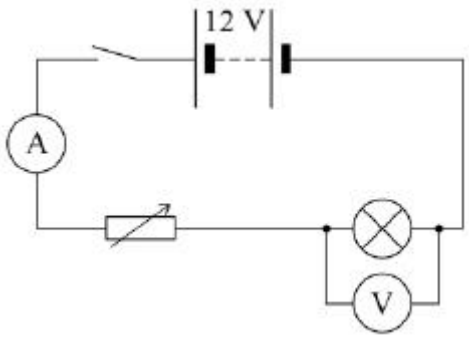
_____

_____

(3)

(e) A student suggests that the circuit shown in **Figure 2** is suitable for collecting data to draw the *I*−*V* characteristic of the lamp up to its working voltage. The maximum resistance of the variable resistor is 6.0 Ω and the internal resistance of the power supply is 2.0 Ω. The resistance of the ammeter is negligible.

Figure 2



Discuss the limitations of this circuit when used to collect the data for the characteristic.

_____

_____

_____

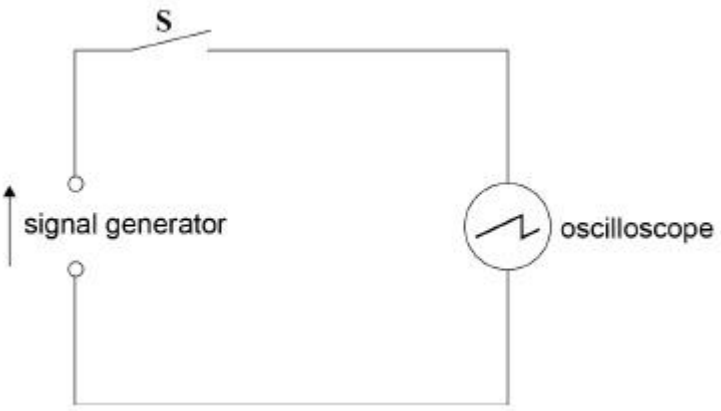
_____

(2)
(Total 10 marks)

Q2.

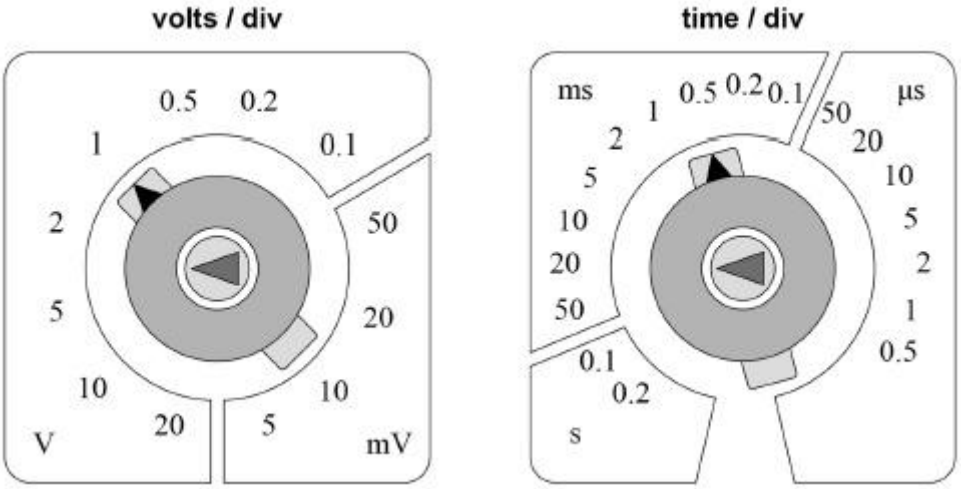
A signal generator is connected to an oscilloscope, as shown in **Figure 1**.

Figure 1



The Y-voltage gain and time-base settings of the oscilloscope are shown in **Figure 2**.

Figure 2



When switch **S** is open (off) the oscilloscope displays the waveform shown in **Figure 3**.

When **S** is closed (on) the oscilloscope displays the waveform shown in **Figure 4**.

(a) Determine the peak-to-peak voltage V of the waveform shown in **Figure 4**.

V = _____ V

(1)

(b) Determine the frequency f of the waveform shown in **Figure 4**.

f = _____ Hz

(2)

Figure 3

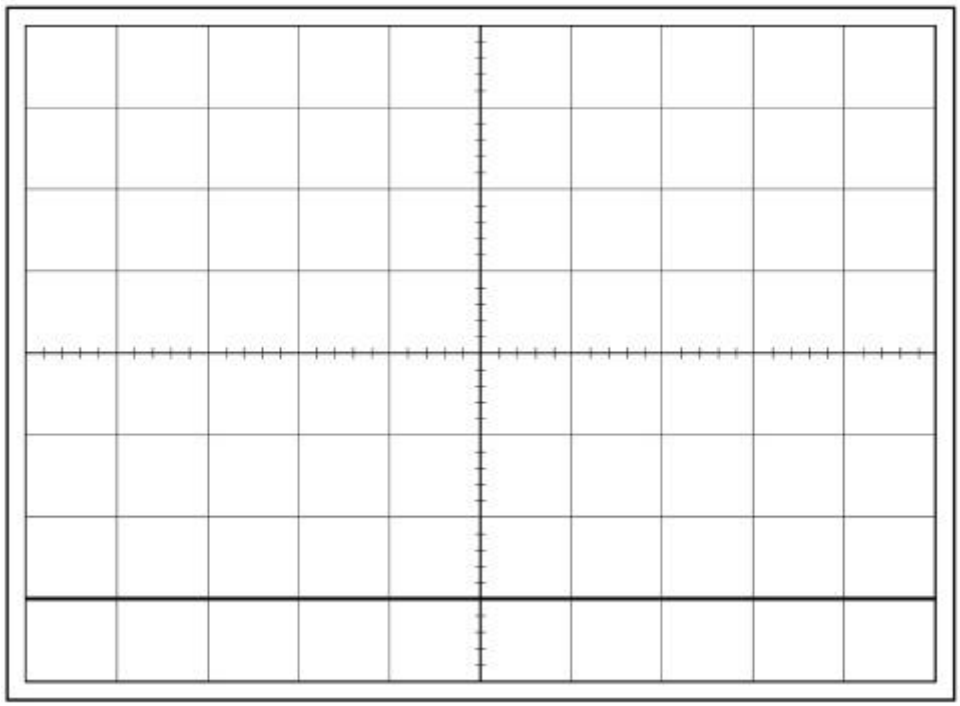
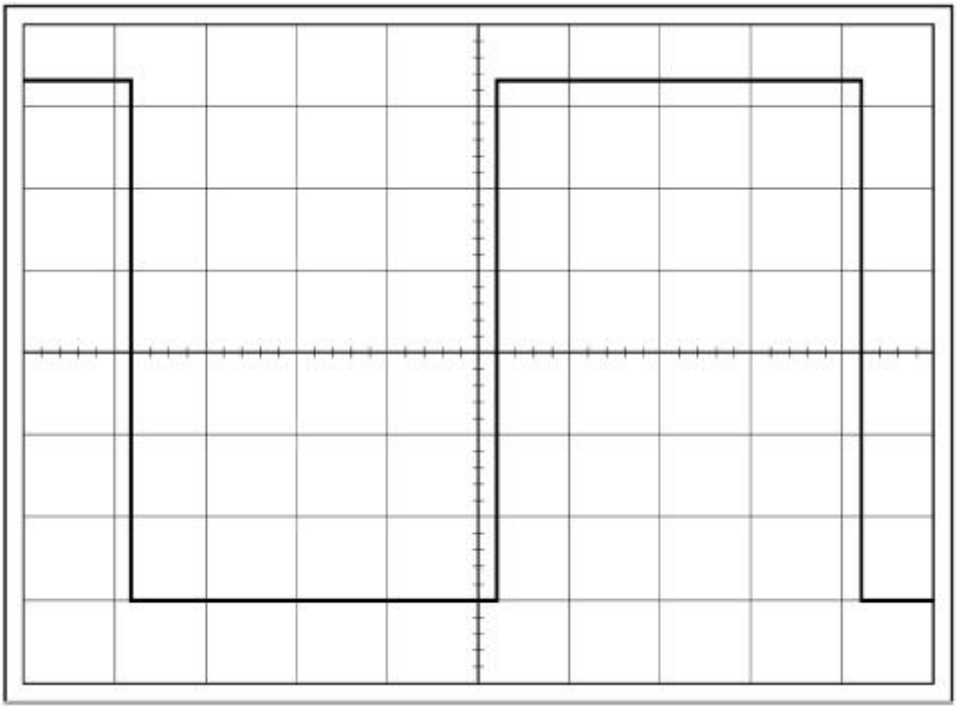
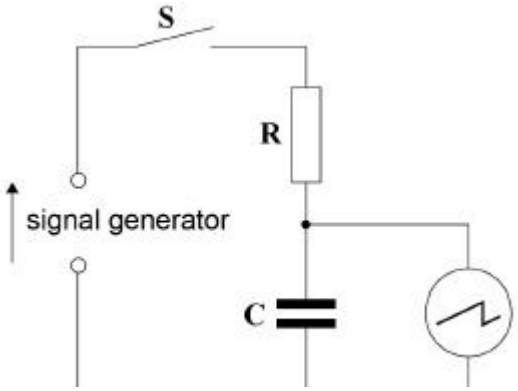


Figure 4



(c) **Figure 5** shows the signal generator connected in series with a resistor **R** and a capacitor **C**.

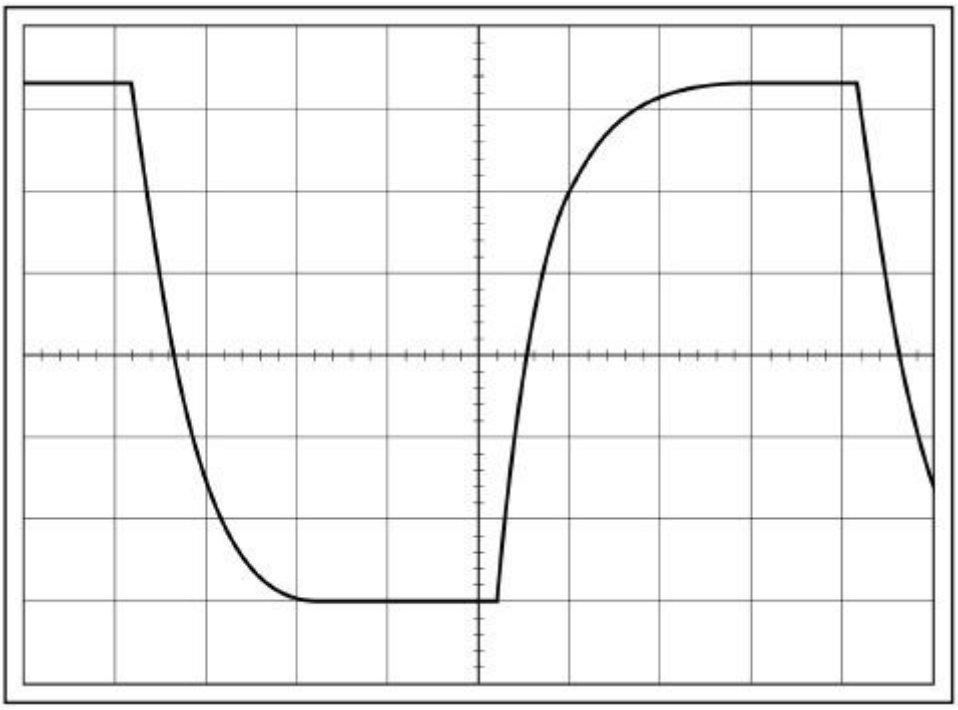
Figure 5



The oscilloscope is connected across the capacitor.
The Y-voltage gain and time-base settings are still the same as shown in **Figure 2**.

When **S** is closed (on) the oscilloscope displays the waveform shown in **Figure 6**.

Figure 6



Determine the time constant of the circuit in **Figure 5**.

time constant = _____ s

(2)

(d) A student suggests that setting the time-base to 0.2 ms division^{-1} might reduce uncertainty in the determination of the time constant.

State and explain any possible advantage or disadvantage in making this suggested adjustment.

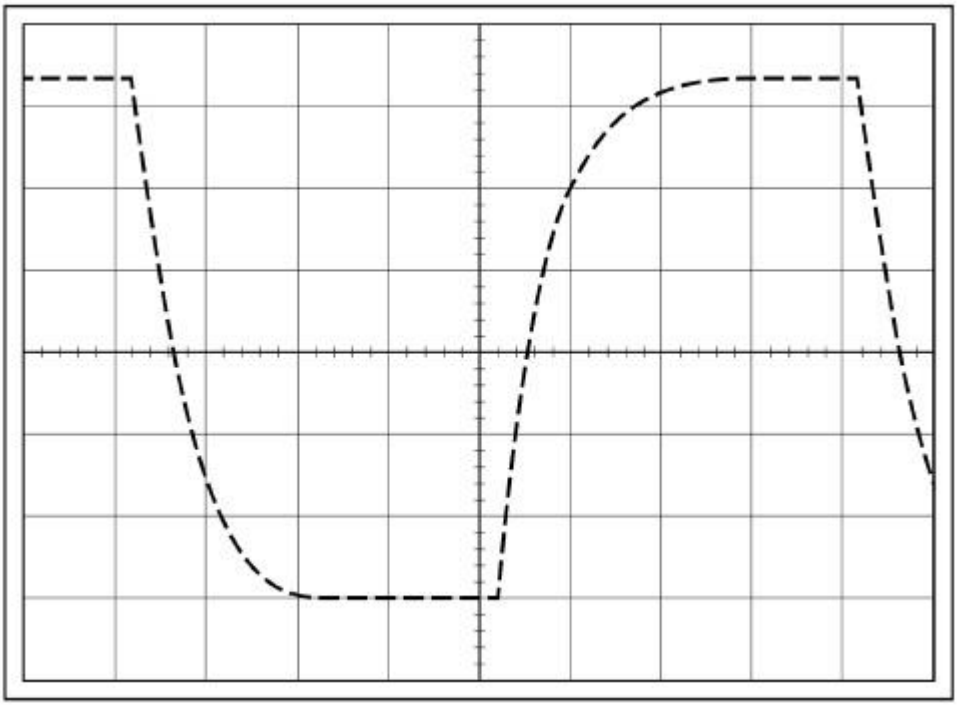
(3)

(e) The student connects an identical resistor in parallel with **R** and uses the oscilloscope to display the waveform across **C**.

Draw on **Figure 7** the waveform you expect the student to see.

The waveform of **Figure 6** is shown as a dashed line to help you show how the waveform changes.

Figure 7



Explain the change in the waveform.

_____

_____

_____

(2)

(f) **Figure 8a** is a graph of voltage against time showing the output of the signal generator. **Figure 8b** shows the voltage across **C** during the same time interval.

The student interchanges the positions of **R** and **C** and connects the oscilloscope across **R**.

Complete **Figure 8c** to draw the voltage across R during the time interval.

Figure 8a

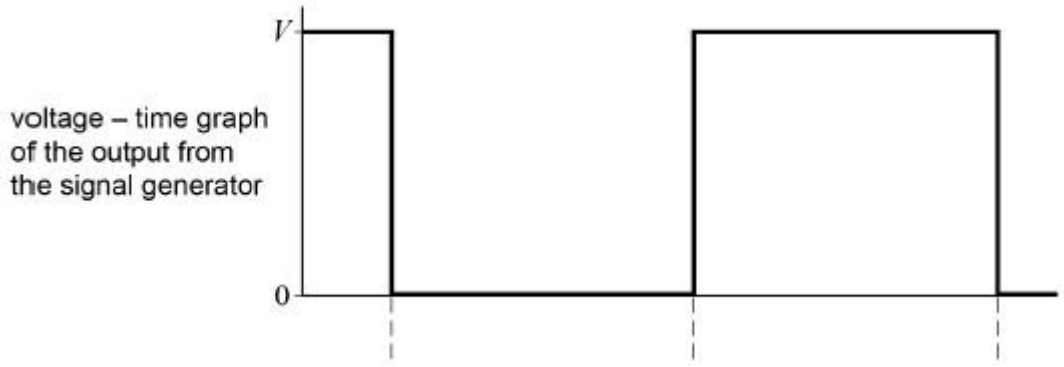


Figure 8b

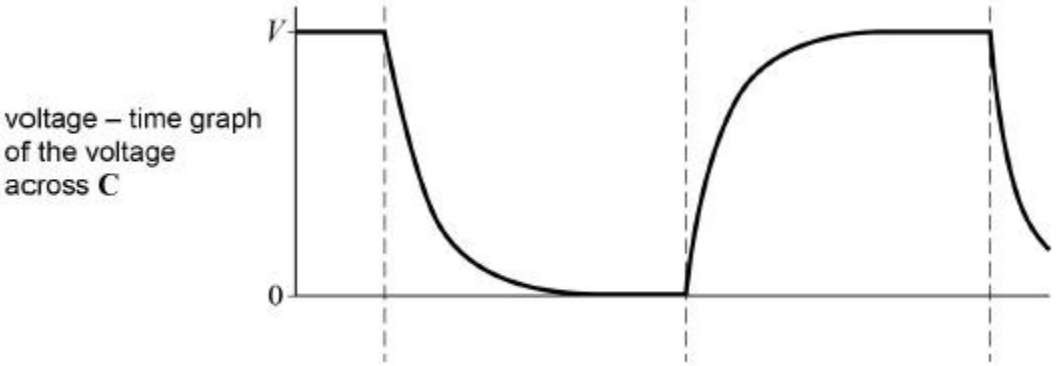
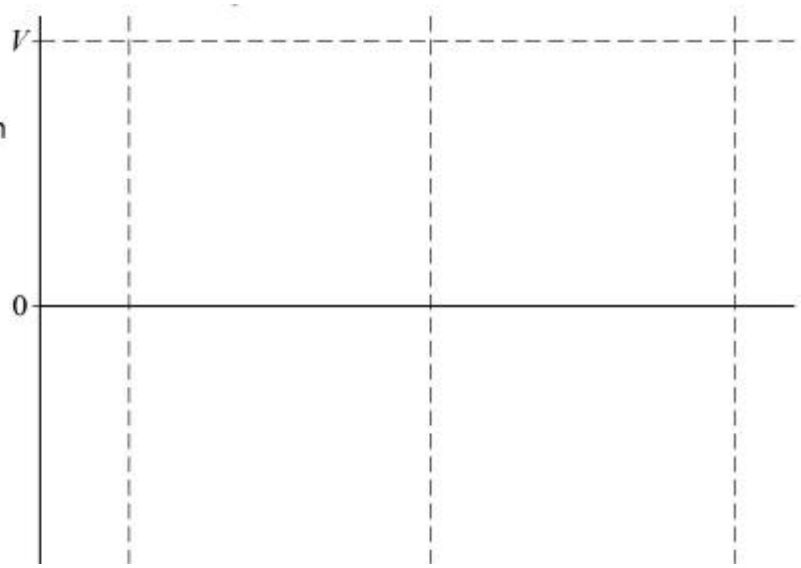


Figure 8c

voltage – time graph of the voltage across **R**



(2)

(g) State and explain what changes, if any, the student needs to make to the settings of the oscilloscope so the waveform across **R** is fully displayed.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(Total 14 marks)