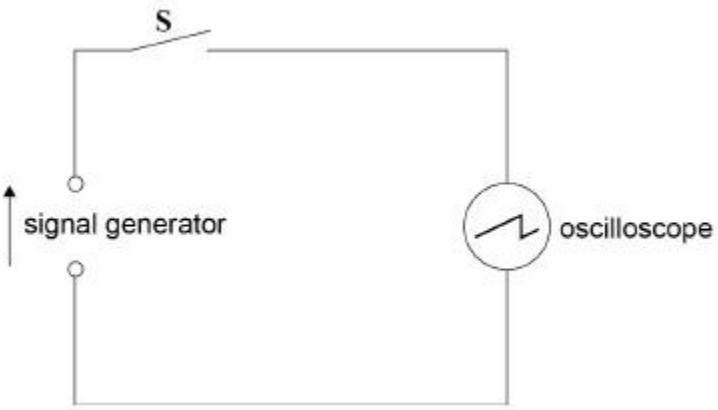
Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Q1.

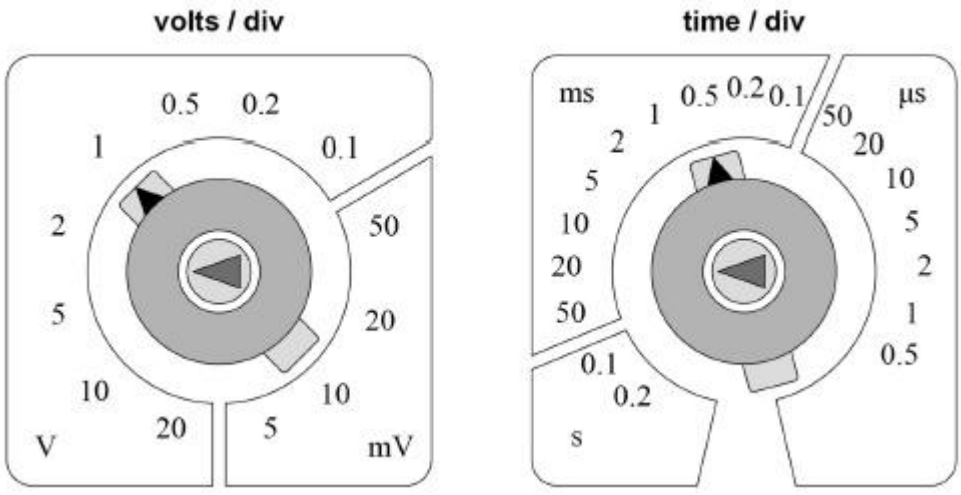
A signal generator is connected to an oscilloscope, as shown in **Figure 1**.

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

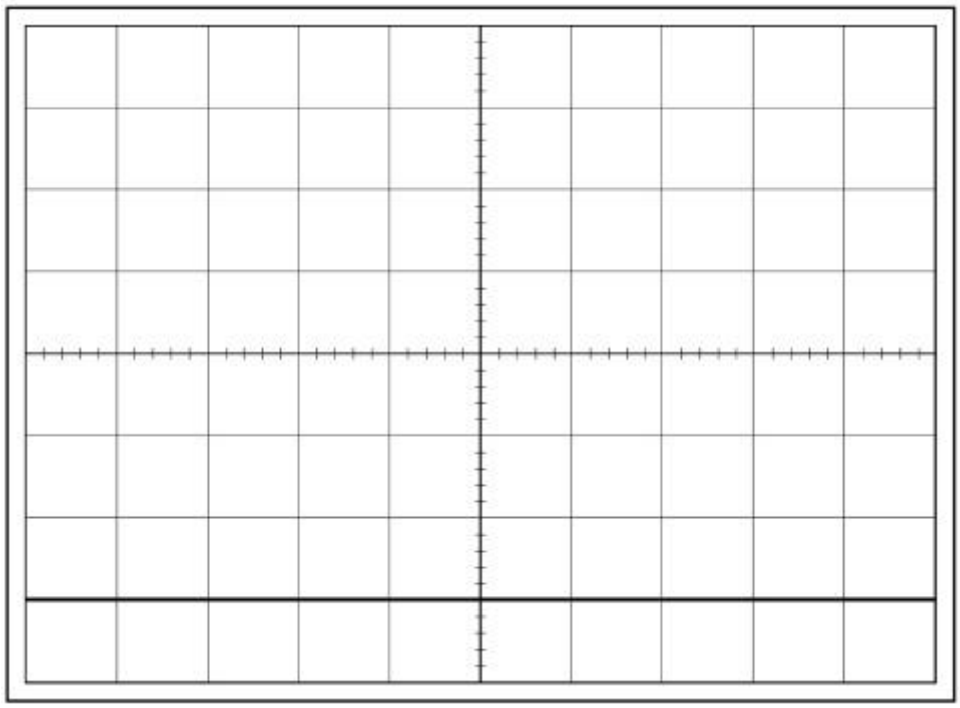
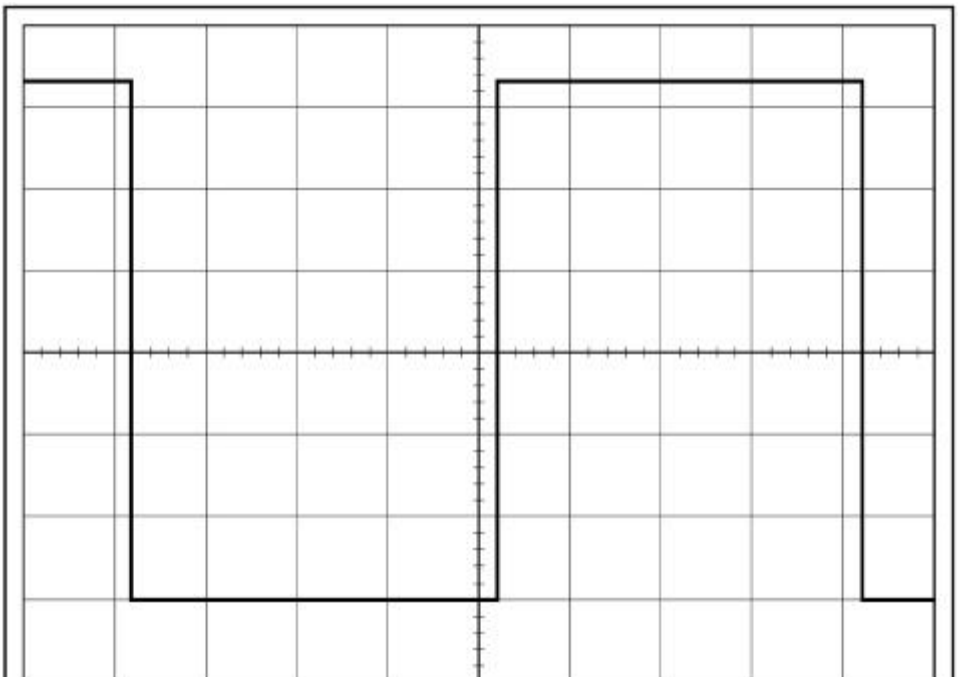
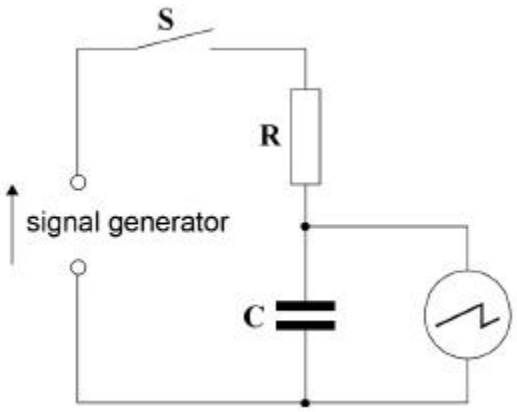


Figure 4



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

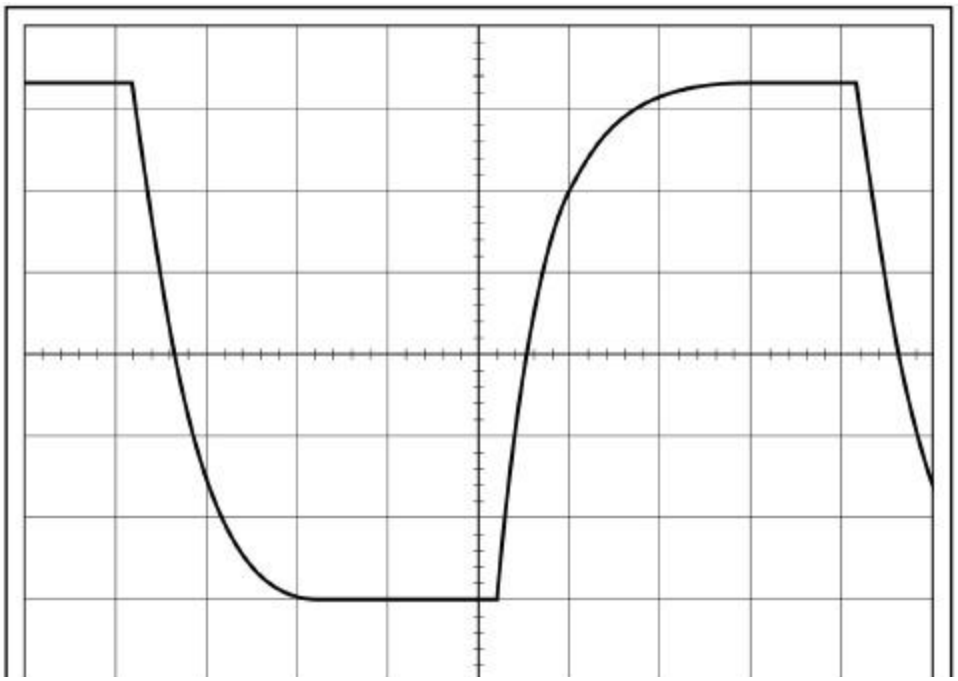
Figure 5



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.

_____

_____

_____

_____

_____

_____

_____

_____

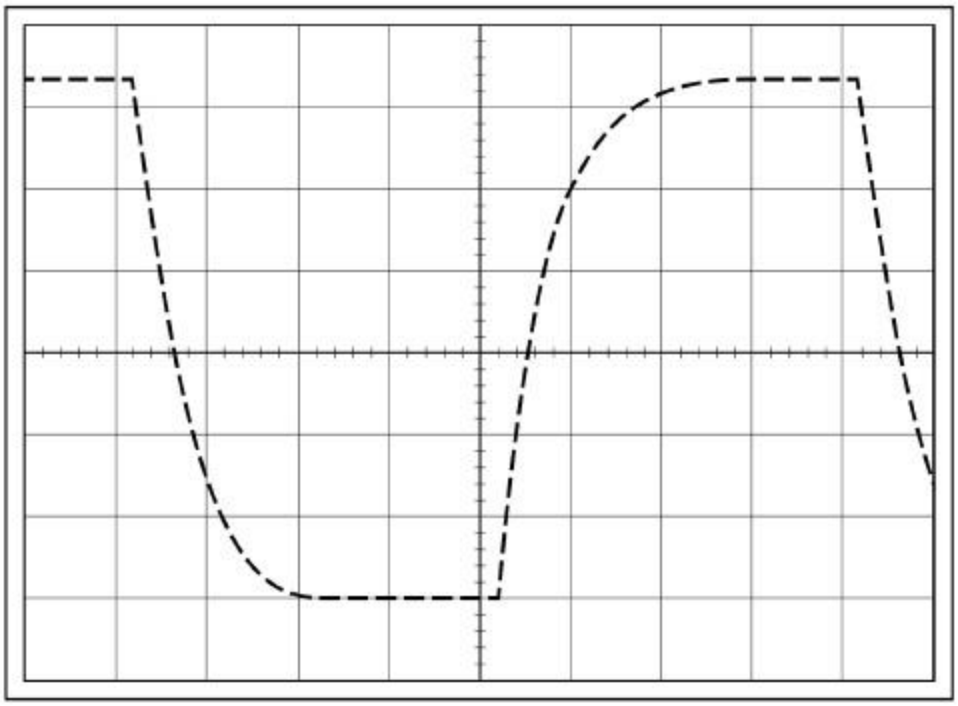
(3)

(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

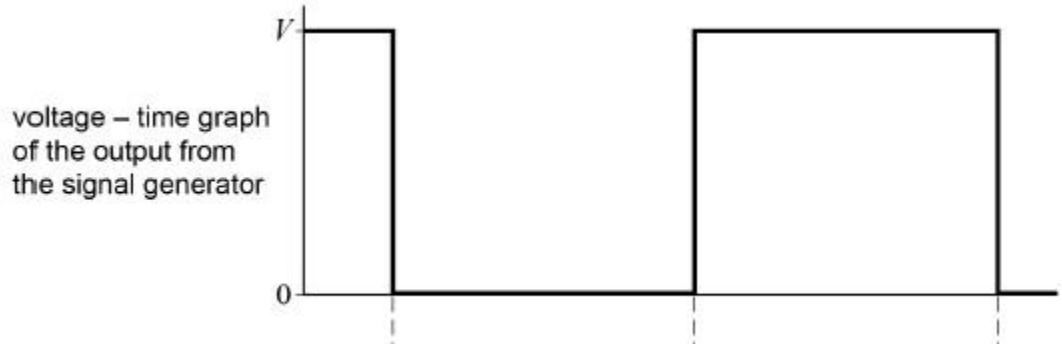


Figure 8b

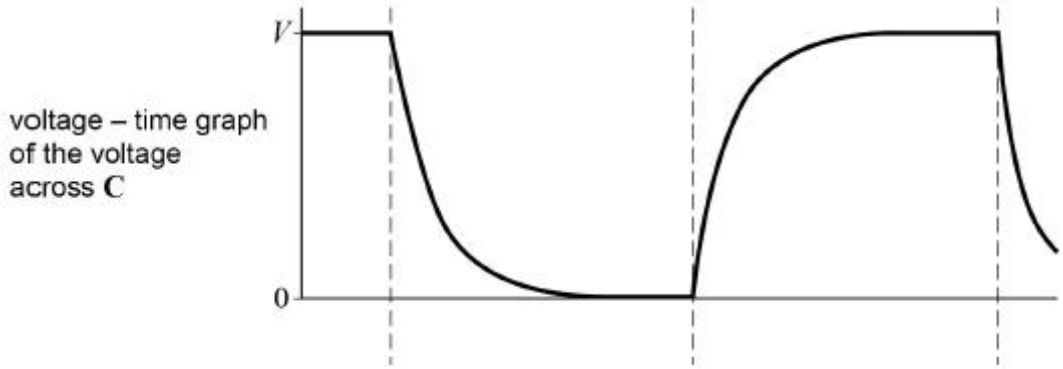
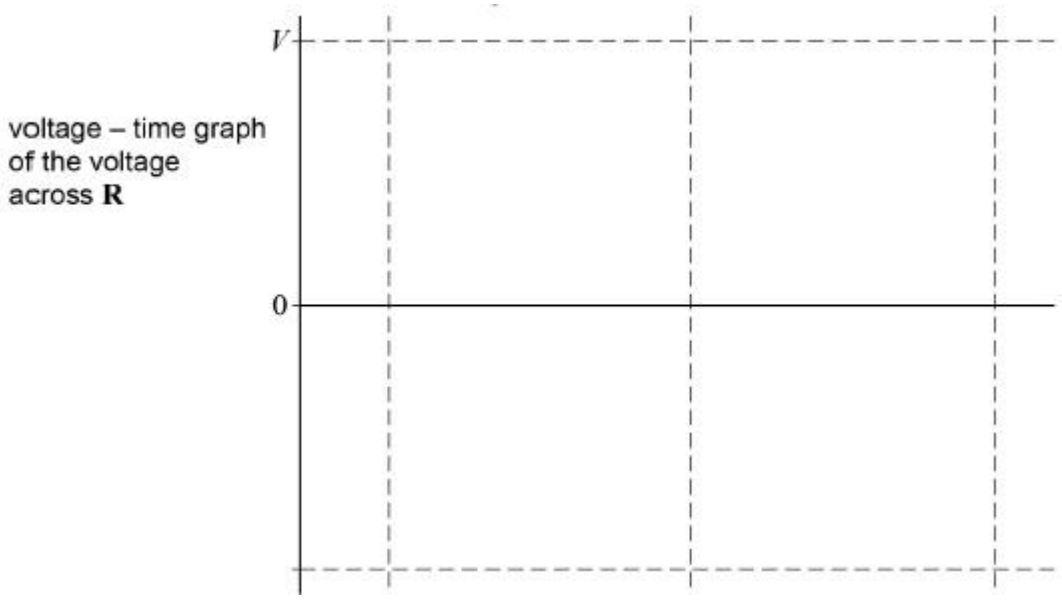


Figure 8c



(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)

Q2.

Draw the ray diagram for a Cassegrain telescope. Your diagram should show the paths of two rays, initially parallel to the principal axis, as far as the eyepiece.

(Total 2 marks)

Q3.

The Kielder Observatory in Northumberland includes two optical telescopes attached to the same mount, so that they can be used to view the same object.
Some of the properties of these telescopes are summarised in the table.

Telescope	Type	Objective diameter/mm
A	refractor	70
B	refractor	400

(a) The telescopes are used to view the same object.

Suggest which telescope in the table produces the brighter image.
Support your answer with a suitable calculation.

(3)

(b) The minimum angular resolution of a telescope can be determined using the Rayleigh criterion.

Explain what is meant by the Rayleigh criterion.

(2)

(c) Discuss which of the two telescopes in the table would be better at resolving the images of two objects that are close together.

(Total 7 marks)