Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Q1.

A student uses a travelling microscope to investigate the perforation holes in a block of postage stamps.

The student positions the microscope to observe the line of perforation holes along the line XY shown in **Figure 1**.

Figure 1

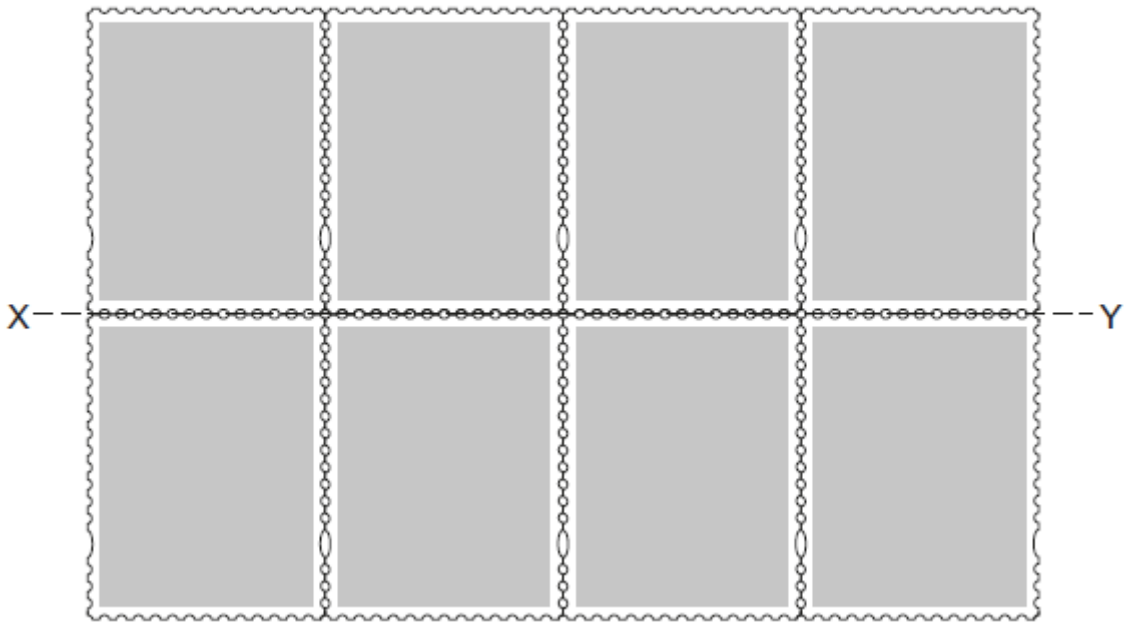
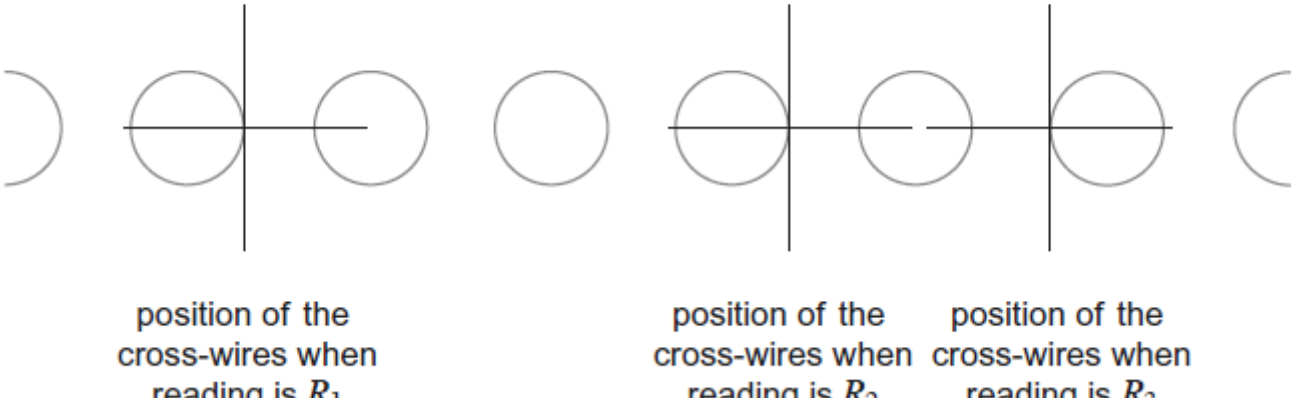


Figure 2 shows the positions of the cross-wires of the microscope when the student makes readings R_1, R_2 and R_3.

Figure 2



The student's readings are shown in the table below.

reading	position / mm
R_1	25.51
R_2	29.80
R_3	31.82

(a) Determine the average separation s between the centres of adjacent perforation holes along line XY.

average separation s = _____ mm

(1)

(b) State the precision of the microscope readings.

precision = _____ mm

(1)

(c) Determine the percentage uncertainty in your result for s.

percentage uncertainty = _____ %

(2)

(d) Determine the diameter d of a perforation hole.

diameter d = _____ mm

(2)

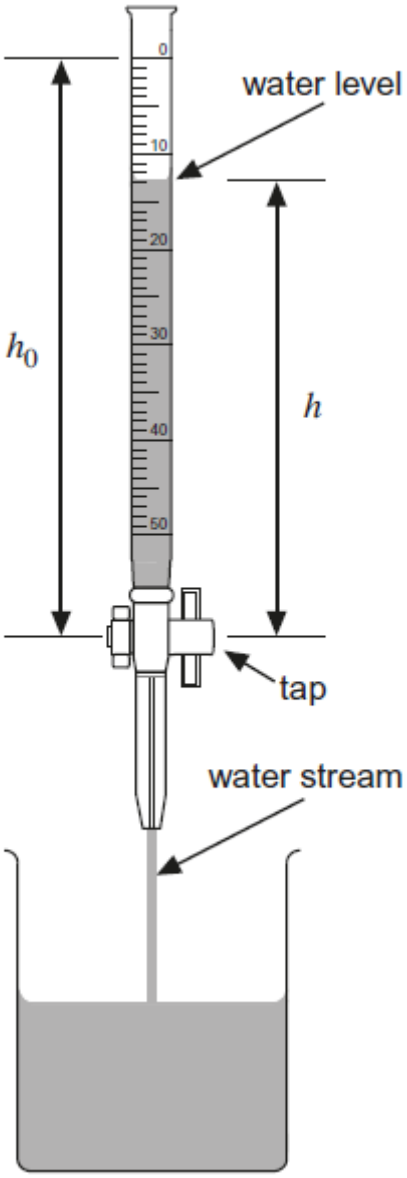
(Total 6 marks)

Q2.

A student investigates how the height *h* of water flowing out of a burette varies with time *t*. A burette is used by chemists to measure a volume of liquid.

The apparatus the student used is shown in **Figure 1**.

Figure 1



h_0 is the height of the water level above the tap in the burette at time $t = 0$.

As the tap was opened the student started a stopclock and recorded the height h every 10.0 s as the water drained into the beaker.

Values of h and h_0 were measured using a metre ruler.

The student repeated this procedure twice more. The results are shown in the table below.

t/s	**Height above the tap/mm**				**ln *(h/mm)***
	h_1	h_2	h_3	**mean height** h	
0	665	665	665	665	6.500
10.0	571	569	576	572	6.349
20.0	517	512	509	513	6.240
30.0	434	429	421	428	6.059
40.0	380	384	379		
50.0	340	338	331		
60.0	291	287	295	291	5.673

(a) Complete the table above.

(1)

(b) Plot the two missing points on the graph in **Figure 2** and draw a best fit straight line.

(2)

(c) Determine the gradient of your line.

gradient = _____

(3)

(d) Theory predicts that the relationship between h and t is given by the equation

$$h = He^{-\lambda t}$$

where H and λ are constants.

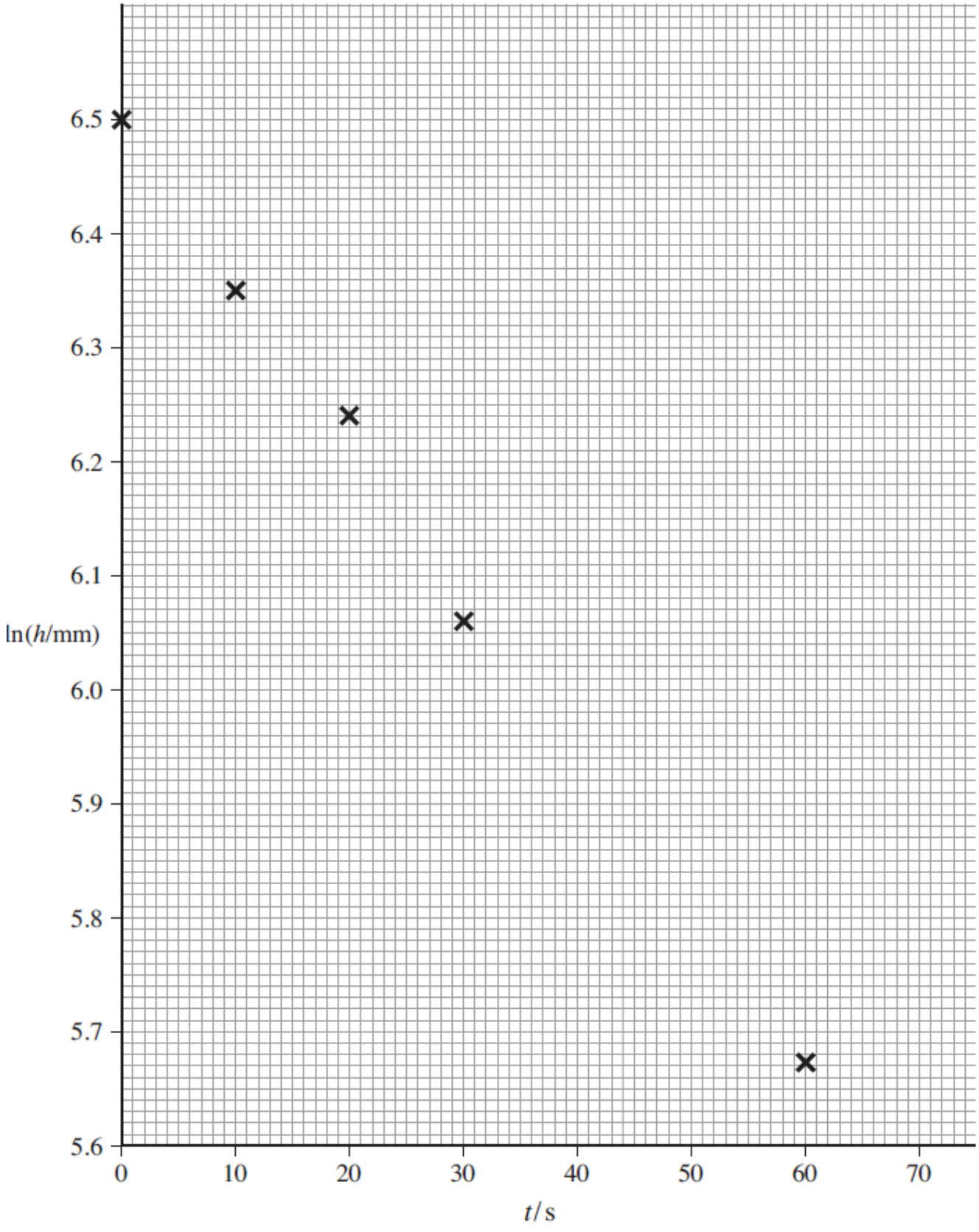
State values for H and λ with their units.

H = _____ unit = _____

λ = _____ unit = _____

(3)

Figure 2



(e) Suggest a possible source of systematic error in the burette experiment.

Explain whether this would have affected the value you found for λ.

Source _____

_____

Explanation _____

_____

(3)

(f) Suggest a possible source of random error in the burette experiment.

Explain whether this would have affected the value you found for λ.

Source _____

_____

Explanation _____

_____

(2)

(Total 14 marks)