Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Q1.

A student investigates the variation of electric potential with distance along a strip of conducting paper of length *l* and of uniform thickness. The strip tapers uniformly from a width 4*w* at the broad end to 2*w* at the narrow end, as shown in **Figure 1**. A constant pd is applied across the two ends of the strip, with the narrow end at positive potential, V_l, and the broad end at zero potential. The student aims to produce a graph of pd against distance *x*, measured from the broad end of the strip.

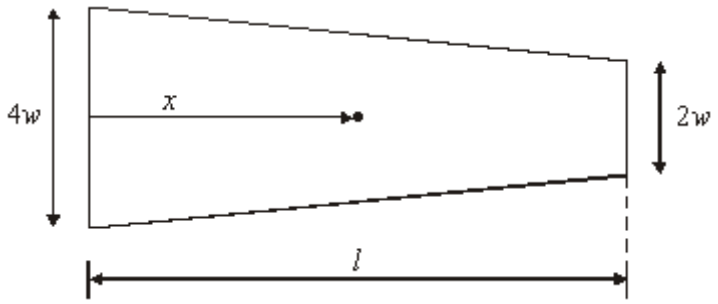


Figure 1

(a) Draw a labelled circuit diagram which would be suitable for the investigation.

(2)

(b) The student obtained some preliminary measurements which are shown below.

pd, *V*/V	0	2.1	4.5	7.2
Distance, *x*/m	0	0.100	0.200	0.300

By reference to the physical principles involved, explain why the increase of *V* with *x* is greater than a linear increase.

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(4)

(c) The potential, V, at a distance x from the broad end is given by

$$V = k - 1.44V_l \ln (2l - x),$$

where V_l is the potential at the narrow end, and k is a constant.

(i) The student's results are given below. Complete the table.
l = 0.400 m

distance x/m	potential V/V	$(2l - x)$/m	$\ln (2l - x)$
0.100	2.1	0.700	– 0.357
0.200	4.5		
0.270	6.4		
0.330	8.3		
0.360	9.3		
0.380	10.1		

(ii) Plot a graph of V against $\ln (2l - x)$ and explain whether or not it confirms the equation.

(iii) Use the graph to calculate V_l.

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(10)

(Total 16 marks)

Q2.

(a) Draw a ray diagram to show the path of two rays, parallel to the axis, through a Cassegrain telescope, as far as the eyepiece.

(2)

(b) The UKIRT is a Cassegrain telescope capable of detecting both infrared and visible radiation. It has an objective diameter of 3.8 m.

(i) Calculate the resolving power of this telescope for infrared light of wavelength 2.0 μm.

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(ii) Explain why the resolving power of this telescope is better in the visible region than in the infrared region.

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(4)

(c) To reduce atmospheric absorption problems, the telescope was built at the top of Mount Mauna Kea in Hawaii.

(i) What, in the atmosphere, is responsible for absorbing infrared radiation?

_____

(ii) The spectrum of light from a star can be used to determine its temperature. Explain why this absorption can lead to errors in the value.

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(3)
(Total 9 marks)

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