Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Q1.

Read the following passage and then answer the questions that follow.

Cool Heads Come Out On Top

The school team are celebrating their win at the regional STEM Club competition for their fan cooled hat.

The photograph shows an early prototype.

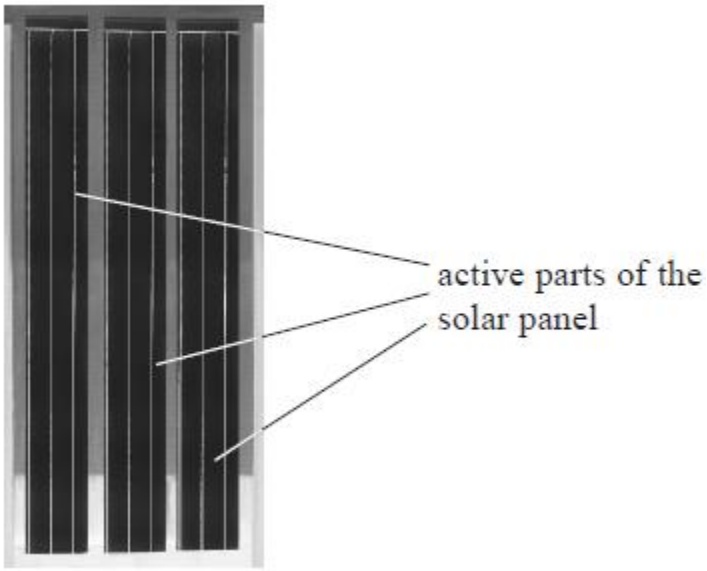


The solar panel on top of the hat powers the fan which is at the front of the hat. This cools the wearer of the hat.

A team member said, "Our cell generates 1.5 V and has a solar to electrical efficiency of about 10%. This doesn't sound like much, but our hat could make a significant contribution to energy conservation and protecting the environment."

(a) The photograph shows the active parts of the solar panel at full size.

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(i) By taking measurements from the full size photograph, show that the total area of the active parts of the solar panel is about 10^{-3} m^2. Include the uncertainty in your answer.

(4)

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(ii) The following results were recorded when the team tested the hat in the laboratory.
intensity of incident light = 1240 W m^{-2}
output current = 102 mA
output potential difference = 1.52 V
Determine whether the team member's statement about the efficiency is correct.

(5)

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(b) Criticise the comment, "our hat could make a significant contribution to energy conservation and protecting the environment".

(2)

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(Total for question = 11 marks)

Q2.
When the photoelectric effect was first observed in the nineteenth century, scientists could not explain it using the wave theory of light.

In 1905 Albert Einstein published a paper, for which he won a Nobel Prize, explaining the photoelectric effect by using a photon model of light, rather than a wave model.

(a) Explain what is meant by a photon.

(2)

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*(b) Explain why the following observations may be understood by using a photon model of light, rather than a wave model.

- Light above a certain frequency causes the emission of electrons from the surface of a metal. This emission occurs instantaneously.
- Light below a certain frequency will not result in the emission of electrons however long it illuminates the surface.

(5)

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(c) Zinc has a work function of 4.3 eV.

(i) Calculate the threshold frequency for zinc.

(3)

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Threshold frequency = ...

(ii) State the part of the electromagnetic spectrum to which radiation of this frequency belongs.

(1)

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(Total for Question = 11 marks)

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