9 A student has been learning about the photoelectric effect.

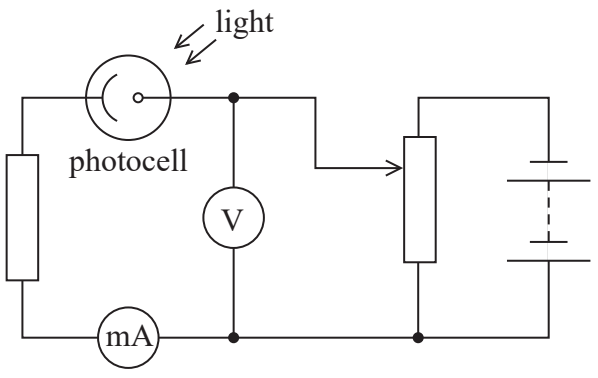
(a) The student was asked by his teacher to explain the photoelectric effect. He gave the following explanation:

> Light above a certain threshold is able to free electrons from a metal, because the light gives energy to electrons in the metal.
> Some of this energy is used to release the electrons from the metal and the rest becomes kinetic energy of the freed electron.

Discuss whether the student's answer fully explains the photoelectric effect.

(4)

(b) The student sets up a circuit to investigate the photoelectric effect.



The student illuminates the photocell with light of known frequency f. A current is produced in the circuit due to the emitted electrons. He adjusts the potential difference, using a potential divider, until the reading on the milliammeter is zero and records the corresponding reading V_s on the voltmeter. He repeats this procedure for other frequencies of light.

When the reading on the milliammeter is zero the maximum kinetic energy of the emitted electrons is given by eV_s.

Explain how the student can use his results to determine a value for the Planck constant h using a graphical method.

(5)

(c) This experiment demonstrates the particle nature of light.

Explain what is meant by the particle nature of light.

(2)

(Total for Question 9 = 11 marks)