**11** **(a)** With reference to the photoelectric effect, state what is meant by *work function energy*.

.....

.....

..... [2]

**(b)** The work function energy of a clean metal surface is $5.5 \times 10^{-19}$ J.

Electromagnetic radiation of wavelength 280 nm is incident on the metal surface. The metal is in a vacuum.

**(i)** Calculate:

**1.** the photon energy

photon energy = ..... J [2]

**2.** the maximum speed $v_{MAX}$ of the electrons emitted from the surface.

$v_{MAX}$ = ..... $m\,s^{-1}$ [3]

**(ii)** Explain why most of the emitted electrons will have a speed lower than $v_{MAX}$.

.....

..... [1]

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**(c)** The electromagnetic radiation incident on the metal surface may change in intensity or in frequency.

Complete Fig. 11.1 by inserting either '*increases*' or '*decreases*' or '*no change*' to describe the effects of the changes shown on the maximum speed and on the rate of emission of electrons.

| change | maximum speed of electrons | rate of emission of electrons |
|---|---|---|
| reduced intensity at constant frequency | ..... | ..... |
| increased frequency at constant intensity | ..... | ..... |

**Fig. 11.1**

[4]

[Total: 12]