9 **(a)** **(i)** Explain what is meant by diffraction of light.

.....

..... [1]

(ii) A parallel beam of red light is incident normally on a diffraction grating, and a diffraction pattern is observed. The red light in is then replaced with blue light.

State and explain the effect on the diffraction pattern, apart from the change in color.

.....

.....

..... [2]

(b) A loudspeaker is held above a vertical tube of liquid, as shown in Figure 9.1.

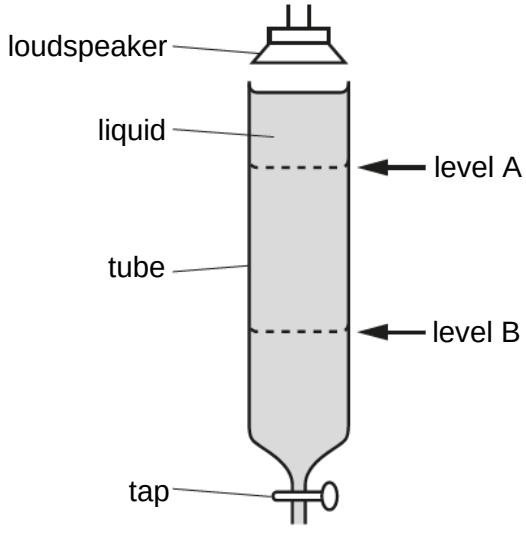

Fig. 9.1

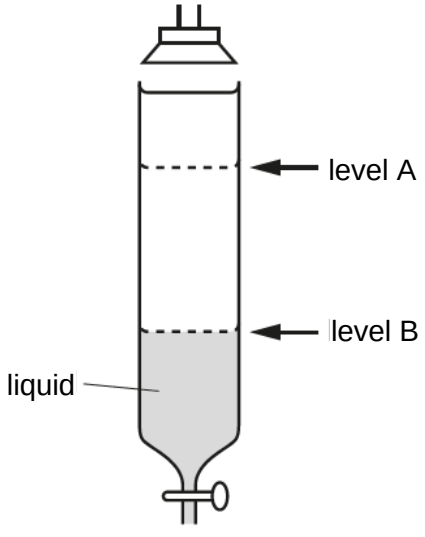

Fig 9.2

A tap at the bottom of the tube is opened so that liquid drains out slowly. The wavelength of the sound from the loudspeaker is 0.30 m.

The sound that is heard first becomes much louder when the liquid surface reaches level A. The next time that the sound becomes much louder is when the liquid surface reaches level B, as shown in Fig. 9.2.

(i) Calculate the vertical distance between level A and level B.

distance = ... m [1]

(ii) On Fig. 9.2, label with the letter N the positions of the displacement nodes of the stationary wave that is formed in the air column when the liquid surface is at level B.

[1]

(c) S_1 and S_2 are two loudspeakers directly facing each other, emitting continuous sound waves of frequency 1100 Hz. **M** is a microphone which runs on a straight track from S_1 to S_2 at a speed of 20 m s^{-1}, as shown in Fig. 9.3.

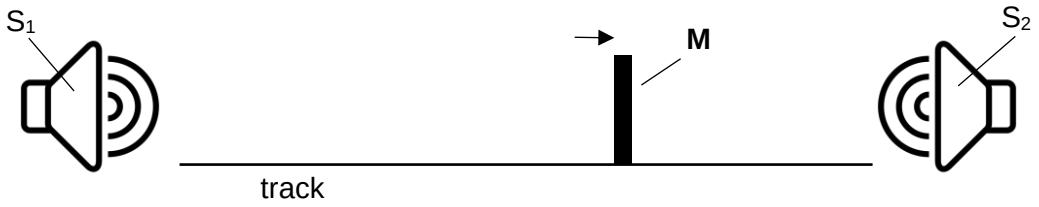

Fig. 9.3

(i) The intensity of sound received by **M** fluctuates regularly. Explain.

.....

.....

.....

..... [2]

(ii) If the speed of sound is known to be 330 m s^{-1}, calculate the frequency at which the maxima in sound are detected by **M**.

frequency = ... Hz [3]

(d) **(i)** With reference to the photoelectric effect, explain why the existence of the threshold frequency provides evidence for the particulate nature of EM radiation.

.....

.....

.....

.....

.....

..... [3]

(ii) Electromagnetic radiation of wavelength λ is incident on a metal surface. Electrons are emitted from the surface, with maximum kinetic energy E_{max}.

The variation of E_{max} with λ is shown in Fig. 9.4.

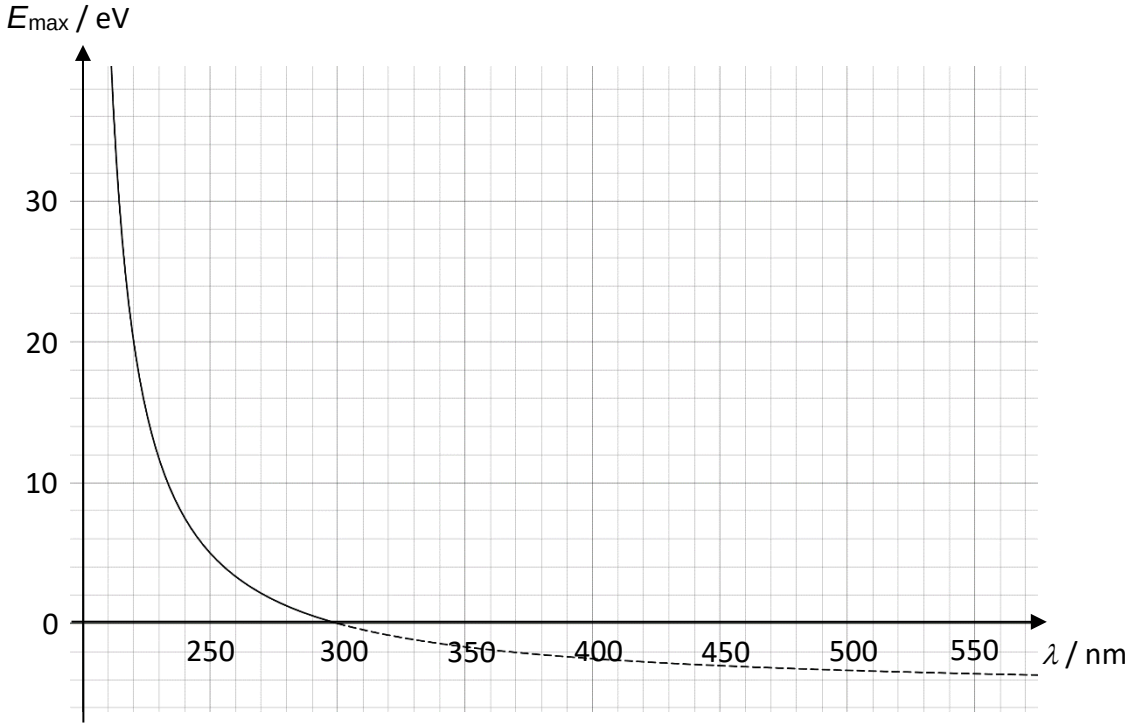

Fig. 9.4

Using Fig. 9.4, determine

1. the work function of the metal,

work function = …….. eV [2]

2. the threshold frequency of the metal, and

threshold frequency = …….. Hz [1]

3. the stopping potential when λ = 220 nm.

stopping potential = …….. V [2]

(iii) On Fig. 9.4, sketch a curve to show the variation with λ of E_{max} for a metal with a higher work function.

[2]

[Total: 20]