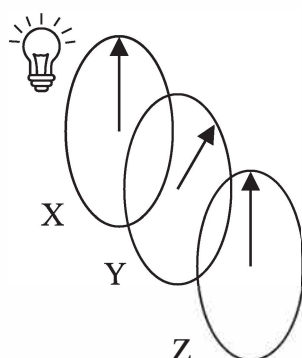


- 5 Three polarising filters X, Y and Z, are placed in front of a source of unpolarised light. The planes of polarisation of the filters are initially parallel.

Filter Y is rotated by 45° as shown.



Filter Z is then rotated clockwise and the intensity of light emerging from Z is measured.

Which angle of rotation of Z will result in the lowest intensity of light?

- A 90°
 B 135°
 C 180°
 D 225°

(Total for Question 5 = 1 mark)

- 6 When light is incident on the surface of a metal, electrons may be emitted by the photoelectric effect. Observations of the photoelectric effect helped to establish that light can exhibit particle behaviour.

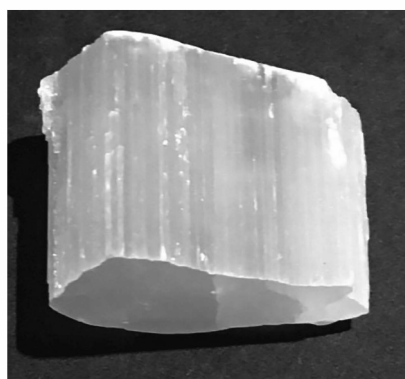
Which of the following observations of the photoelectric effect could also be explained by light behaving as a wave?

- A Emission of photoelectrons occurs immediately the surface is illuminated.
 B Photoelectrons are only emitted when the frequency of the light is more than a certain minimum value.
 C The maximum kinetic energy of the photoelectrons is independent of the intensity of the incident light.
 D When the intensity of the incident light increases, photoelectrons are emitted at a greater rate.

(Total for Question 6 = 1 mark)



- 12 The photograph shows a sample of the mineral selenite. Selenite is made up of many long, narrow crystals.



Selenite has a refractive index of 1.52

- (a) Calculate the speed of light in selenite.

(2)

Speed of light in selenite =

- (b) (i) State what is meant by critical angle.

(1)



(ii) Calculate the critical angle for light in selenite.

(2)

.....

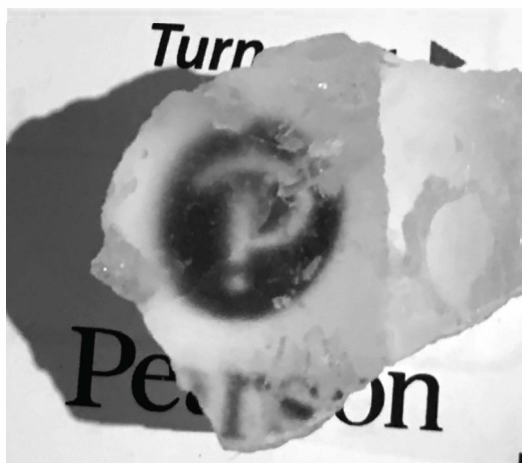
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Critical angle for light in selenite =

(c) Selenite can act as a collection of optical fibres, so that an image of writing beneath the mineral sample appears as if it is at the upper surface as shown.



Explain how light travels through a selenite crystal.

(2)

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(Total for Question 12 = 7 marks)

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15 The photograph shows an ultrasonic mouse repeller used in a house.



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The mouse repeller produces ultrasound that repels mice but cannot be heard by humans. The mouse hears ultrasound directly and by reflection from the walls.

The mouse repeller produces ultrasound of frequency 26.0 kHz.

speed of sound = 340 m s^{-1}

(a) Calculate the wavelength of the ultrasound produced.

(2)

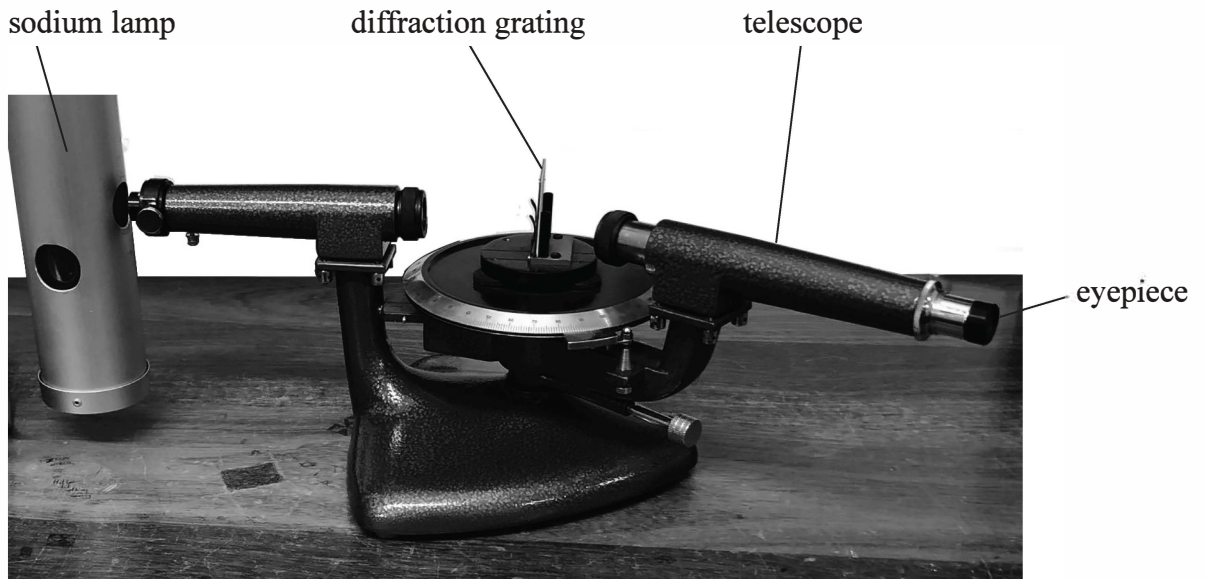
Wavelength =

(b) State what is meant by superposition of waves.

(2)



17 The photograph shows a school spectrometer.



The spectrometer allows parallel rays of light to be passed through a diffraction grating and the resulting angles of diffraction to be measured.

- (a) In the telescope, light from the grating is focused to make a real image 16.7 mm in front of the eyepiece lens. The eyepiece lens then uses this real image as an object to produce a magnified virtual image for the observer.

Calculate the magnification produced by the eyepiece lens.

focal length of eyepiece lens = 17.9 mm

(3)

Magnification =



(ii) Diffraction gratings with the following spacings are available:

$d/10^{-6}$ m	1.0	1.7	2.0	3.3
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Explain which would be the best spacing to use to measure the diffraction angle for the third order maximum for yellow light of wavelength 589 nm.

(3)

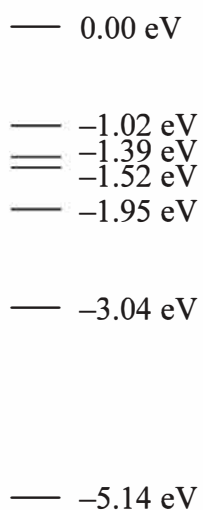
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(c) The diagram shows some of the energy levels in a sodium atom.



Add an arrow to the diagram to show the transition involved in the emission of yellow light of wavelength 589 nm.

Show your working below.

(4)

(Total for Question 17 = 16 marks)

