

7 A fluorescent lamp has a power input of 14 W.

The rate of transfer to thermal energy by the lamp is 9.8 W, the remainder of the energy becoming light.

Which of the following is the efficiency of the lamp?

- ☐ A 0.30
- ☐ B 0.43
- ☐ C 0.70
- ☐ D 1.43

(Total for Question 7 = 1 mark)



13 The orbits of planets around the Sun are elliptical.

The intensity of radiation received at the top of the Earth's atmosphere is monitored during one orbit of the Earth around the Sun.

The following data is recorded:

maximum intensity of radiation = 1.41 kW m^{-2}

minimum intensity of radiation = 1.32 kW m^{-2}

- (a) Calculate the minimum distance between the Earth and the Sun.

power of the Sun = $3.83 \times 10^{26} \text{ W}$

(3)

Minimum distance =

- (b) As Mars orbits the Sun, the intensity of radiation received at the top of its atmosphere varies from 491 W m^{-2} to 711 W m^{-2} .

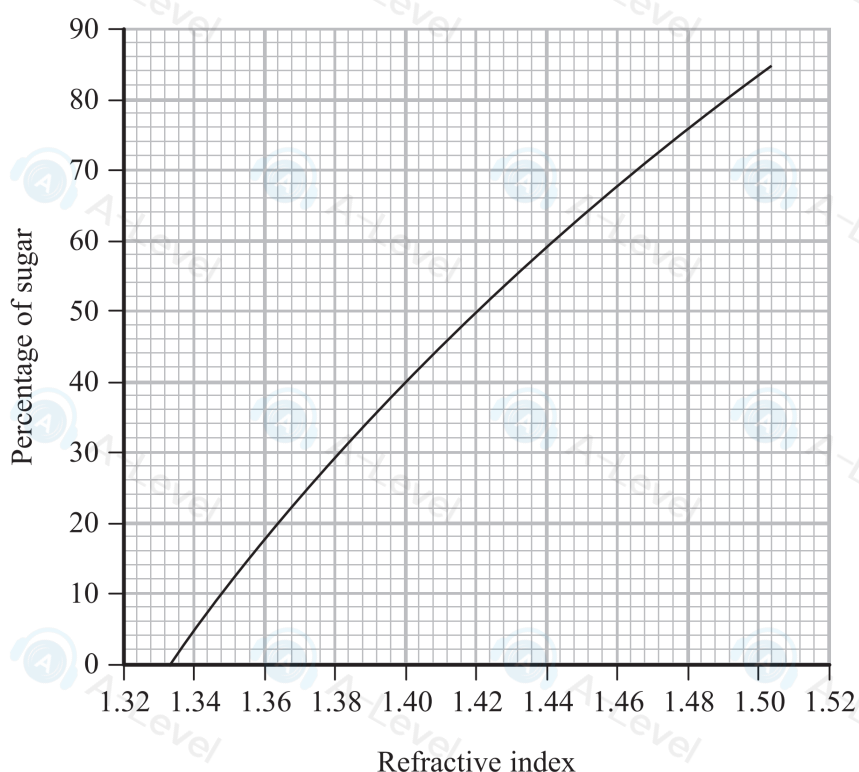
Explain two differences between the orbits of Mars and Earth that can be deduced from this data.

(3)

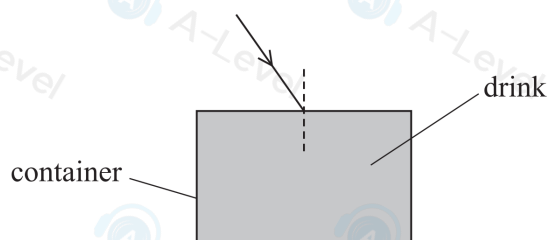
(Total for Question 13 = 6 marks)

17 The refractive index of a drink can be used to determine the percentage of sugar in the drink.

The graph shows how the refractive index of a drink varies with the percentage of sugar in the drink.



- (a) The drink is poured into a container with thin Perspex walls. A laser is used to shine a ray of light through the drink. The diagram shows the arrangement viewed from above.



- (i) Explain how the percentage of sugar in the drink affects the path of the ray as it enters the drink.

(2)



- (ii) The angle of incidence and the angle of refraction of the light ray as it passes into the drink are measured.

Determine the percentage of sugar in the drink. You can ignore the effect of the light ray passing through the Perspex. (3)

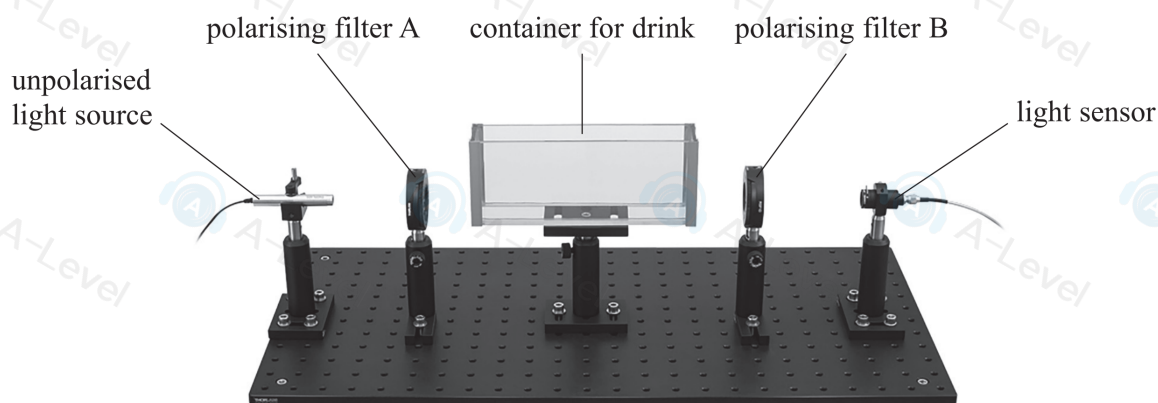
angle of incidence = 40°

angle of refraction = 26°

Percentage of sugar =



- (b) An alternative method to determine the percentage of sugar in a drink is shown.
As polarised light passes through the drink, the plane of polarisation rotates by an amount dependent on the percentage of sugar in the drink.



- (i) Explain what is meant by the plane of polarisation.

(2)

- (ii) Initially there is no drink in the container and the polarising filters are aligned so that no light is detected by the light sensor.

Explain how the alignment of the two polarising filters, A and B, ensures that no light is detected.

(2)



- (iii) The polarising filters are kept in alignment so no light is detected. Then the container is filled with drink and light is detected.

Explain why the intensity of the light detected is less than the intensity of the light transmitted by polarising filter A.

(2)

- (iv) Explain how the angle through which the plane of polarisation has been rotated can be determined using this apparatus.

(3)

(Total for Question 17 = 14 marks)

