

1. (a) Which would be a correct lens prescription for a person with hypermetropia and astigmatism?

Tick (✓) **one** box.

-2.00	+0.50	75	<input type="checkbox"/>
+2.00	-0.50	75	<input type="checkbox"/>
-2.00	+0.50	255	<input type="checkbox"/>
+2.00	-0.50	255	<input type="checkbox"/>

(1)

(6)

(Total 7 marks)

2.

- (a) State and explain **two** differences between the perceived image of a brightly coloured object in bright light and the perceived image of the same object when viewed in very dark conditions.

In your answer you should refer to the visual receptors in the eye.

Difference 1 _____

Difference 2 _____

(5)

According to some legends, in the 17th century a pirate with two healthy eyes covered one eye with a patch to keep the eye in the dark. The patch was removed when going from bright conditions outside to the very dark conditions below decks in an enemy ship.

It was necessary for the pirate to put the patch on about 45 minutes before going into the very dark conditions inside the ship.

(b) What is the name of the process which occurs when the pirate's eye is covered by the patch?

Tick (✓) **one** box.

- aberration
- accommodation
- adaptation
- adjustment

(1)

(c) Discuss why it was necessary to wear the eye patch for 45 minutes before entering the ship.

(3)

(Total 9 marks)

3.

Car drivers must be able to

- read a speedometer from a distance of 50 cm
- read a number plate from a distance of 20.5 m.

A driver has an unaided far point of 55 cm and an unaided near point of 25 cm.

(a) Identify the driver's eye defect.

Tick (✓) **one** box.

Astigmatism	
Hypermetropia	
Myopia	

(1)

(b) **Figure 1** shows the position of a number plate at a distance of 20.5 m in front of the driver's unaided eye.

Figure 2 shows the same situation and the position of a corrective lens.

Complete both ray diagrams to show how and where the image of the number plate is formed in each case.

Add a suitable lens to **Figure 2**.

Figure 1

Without corrective lens

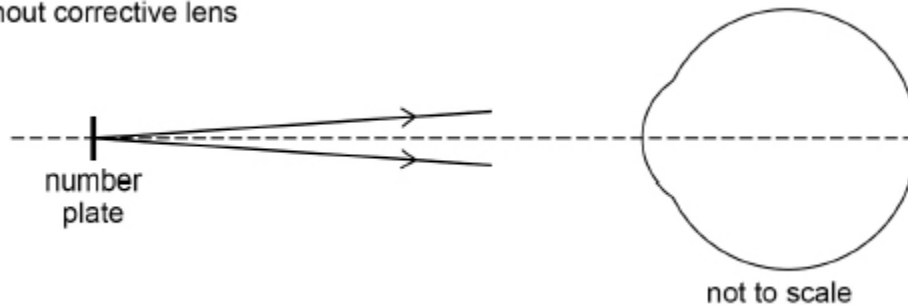
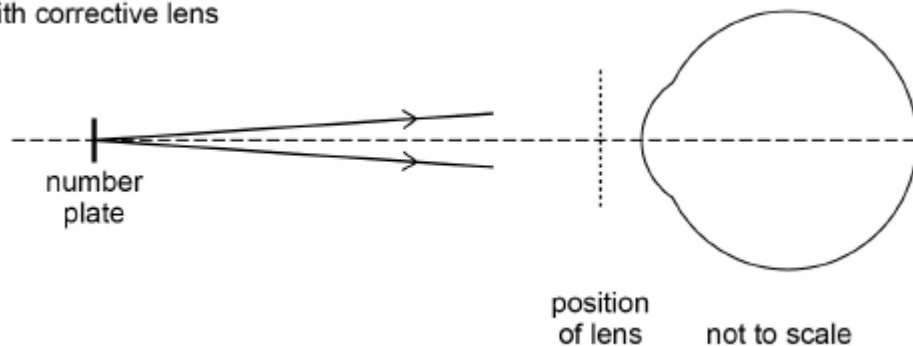


Figure 2

With corrective lens



- (c) An optician considers the use of **three** different lenses, **A**, **B** and **C**, for use by the driver when driving.

Power of **A** = -2.18D

Power of **B** = -1.77D

Power of **C** = $+1.95\text{D}$

Deduce which lens is suitable.

Support your answer with calculations.

(5)

(Total 10 marks)

4.

- (a) The fovea in a typical human eye consists of cones which have an average diameter of 1.5×10^{-6} m

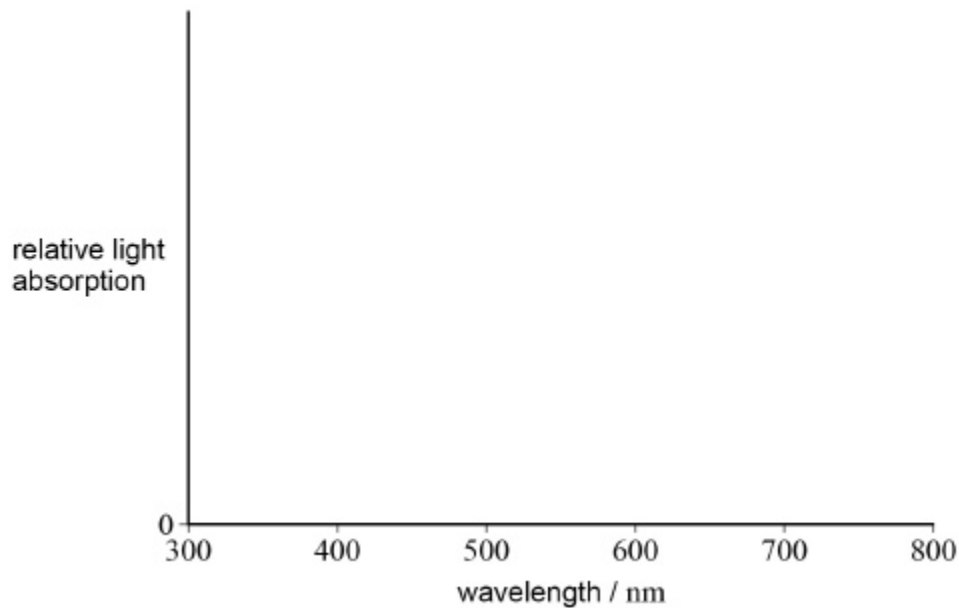
An eye looks directly at two point sources of light which are 12 mm apart at a distance of 61 m from the centre of the eye lens. The fovea is at the centre of the retina a distance of 21 mm behind the centre of the eye lens.

Deduce whether the eye would be able to resolve the two images formed at the fovea.

(4)

- (b) Three types of cone are present at the fovea.

On the axis below sketch and clearly label **three** curves to show how the relative light absorption of each type of cone varies with wavelength.



(3)

(Total 7 marks)

5.

A person suffers from hypermetropia (long sight).

Use of a spectacle lens of power +2.0D allows the person to just see clearly an object placed 24 cm away from the eye.

- (a) Explain why the unaided defective eye cannot form a clearly focused image of the object placed 24 cm from the eye.

(2)

- (b) An object is placed 24 cm from the spectacle lens.

Calculate the distance of the image formed from the spectacle lens.
Give your answer to a suitable number of significant figures.

image distance = _____ cm

(3)

- (c) What is the name for the position where the image is formed by the spectacle lens?

Tick (✓) the correct box.

The eye's aided far point

The eye's aided near point

The eye's unaided far point

The eye's unaided near point

(1)

- (d) Draw a ray diagram to show how this spectacle lens forms an image of the object placed 24 cm from the spectacle lens.
On your diagram clearly label the object, image and a principal focus of the lens. Your diagram does not have to be drawn to scale.

(3)

(Total 9 marks)