Mark schemes

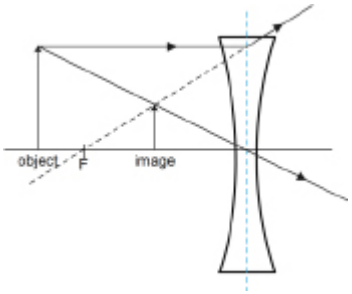
1. (a) +2.00 −0.50 75

1

(b) **The mark scheme gives some guidance as to what statements are expected to be seen in a 1 or 2 mark (L1), 3 or 4 mark (L2) and 5 or 6 mark (L3) answer.**

Mark	Criteria
6	All 3 areas covered in some detail. 6 marks can be awarded even if there is an error and/or parts of one aspect missing.
5	All 3 areas covered at least 2 in detail. Whilst there will be gaps, there should only be an occasional error.
4	Two areas successfully discussed, or one discussed and two others covered partially. Whilst there will be several gaps, there should only be an occasional error.
3	One area discussed and one discussed partially, or all three covered partially. There are likely to be several errors and omissions in the discussion.
2	Only one area discussed, or makes a partial attempt at two areas.
1	None of the three areas covered without significant error.
0	No relevant analysis.

Ray diagram



- Concave lens
- Principal axis shown
- Focal length labelled / principal focus labelled
- Rays bend outward at lens
- Object beyond focal length
- Image inside focal length
- Virtual image smaller than object
- Object and image labelled

Description of myopia

- Far point of eye closer than infinity
- Can't focus on objects further than far point
- Image formed in front of retina
- Can focus near objects but not those far away

Explanation for lens correcting vision

- Student is incorrect due to magnification factor < 1 / smaller image than object
- Use of concave lens
- Image is formed on retina
- Creates image closer than the eye's unaided far point (and further than eye's unaided near point)

AO1 - 1
AO2 - 3
AO3 - 2

[7]

2. (a) Bright light uses only cones and very dim light uses only rods ✓

The first mark may be in either answer and is independent.

Comparison between high resolution in bright light and low resolution in low light ✓
Because cones have a nerve each, rods share nerves ✓

Ignore clearer, more focused.

Comparison between coloured image in bright light and black and white image in low light ✓
Cones see in colour, rods see in black and white ✓

If no comparison is given award one mark max for one valid statement about resolution and one about colour, eg bright light is in colour and high resolution.

The explanation must match the description to gain credit.

5

(b) Adaptation ✓

1

(c) Takes time for rods to adapt to the dark ✓

First marking point is for time taken, ignore wrong term for process.

Time for rods to regenerate rhodopsin/visual purple/ reverse the effects of bleaching the rods ✓

It allows the pirate's eye to see immediately in low light levels / the pirate's eye is already dark-adapted ✓

Rods must be mentioned in answer for 3 marks.

3

[9]

3. (a) Myopia

1

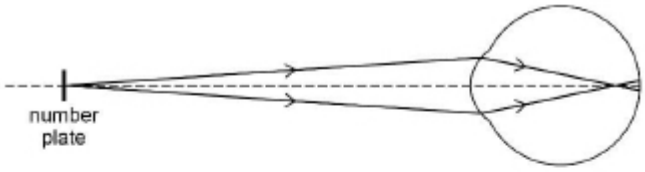
(b) Rays bends inward at **cornea** on both diagrams ✓

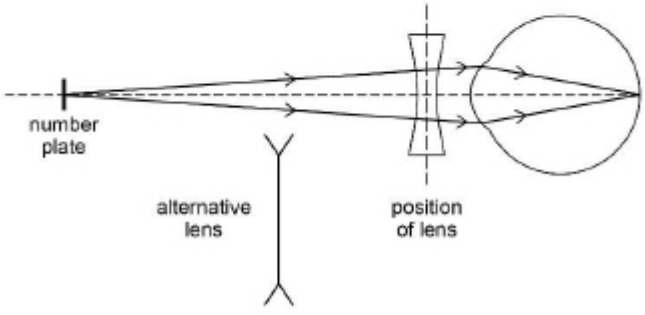
Figure 1 image in front of retina ✓

Figure 2 image on retina ✓

Concave lens drawn, which bends rays outward ✓

Max 3, if light rays are not drawn with a ruler





4

(c) rejection of C / +1.95 D since it is the wrong shape / wrong sign / convex / corrects wrong defect ✓1

✓1 must have a valid reason

1

Any valid substitution demonstrating $P = \frac{1}{f}$ and evidence of the correct usage of u and v ✓2

✓2 f may be calculated and substituted or P used as $\frac{1}{f}$ in equation.

Ignore use of $\frac{1}{x'}$, correct use of u, v must be seen

For virtual image location v must be subject

1

1st valid calculation of either virtual image location or aided near / far point for A, B or C
or
calculation of lens needed to correct far point
or
calculation of lens needed to see number plate✓3

For aided near/far point u must be subject

Ignore PoT and sign errors

✓3 and ✓4

Mark 3 (options)

Lens to correct far point P =−1.82 D or f = −0.55 m

Lens to see number plate P =−1.77 D or f = −0.57 m

Lens C speedometer v =−20 m

Lens C number plate v =53 cm (=0.53 m)

1

2nd valid calculations of either virtual image location or aided near / far point for A, B ✓4

Mark 3 or Mark 4 (options)

Lens A speedometer v =−24 cm

Lens A number plate v =−45 cm

Lens B speedometer v =−27 cm

Lens B number plate v =−55 cm

Lens A aided far point u = ∞ (-2.76m)

Lens A aided near point u = 55 cm

Lens B aided far point u = 2080 cm (= 20.8 m)

Lens B aided near point u = 45 cm

1

Lens B / –1.77 D because it is the only lens where both number plate and speedometer can be seen (lens A cannot focus on speedometer) ✓5

✓5 *must be supported by calculations for B showing both number plate and speedometer can be seen*

Identification of the lens with no supporting evidence scores 0.

1

[10]

4. (a) d / 21 × 10^{-3} = 12 × 10^{-3} / 61 ✓

d = 4.1 × 10^{-6} m ✓

4.1 / 1.5 = 2.75 ✓

Eye can resolve the images as they are more than 2 cell diameters apart / a distance greater than 3 × 10^{-6} m apart / separated by at least 1 unstimulated cell ✓

Marks 3 and 4 are ECF.

4

(b) Three curves labelled blue, green, red from left to right ✓

Roughly at correct height green, red above 2/3 green, and blue less than 1/3 green ✓

Blue 375 to 500, green 425 to 675, red 475 to 725 ; all + or –30 ✓

3

[7]

5. (a) Eye lens cannot be made powerful enough / rays cannot be bent enough / eyeball is too short ✓

cannot be brought to a focus on the retina / fovea / back of the eyeball ✓

Accept not strong / fat / convex enough

Do not accept fat enough – neutral answer

Accept rays would be / are focused behind the retina

2

(b) $\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$

$\frac{1}{0.24}+\frac{1}{v}=2$ ✓

v = (-) 46 (cm) ✓

ans to 2 sig figs ✓

Use of 2 and 1/24 is AE

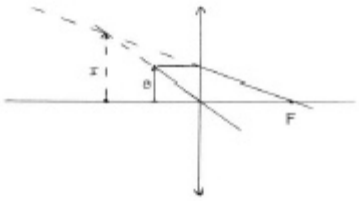
Answer 0.46 gets 1 working mark

3

(c) **D** the eye's unaided near point

1

(d) first correct ray ✓
completed ray diagram with two rays and 'image' drawn ✓
labelled object, image and at least 1 principal focus. ✓



First two marks are for a diagram showing a virtual image

Third mark is for any diagram. Do not allow f for F unless other labelling is present.

3

[9]