M1.(a) **Only** cones at fovea ✓

Allow centre for fovea

as you move away from fovea fewer cones more rods ✓

2

(b) three labelled curves blue, green, red in order from left to right ✓
roughly at correct height ✓ Green > Red >> Blue
each curve covers the correct range of wavelengths
Blue 375 to 500; Green 425 to 675; Red 475 to 725 (all + or − 30} ✓

Green>red>2 / 3 green Blue <1 / 4 green

3

(c) the two images fall on receptors with at least one (unstimulated) receptor between them ✓

Allow 'separated by at least 2 cell diameters'

1

(d) Cones used in bright light, rods used in dim light resolution in bright light better because size of cones smaller than size of rod: or resolution in dim light worse because several rods connected to 1 nerve (well away from fovea)

Do not accept, 'greater density of cones'

2

[8]

M2. (a) (i) Ciliary muscles contract / suspensory ligaments relax Producing a lens of greater power / shorter focal length

2

(ii) (Iris circular muscles contract and /or radial muscles relax produces) constricted pupil /pupil becomes smaller

Cones turn on and rods become inactive

2

(b) Colours seen in bright light, but black and white in very dim light Good detail

in bright light, but much less detail in very dim light

2

(c) (i) Image is focussed in a given plane and out of focus in **perpendicular** plane

1

(ii) non-spherical cornea

1

(iii) cylindrical lens

1

[9]

M3. (a) diagram to show: rays reflected inwards at cornea **(1)**
rays reflected at lens **(1)**
rays focused at optic axis on retina **(1)**

max 2

(b) only cones at fovea **(1)**
moving away from fovea, more rods, less cones **(1)**

2

(c) (i) to control the intensity of light reaching retina **(1)**

(ii) forms a small pupil **(1)**

2

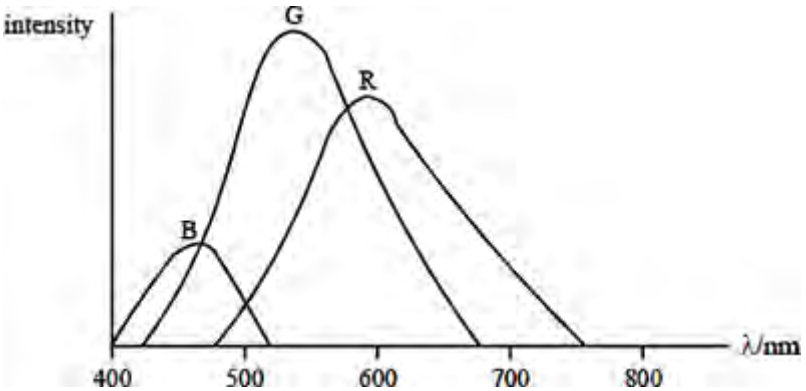
(d) (i) accommodation: ability of the eye/lens to (change and) focus on different object distances **(1)**
[adjustment of the eye/lens to form a clearly focused image on the retina]

(ii) changing the shape of the lens
[or using the cillary muscles] **(1)**

2

[8]

M4.(a)



three overlapping colour curves labelled blue, green and red **(1)**
unit and scale on wavelength axis **(1)**
peaks at ≈ 430 (blue), 520 (green), 570 (red) **(1)**(± 30 for each)
ranges ≈ 400 - 520 (blue), 430 -670 (green), 480 - 730 (red) **(1)** (± 30)

4

(b) (i) two stimulated receptors must be separated by
(at least) one unstimulated receptor **(1)**

(ii) (in bright light) cones activated **(1)**
cones smaller than rods **(1)**
angular separation thus smaller **(1)**

max 3

(c) (i) lights flashing at ≥ 20 Hz appear steady
[or image appears steady although stimulus is flashing] **(1)**

(ii) any correct example e.g. cine films, television **(1)**

2

[9]