

5.2 Brain, eye and temperature

Name: _____ Class: _____ Date: _____

Total: 20 marks

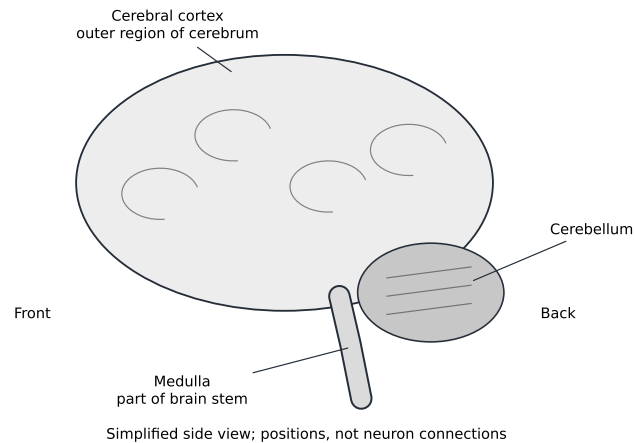
KEY WORDS accommodation • myopia • thermoregulatory centre

Objective

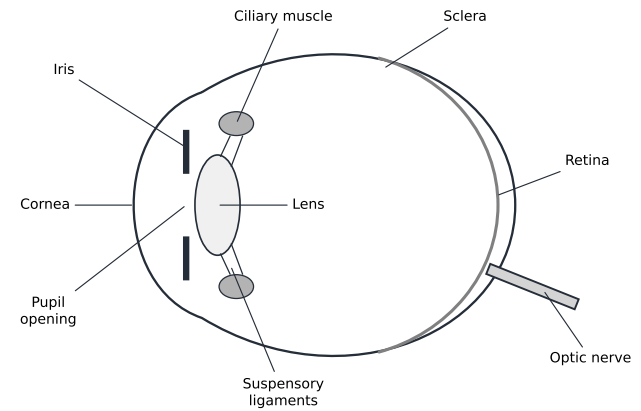
Identify brain regions, relate eye structures to functions, explain accommodation, eye defects and temperature control. Biology only. Original questions for spec statements 4.5.2.2–4.5.2.4.

1 Key knowledge and worked examples

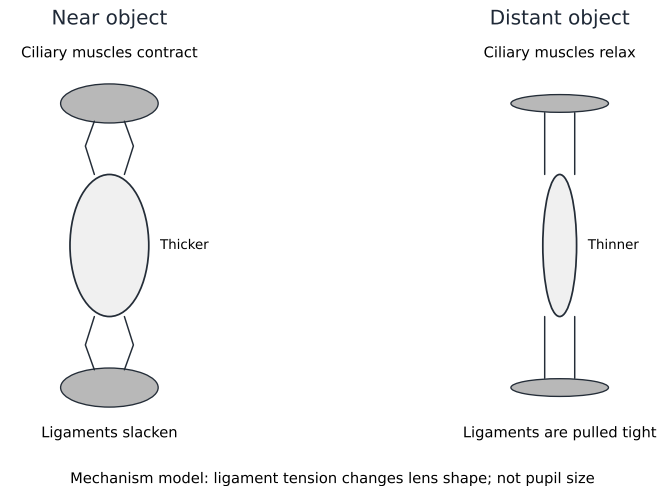
Brain: cerebral cortex – consciousness, memory, language; cerebellum – balance and coordination; medulla – heartbeat and breathing.



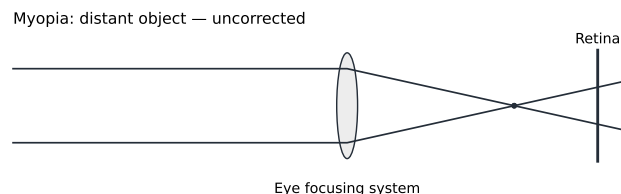
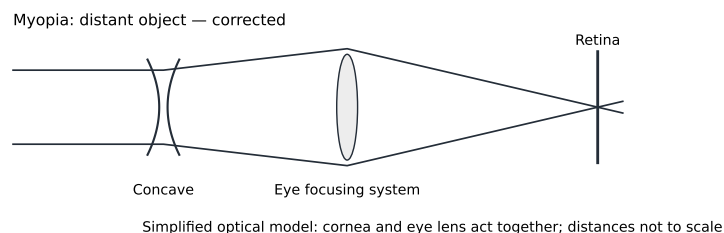
(HT) Damage studies, electrical stimulation and MRI help map brain regions. Connections, complexity and delicate tissue make conclusions and treatment difficult. Weigh evidence and expected benefit against possible harm; an MRI image alone does not prove causation.



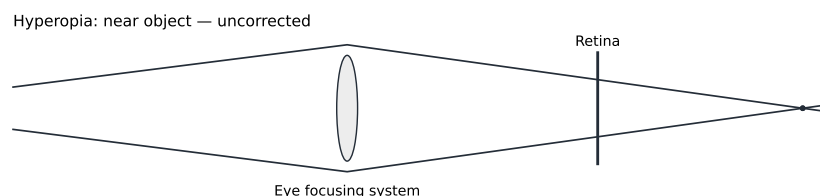
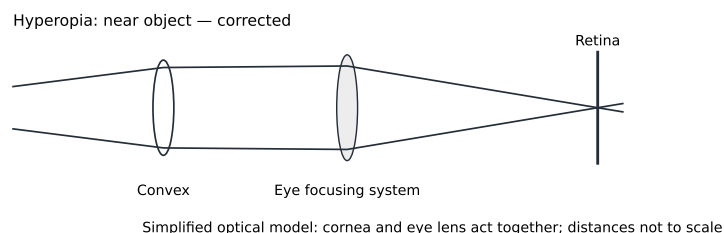
Retina detects light; **optic nerve** carries impulses; **sclera** protects; **cornea** refracts. The **iris** controls the pupil opening. Bright light: circular muscles contract, pupil narrows, less light enters. Dim light: radial muscles contract, pupil widens, more light enters. Opposing muscles relax. This brain-coordinated reflex needs no conscious decision.



Accommodation: near – ciliary muscles contract, ligaments slacken, lens thickens and refracts more strongly. Distant – muscles relax, ligaments tighten, lens thins and refracts less strongly. Ligaments do not actively contract. Iris changes light entry; ciliary muscles change focus.



Myopia: distant image in front of retina; concave lens diverges incoming rays.



Hyperopia: near image behind retina; convex lens adds convergence. Both corrections bring the image onto the retina. Spectacles/contact lenses alter entering rays; laser surgery reshapes the cornea; replacement lenses alter internal focusing. Compare suitability and risks using supplied evidence.

Temperature: the thermoregulatory centre monitors blood; skin receptors send impulses. Hot – skin arterioles dilate, more blood near the surface; sweat evaporates and transfers energy away. Cold – arterioles constrict, less surface flow; less sweating reduces evaporation; shivering increases respiration and energy release. These responses oppose the temperature change. Capillaries do not actively constrict.

Worked context (HT). In AQA 2021 Q03, ice-cold water cools blood in the mouth/stomach; this blood flows to the brain. Impulses reduce sweating; less evapo-

ration reduces cooling. The graph starts at 37.4 °C and shows less sweating, not zero sweating. Movement is controlled because it releases extra energy.

Worked explanation (3 marks, teacher-written). Shivering needs muscle contraction; increased respiration supplies energy and transfers heat to the blood; circulating blood distributes energy and raises core temperature toward normal.

2 Practice

2.1 Name the brain region controlling balance and the region controlling breathing. [2]

2.2 Copy and complete: to focus on a near object, the ciliary muscles _____, the suspensory ligaments _____, and the lens becomes _____. [3]

2.3 Name the defect in which light focuses in front of the retina, and one way it is treated. [2]

3 Exam-style questions

3.1 Explain how the eye responds to dim light and why this is a reflex. [4]

3.2 A person moves from looking at a distant hill to reading a book. Explain the changes in the eye that focus the book, and compare them with a person with hyperopia reading the same book. [5]

3.3 (*HT*) Explain two ways the body responds to a fall in body temperature and how each response helps restore normal temperature. [4]

Solutions

2.1 Cerebellum; medulla.

2.2 Contract; loosen/slacken; thicker.

2.3 Myopia/short sight; concave spectacle/contact lens (or laser surgery to reshape the cornea, replacement lens).

3.1 In dim light the radial muscles of the iris contract, so the pupil dilates/widens; more light enters the eye and reaches the retina's receptors; the response is automatic and rapid, without conscious decision. It is coordinated in the brain; it is not a spinal withdrawal reflex.

3.2 For near focus the ciliary muscles contract and the suspensory ligaments loosen; the lens becomes thicker and refracts light rays more strongly; this focuses the book's image exactly on the retina. In hyperopia, near objects focus behind the retina because the lens cannot refract enough/eyeball too short; a convex lens adds refraction so the image focuses on the retina.

3.3 Any two, effect + mechanism: vasoconstriction – skin arterioles narrow so less blood flows through capillaries near the surface, reducing energy transfer to the environment; shivering – rapid involuntary muscle contractions, and respiration in the muscles transfers energy as heat, warming the blood. Also accept: sweating decreases or stops, so less energy is transferred away by sweat evaporation. Other routes of energy transfer still occur.