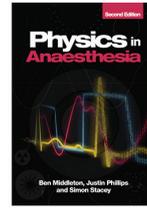


Chapter 15

Optics



Self-assessment questions

These questions and answers, in both MTF and SBA formats, accompany *Physics in Anaesthesia 2e* and link back to the book for guidance.

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Multiple true / false questions

For each of the following questions, mark all answers as either true or false

1. In a fibreoptic bronchoscope:

- There is a channel dedicated to passing infrared light down
- There is an ordered bundle of optical fibres for the transmission of images
- There is a non-ordered bundle of optical fibres for illumination
- A biopsy/suction channel relies on total internal refraction
- A mouthguard is used to protect the delicate shaft of the scope

Pointer

- See Figures 15.6 and 15.7.

2. Regarding the absorption spectra of different types of haemoglobins:

- Oxyhaemoglobin and deoxyhaemoglobin have the same absorbance at the isosbestic wavelength
- The absorption spectrum is a plot of absorbance or extinction coefficient against wavelength
- Pulse oximeters will under-read oxygen saturations if carboxyhaemoglobin is present
- Deoxyhaemoglobin has a higher absorbance than oxyhaemoglobin in the red part of the visible spectrum
- Deoxyhaemoglobin has a higher absorbance than oxyhaemoglobin in the near-infrared part of the visible spectrum

Did you know?

- Carbon monoxide has a chemical affinity for haemoglobin around 250 times stronger than that of oxygen, thus actively displaces oxygen from its binding site on oxyhaemoglobin.
- Carboxyhaemoglobin has a similar absorbance of red light as oxyhaemoglobin hence the inaccuracy in the readings from pulse oximeters.

3. Near-infrared spectroscopy can measure:

- Cerebral oxygen saturations
- Bilirubin concentration
- Carboxyhaemoglobin concentration
- Changes in blood volume
- Changes in brain blood flow

Did you know?

- Studies have found NIRS to be a good tool for screening of intracranial haematomas in war zones, where CT scanners are not available.

Single best answer questions

For each of the following questions, select the single best answer – note that more than one answer may be true but only one option represents the best answer

1. If light is travelling from one transparent medium (refractive index of 1.5) into another less transparent medium (refractive index 1.8), how would you calculate the critical angle (θ_c)?

- a. $\sin\theta_c = 1.8 \div 1.5$
- b. $\theta_c = \sin^{-1}(1.5 \div 1.8)$
- c. $\sin(1.5 \times 1.8) = \theta_c$
- d. $\sin\theta_c = 90$
- e. $\sin\theta_r = 90$

Reminder

- The critical angle is the minimum angle of incidence which allows total internal reflection.

Pointer

- See Snell's law (Equations 15.2 and 15.3).

2. What best describes Beer's law?

- a. Absorbance is inversely proportional to extinction coefficient
- b. For light passing through a solution there is a linear relationship between absorbance and both the concentration and path length of that solution
- c. There is an exponential increase in the intensity of light travelling through the medium as the optical path increases
- d. It helps explain why ale is darker in colour than lager
- e. The molar extinction coefficient is a measure of how strongly absorbing a solution is for a given wavelength

Did you know?

- Beer's law also describes the attenuation of radiation through the earth's atmosphere.

3. How does a CO-oximeter work?

- a. A probe transilluminates a finger with two wavelengths of light and a photodetector measures the amount of light transmitted
- b. It is placed directly into a vessel and transmits pressure through a reflective membrane and bundle of optic fibres
- c. They work either standalone or incorporated in blood gas analysers
- d. They are the gold standard measurement of oxygen saturation
- e. A heparinised blood sample undergoes ultrasonically induced haemolysis and has light transmitted through it to a spectrometer via an optical fibre

Pointer

- For a recap on other measuring devices present in blood gas analysers, see Section 11.6.

Answers to questions for Chapter 15 – Optics

Multiple true / false questions

The following answers are true:

1. b, c and e
2. a, b and d
3. a, d and e

Single best answer questions

The options below represent the single best answer, although other options may also be true:

1. b
2. b
3. e