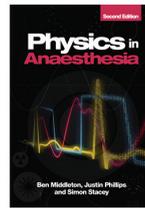


Chapter 27

Basic mathematical concepts



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. Regarding gradients on a curve:

- A horizontal line has a zero gradient
- Differentiation allows the gradient of a graph to be calculated from a curve
- The higher the value of the gradient, the shallower the slope
- Sine and cosine waves share the same gradient
- Sinusoidal waves can have gradients that are positive, negative and zero

Reminder

- The gradients of cosine and sine waves are equal: $dy/dx = \cos x = -\sin x$.
- The difference between these two functions is that they are out of phase of each other by $\pi/2$ radians (90°).

2. The following are examples of exponential growth:

- Radioactive decay
- The number of cases of infection from a highly contagious respiratory virus with no barriers to transmission in place
- Polymerase chain reactions
- The relationship between pressure and volume of an ideal gas (Boyle's law)
- Mitosis

Pointer

- Radioactive decay and Boyle's law are examples of exponential decay.

3. Regarding the pH scale:

- It is a natural logarithm
- It is a common logarithm
- Substantial differences in hydrogen ion concentration show large numerical differences in pH
- Arterial blood gas machines do not give precise enough readings to show small differences in hydrogen ion concentration
- Substantial differences in hydrogen ion concentration show small numerical differences in pH

Pointer

- See Table 27.1.

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. Pi, as a number, is described as:

- a. Distressed
- b. Annihilated
- c. Pressured
- d. Irrational
- e. Scattered

Did you know?

- As the most famous constant in mathematics, Pi has its own annual celebration on March 14th (3.14).
- March 14th was Einstein's birthday and also the date Stephen Hawking passed away.

2. If you were presented with a large and unfamiliar sized syringe with no measurement labels, just using a ruler how could you calculate the approximate volume of liquid it could hold?

- a. $\pi \cdot r^2$
- b. $4 \cdot \pi^2$
- c. $4/3 \cdot (\pi \cdot r^3)$
- d. $\pi \cdot r^2 \cdot h$
- e. $\pi \cdot r^3 \cdot h$

Reminder

- Other important equations including π and r include Poiseuille's law and the Hagen–Poiseuille law (see *Equation 8.4*).
- Poiseuille's law explains why doubling the diameter of a catheter would result in a 16-fold increase in flow rate: $\pi(r)^4$ versus $\pi(2r)^4$.
- The Hagen–Poiseuille law explains why for two tubes to have the same resistance to laminar flow, with one being twice as wide, the wider tube would need to be 16-fold longer (see *Figure 8.5*).

3. In lithium chloride dilution techniques, the arterial lithium concentration can be plotted over time. The area under the curve can then be calculated to derive the cardiac output. Which mathematical tool is used to do this?

- a. Integration
- b. Differentiation
- c. Logarithm
- d. Algebra
- e. Calculus

Pointer

- For more on cardiac output techniques see *Chapter 16*.

Answers to questions for Chapter 27 – Basic mathematical concepts

Multiple true / false questions

The following answers are true:

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

Single best answer questions

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

1. d
2. d
3. a