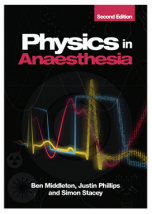
Chapter 1

Atoms and matter



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 the heating up of water:

a. It would take 4.18 J to heat 1 kg by 1°C
b. At the latent heat of vaporisation covalent bonds between water molecules are broken as it boils
c. During the transition from solid to liquid the temperature of water stays the same until it has completed its phase change
d. Water boils at a higher temperature at lower atmospheric pressures
e. At temperatures above 374°C water exists as a gas no matter the pressure

Pointer

- Make sure you look carefully at the units – the specific heat capacity of water is 4180 $J{\cdot}kg^{-1}{\cdot}°C^{-1}$ or 4.18 $J{\cdot}g^{-1}{\cdot}°C^{-1}$.
- *Figure 1.3* and *Figure 1.4* will help you answer the rest of these questions.

Did you know?

- A water molecule consists of two hydrogen atoms covalently linked to the same oxygen atom (interatomic bonds).
- Water molecules join together through hydrogen bonds where there is a slight positive attraction of a hydrogen atom on one molecule to the slightly negative oxygen atom on another (intermolecular bonds) (see *Section 2.4*).
- Hydrogen bonds are 10% the strength of covalent bonds.

2. The following processes involve the liberation of energy:

a. Freezing
b. Melting
c. Deposition
d. Condensation
e. Ionization

Reminder

- For a matter to change state energy must be either added or removed – this is known as the latent heat (*L*).
- Energy is liberated on changing states in this direction:
  plasma → gas → liquid → solid (see *Figure 1.2*).

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

3. What do carbon-14 (^{14}C) and nitrogen-14 (^{14}N) have in common?

a. They are two isotopes that have exactly the same atomic mass
b. They have exactly the same atomic number
c. They have approximately the same atomic number
d. Are differing nomenclature for the same atom and isotope
e. They are both isotopes

Reminder

- Isotopes are atoms that have the same number of protons and electrons, but a different number of neutrons.

Did you know?

- Radiocarbon, or **carbon-14** is a radioactive isotope of carbon with an atomic nucleus containing six protons and eight neutrons.
- The major stable isotope of nitrogen is **nitrogen-14** which has seven protons and seven neutrons in its atomic nucleus.

4. When a substance is at its triple point:

a. It can exist only as a gas
b. It can exist as a solid and a liquid
c. It is at a very specific temperature and pressure where it can exist as a solid, liquid and a gas
d. It is at a very specific temperature where it can exist as a solid, liquid and a gas
e. It can exist as a solid, liquid and a gas at any given pressure

Reminder

- The triple point of water is at a temperature of 0.01°C and 0.006 atmospheres (an incredibly low pressure).

Did you know?

- In the world of thermodynamics there was one rather hot (or you could say cold) family. James Thompson was the man who coined the term "triple point" and his brother William Thompson (later titled Lord Kelvin) invented the international system of the absolute temperature scale!
- Absolute zero is 0 kelvin (K) or -273°C.

Answers to questions for Chapter 1 – Atoms and matter

Multiple true / false questions

The following answers are true:

1. c and e

2. a, c and d

Single best answer questions

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

1. a

2. c