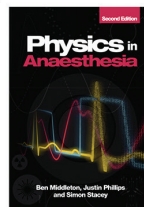


Chapter 3

Energy and power



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. What constitutes work done?

- a. Lifting a 1 kg weight above your head
- b. Holding a 1 kg weight above your head
- c. Blowing up a balloon
- d. A car colliding with a wall
- e. A ball bearing rolling across a glass surface

Reminder

- Work done can be positive or negative depending on whether energy transferred is applied by, or applied to, a system.

Pointer

- The energy exerted in holding an object in the same position does not constitute work done because the object has not moved.

2. During strenuous exercise:

- a. The airway resistance reduces
- b. The power of the heart increases and the power of breathing decreases
- c. There is more turbulent flow in the airways
- d. The power of breathing can rise up to be 25% of the total metabolism
- e. There is more laminar flow in the airways

Reminder

- The term power in physics refers to work done per unit of time

Did you know?

- The power of controlled breathing (yogic breathing or 'pranayama') is a well-known ancient practice yet only recently has it been scientifically shown to improve respiratory efficiency in healthy people.
- Six breaths per minute has been found to be the sweet spot of maximum benefit. Do practise this at home.

3. A 30-year-old lady is intubated and on a pressure-controlled ventilation setting in the ICU following a life-threatening asthma attack. With regard to her breathing:

- The narrowed airways have an increased resistance to airflow
- The work done by the ventilator is the product of the inspiratory pressure and the volume of gas that flows into the lungs
- Compliance of the lung is equal to the gradient of the volume–pressure curve
- The ventilator has a pump to generate pressure
- Efficiency is 100%

Pointer

- The volume–pressure curve can be seen in *Figures 3.3 and 3.4*.

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

4. Select the most comprehensive list of conditions that decrease lung compliance?

- a. Fibrosing alveolitis, deficiency of pulmonary surfactant, pulmonary oedema, consolidation
- b. Emphysema, allergic asthma, pulmonary oedema, atelectasis, consolidation
- c. Deficiency of pulmonary surfactant, atelectasis
- d. Consolidation, COPD
- e. Pulmonary oedema, consolidation, idiopathic pulmonary fibrosis

Reminder

- Compliance is a measure of the stiffness of the lungs and is expressed as a change in volume divided by the change in pressure.

Pointer

- Diseases that decrease lung compliance result in extra work being required to expand the lungs and chest wall during inhalation.
- Diseases that increase lung compliance result in extra work being required to breathe during exhalation.

5. Which forms of energy are involved when a wind generator powers an anaesthetic machine via the National Grid?

- a. Kinetic, chemical, potential, electrical
- b. Kinetic, potential, electrical, heat
- c. Kinetic, electrical, heat
- d. Kinetic, electrical
- e. Electrical, heat

Reminder

- No physical process is 100% efficient.
- Energy gained by one system must equal the amount lost by another.

6. With regard to the pressure and power of laminar flow:

- a. Pressure proportional to square of flow, power proportional to square root of flow
- b. Pressure proportional to square of flow, power proportional to square of flow
- c. Pressure proportional to square of flow, power proportional to flow
- d. Pressure proportional to flow, power proportional to square of flow
- e. Pressure proportional to square of flow, power proportional to cube of flow

Pointer

- See Equation 3.9.

Answers to questions for Chapter 3 – Energy and power

Multiple true / false questions

The following answers are true:

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

Single best answer questions

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

1. a
2. c
3. d