



Muscle and motility: practice questions

8 questions • 27 marks • mark scheme at the back

For IB Diploma Biology, Standard Level and Higher Level (first assessment 2025). **HL only** is additional higher level content, for HL students only.

Name

Total / 27

1 PAPER 1A STYLE

[1 mark]

HL only

What happens to the bands of a sarcomere during muscle contraction?

- A. ☐ The A band shortens and the I band stays the same length
- B. ☐ The I band shortens and the A band stays the same length
- C. ☐ Both the A band and the I band shorten
- D. ☐ The actin and myosin filaments both shorten

2 PAPER 1A STYLE

[1 mark]

HL only

Which statement about skeletons is correct?

- A. ☐ Arthropods have endoskeletons with muscles attached to the outer surface
- B. ☐ Vertebrates have exoskeletons made of chitin
- C. ☐ Arthropods have exoskeletons with muscles attached to the inner surface
- D. ☐ Skeletons act as levers but do not provide anchorage for muscles

3 PAPER 2A STYLE

[3 marks]

HL only

Explain how the internal and external intercostal muscles act as an antagonistic pair.

4 PAPER 2A STYLE**[3 marks]****HL only**

Outline the structure and function of a motor unit.

5 PAPER 1B STYLE**[4 marks]****HL only**

Students used a goniometer to measure the range of motion of the hip in three dimensions. (a) Calculate the mean range of hip flexion. (b) Identify the movement with the smallest range. (c) Suggest one reason why the measurements varied between trials. (d) Suggest why the hip has a larger range of motion in more dimensions than the knee.

Range of motion of the hip of one student / ° (practice data)

Movement	Trial 1	Trial 2	Trial 3
Flexion	118	122	120
Abduction	42	45	39
Extension	18	22	20

Answer =

6 PAPER 2A STYLE**[4 marks]****HL only**

Outline four reasons for locomotion in animals, giving a named example of each.

7

HL only

[7 marks]

[illegible]

8

HL only

[4 marks]

[illegible]

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1] **HL only**

B B [1]

2. [1] **HL only**

C C [1]

3. [3] **HL only**

- muscles can only exert force/pull when they contract [1]
- muscle fibres in the two layers have different orientations [1]
- external intercostals move ribcage up and out; internal move it down and in [1]
- contraction of one layer stretches the other [1]
- potential energy stored in titin (of stretched sarcomeres) helps recoil [1]
- max 3

4. [3] **HL only**

- one motor neuron and the muscle fibres it stimulates [1]
- connected by neuromuscular junctions/synapses [1]
- acetylcholine released at junctions stimulates fibres [1]
- all fibres in the unit contract together [1]
- more motor units recruited for greater force / small units for fine control [1]
- max 3

5. [4] **HL only**

- (a) $(118 + 122 + 120) \div 3 = 120^\circ$ [1]
- (b) extension [1]
- (c) goniometer not placed exactly on the joint centre/arms not aligned with bones the same way each time / student moved by different amounts [1]
- (d) hip is a ball-and-socket joint (allowing movement in several planes) whereas the knee is a hinge joint [1]

6. [4] **HL only**

- foraging for food, e.g. honeybees flying to flowers for nectar [1]
- escaping from danger, e.g. squid using jet propulsion to escape predators [1]
- searching for a mate, e.g. male moths following female pheromones [1]
- migration, e.g. Arctic terns between Arctic and Antarctic [1]
- Accept other valid named examples. Reason and example both required for each mark.

7. [7] HL only

- muscle fibre/myofibril made of repeating sarcomeres between Z lines [1]
- actin (thin) filaments attached to Z lines; myosin (thick) filaments in centre [1]
- calcium ions released expose binding sites on actin [1]
- myosin heads bind to actin forming cross-bridges [1]
- heads swivel/power stroke pulls actin towards centre of sarcomere [1]
- ATP binds causing myosin to detach [1]
- hydrolysis of ATP re-cocks/re-energises myosin head [1]
- filaments slide past each other; sarcomere shortens/Z lines closer [1]
- I band and H zone shorten, A band unchanged [1]
- muscle can only pull so an antagonistic muscle stretches it back [1]
- titin stores potential energy when stretched and recoils [1]
- titin prevents overstretching [1]
- max 7

8. [4] HL only

- (a) cartilage reduces friction/absorbs shock between femur and pelvis [1]
- (a) synovial fluid lubricates the joint/reduces friction [1]
- (b) tail forms a (horizontal) fluke moved up and down for propulsion [1]
- (b) blowhole on top of head closes during dives / allows rapid breathing at surface between dives [1]