Locomotion and Movement

Standard difficulty · 20 questions · 40 marks · Time: 36 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer 8 × 1 = 8 marks

1. The number of bones in the adult human skeleton is:

(a) 212 **(b)** 196 **(c)** 208 **(d)** 206

2. A sarcomere is 3.4 µm long (thick filaments 1.6 µm long; thin filaments 1.0 µm long from each Z line). The I band is:

(a) 1.8 µm **(b)** 1.4 µm **(c)** 1.6 µm **(d)** 2.4 µm

3. How many bones are there in the tarsals of one ankle?

(a) 11 **(b)** 5 **(c)** 7 **(d)** 9

4. The joint at the hip is a:

(a) saddle joint
(b) gliding joint
(c) hinge joint
(d) ball and socket joint

5. In a muscle fibre, what is the M line?

(a) Bisects the I band; the boundary of a sarcomere
(b) Holds the thick filaments together at the middle of the A band
(c) Binds Ca^{2+} and uncovers the binding sites on actin
(d) Stores calcium ions in the muscle fibre

6. Gout is:

(a) rapid spasms in muscle due to low Ca^{2+} in the body fluid
(b) decreased bone mass and more fractures, often from low oestrogen
(c) inflammation of joints due to the build-up of uric acid crystals
(d) progressive degeneration of skeletal muscle, mostly genetic

7. A sarcomere shortens from 3.3 µm to 2.2 µm during contraction. What happens to its bands?

(a) I band shortens by 1.1 µm; A band unchanged
(b) I band lengthens by 1.1 µm
(c) A band shortens by 1.1 µm; I band unchanged
(d) Both A and I bands shorten by 0.55 µm

8. Assertion (A): When a sarcomere (thick filaments 1.6 µm long; thin filaments 1.0 µm long from each Z line) contracts from 3.0 µm to 2.6 µm, the A band stays 1.6 µm long.
Reason (R): During contraction the thin filaments slide over the thick filaments; neither kind of filament changes length.

(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

Section B — Short answer — 8 × 2 = 16 marks

9. Name the three types of movement shown by cells of the human body.

10. A sarcomere is 2.6 µm long (thick filaments 1.6 µm long; thin filaments 1.0 µm long from each Z line). Find the lengths of the A band, the I band and the H zone.

11. How many bones are there in the metacarpals of one hand, and in the phalanges of one hand?

12. What type of joint is found at the hip?

13. What is the sarcoplasmic reticulum in a skeletal muscle fibre?

14. What is osteoporosis?

15. What type of movement is shown by the removal of dust from the trachea?

16. A sarcomere contracts from 3.3 µm to 2.8 µm (thick filaments 1.6 µm long; thin filaments 1.0 µm long from each Z line). By how much do the I band and the H zone shorten?

Section C — Word problems — 4 × 4 = 16 marks

17. Describe the structure of a skeletal muscle and its contractile proteins.

18. A relaxed sarcomere is 3.2 µm long; when contracted it is 2 µm (thick filaments 1.6 µm long; thin filaments 1.0 µm long from each Z line). (a) Find the A band, I band and H zone in each state. (b) Which band does not change, and why? (c) What would the H zone be at 2.0 µm?

19. Give the number of bones in: the cervical region of the vertebral column; the cranium; the axial skeleton; each hind limb. How many bones are in the two forelimbs and two hind limbs together?

20. Name the type of joint at each place and say how much movement it allows: adjacent vertebrae; the hip; the carpals; the atlas and axis.

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Answer key

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Q	Answer	Working
1	**(d) 206**	80 axial, 126 appendicular
2	**(a) 1.8 µm**	I band = sarcomere − A band = 3.4 − 1.6
3	**(c) 7**	—
4	**(d) ball and socket joint**	—
5	**(b) Holds the thick filaments together at the middle of the A band**	—
6	**(c) inflammation of joints due to the build-up of uric acid crystals**	—
7	**(a) I band shortens by 1.1 µm; A band unchanged**	thin filaments slide over thick ones; thick filaments keep their length
8	**(a) Both A and R are true, and R is the correct explanation of A.**	A is true: the A band is the length of the thick filaments, which does not change. R is true and explains A.
9	**Amoeboid (macrophages and leucocytes), ciliary (cilia in the trachea and fallopian tubes) and muscular (movement of limbs, jaws, tongue).**	—
10	**A band 1.6 µm; I band 1 µm; H zone 0.6 µm**	I = 2.6 − 1.6; H = 2.6 − 2 × 1.0
11	**5 and 14**	—
12	**Ball and socket**	—
13	**Stores calcium ions in the muscle fibre**	—
14	**Decreased bone mass and more fractures, often from low oestrogen**	—
15	**Ciliary**	—
16	**Each by 0.5 µm (I: 1.7 → 1.2; H: 1.3 → 0.8)**	the A band stays 1.6 µm

Q	Answer	Working
17	**A muscle is made of bundles (fascicles) of muscle fibres, each a multinucleate cell with sarcoplasm and sarcoplasmic reticulum, packed with myofibrils. Myofibrils show light I bands (thin actin filaments) and dark A bands (thick myosin filaments); each I band is bisected by a Z line, and the middle of the A band is the H zone with the M line. Actin filaments have troponin and tropomyosin; myosin is made of meromyosins whose globular heads have ATPase activity and actin-binding sites.**	—
18	**(a) relaxed: A 1.6, I 1.6, H 1.2 µm; contracted: A 1.6, I 0.4, H 0 µm. (b) The A band, because it is the length of the thick filaments, which do not shorten. (c) 0: the thin filaments meet in the middle.**	I = sarcomere − 1.6; H = sarcomere − 2.0
19	**the cervical region of the vertebral column: 7; the cranium: 8; the axial skeleton: 80; each hind limb: 30; limbs together 120**	30 in each limb
20	**adjacent vertebrae: cartilaginous (slightly movable); the hip: ball and socket; the carpals: gliding; the atlas and axis: pivot**	fibrous joints do not move; cartilaginous move a little; synovial joints move freely