A LEVEL Cambridge Topical Past Papers

PHYSICAL EDUCATION

2017 — 2023

P1

1 - (9396/11_Winter_2017_Q1) - *Applied Anatomy And Physiology*

(a) Muscles often work in antagonistic pairs.

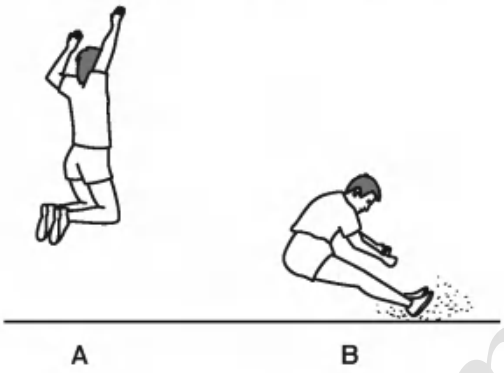
Using the elbow joint as an example, explain the term *antagonistic pair*. [4]

(b) There are different types of muscle contractions.

(i) Distinguish between isokinetic and isometric muscle contractions. [1]

(ii) Distinguish between concentric and eccentric muscle contractions. [1]

(c) The diagram shows a performer completing the long jump.



Identify the items 1 to 5 in the table to describe a movement analysis of the hip and shoulder joints from position **A** to the finishing position **B**. Your analysis should include the type of muscle contraction, the type of movement occurring and the main agonist.

	type of muscle contraction	type of movement occurring	main agonist
hip joint	1	2	3
shoulder joint		4	5

[5]

(d) The physical demands of exercise are met by increasing blood flow to some areas of the body.

(i) Define the terms *cardiac output* and *stroke volume*, and state the relationship between them. [3]

(ii) State the effects of training on resting cardiac output and stroke volume. [2]

(iii) During a sustained period of exercise a trained performer's stroke volume will increase.

Explain how this increase is achieved. [4]

(e) Describe how oxygen and carbon dioxide are transported by the blood. [3]

(f) When exercising, the respiratory system plays an important role in the gaseous exchange process.

(i) Describe the changes that occur to the mechanics of breathing during exercise. [3]

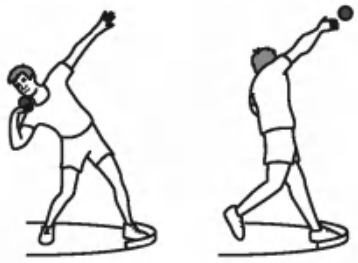
(ii) Describe the effects of long-term endurance training that help make the gaseous exchange process more efficient. [4]

2 - (9396/12_Winter_2017_Q1) - *Applied Anatomy And Physiology*

(a) Compare the structure of the shoulder and knee joints in terms of both range of movement and stability. [4]

(b) Identify **two** structural and **two** functional characteristics of a slow oxidative muscle fibre. [4]

(c) The diagrams show a shot put being thrown.



A B

Identify the items 1–5 in the table to describe a movement analysis from position **A** to position **B** for the right shoulder joint and the right hip joint. Your analysis should include the type of muscle contraction, the type of movement occurring and the main agonist.

	type of muscle contraction	type of movement occurring	main agonist
right shoulder joint	1	2	3
right hip joint		4	5

[5]

(d) Heart rate values vary before, during and after physical activity.

(i) Explain what is meant by anticipatory rise. [2]

(ii) Neural control of heart rate involves the autonomic nervous system.

Identify and explain the role of different receptors involved in increasing heart rate. [4]

(e) While exercising, a performer will experience changes in breathing rate and lung volumes.

Complete items 6–8 in the table to show how the tidal volume, inspiratory reserve volume and expiratory reserve volume change during exercise.

	value at rest	change during exercise
breathing rate	16 breaths min^{-1}	increases
tidal volume	500 cm^3	6
inspiratory reserve volume	3000 cm^3	7
expiratory reserve volume	1000 cm^3	8
vital capacity	4500 cm^3	no change

[3]

(f) Explain the changes in the pressure and velocity of blood between leaving the left ventricle and returning to the right atrium of the heart. [4]

(g) Describe the effects of altitude on the respiratory system. [4]

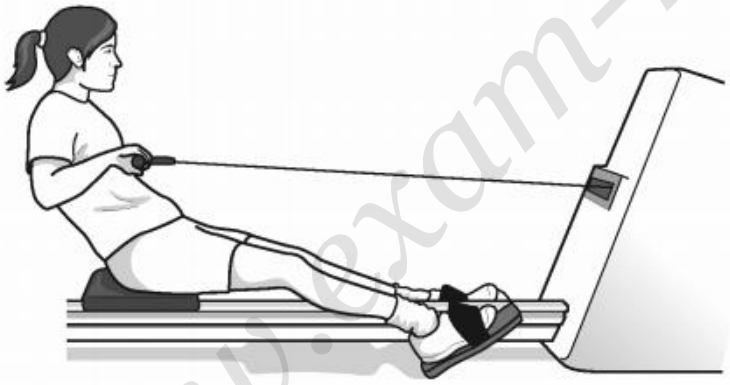
3 - (9396/13_Winter_2017_Q1) - *Applied Anatomy And Physiology*

(a) (i) Name **two** different types of joint located in the spine and state a type of movement that is possible at each of these joints. [4]

(ii) Explain, using examples from physical activities, the role of the external obliques and the role of the erector spinae muscles. [4]

(b) The diagrams show a performer rowing.

A



B

Identify the items 1 to 5 in the table to describe a movement analysis of the hip and shoulder joints from position **A** to position **B**. Your analysis should include the type of muscle contraction, the type of movement occurring and the main agonist.

	type of muscle contraction	type of movement occurring	main agonist
hip joint	1	2	3
shoulder joint		4	5

[5]

(c) Heart rate and stroke volume increase during exercise.

(i) Explain how this increase in stroke volume is achieved. [2]

(ii) Explain how structures within the heart control the heart rate. [4]

(d) Venous return is assisted by the action of pocket valves.

Name and describe **two** other mechanisms that assist venous return during exercise. [4]

(e) Explain the role of haemoglobin and the role of myoglobin in the transport of oxygen to a muscle cell. [3]

(f) Explain how the structure of the lungs aids the process of gaseous exchange. [4]

ANSWERS

1 - (9396/11_Winter_2017_Q1) - *Applied Anatomy And Physiology*

(a)	4 marks for 4 of: (sub-max. 2) 1 movement created when one muscle contracts AND another muscle relaxes; 2 movements at elbow are flexion AND extension; (sub-max. 2) *during flexion:* 3 biceps brachii acts as agonist / prime mover; 4 (agonist) muscle shortens (under tension); 5 joint angle is reduced / concentric; 6 triceps brachii acts as antagonist; *during extension:* 7 triceps brachii as agonist / prime mover; 8 (agonist) muscle shortens (under tension); 9 joint angle is increased / eccentric; 10 biceps brachii is antagonist;	**4**
(b)(i)	1 mark for: 1 isokinetic: movement AND isometric: no movement;	**1**
(b)(ii)	1 mark for: 1 concentric: muscle shortens AND eccentric: muscle lengthens;	**1**
(c)	5 marks for: 1 concentric / isotonic; 2 flexion; 3 iliopsoas / sartorius / rectus femoris; 4 extension; 5 latissimus dorsi / supraspinatus / subscapularis / infraspinatus / teres minor / pectoralis major / rotator cuff muscles / (posterior) deltoid;	**5**
(d)(i)	3 marks for: 1 cardiac output: volume of blood leaving the heart / left ventricle per minute; 2 stroke volume: volume of blood leaving the heart / left ventricle per beat; 3 cardiac output = stroke volume x heart rate / Q = SV × HR;	**3**
(d)(ii)	2 marks for: 1 cardiac output: same / unchanged; 2 stroke volume: increases / larger;	**2**

(d)(iii)	4 marks for any 4 of: 1 during exercise – increased venous return; 2 increased diastolic filling / preload; 3 increased stretch of cardiac muscle / elastic; 4 increased the force of contraction / stronger / more powerful; 5 known as Starling's law; 6 higher percentage of blood ejected from heart per beat / increased ejection fraction; 7 end systolic volume lower than at rest;	**4**
(e)	3 marks for 3 of: (sub-max. 2 marks) *oxygen:* 1 combines with haemoglobin / forms oxyhaemoglobin; 2 dissolved / eq. in blood plasma; (sub-max. 2 marks) *carbon dioxide:* 3 as bicarbonate / hydrogen carbonate ions / carbonic acid; 4 dissolved / eq. in blood plasma; 5 combined / eq. with plasma proteins / haemoglobin / as carbaminohaemoglobin;	**3**
(f)(i)	3 marks for any 3 of: *(during exercise)* 1 rate / depth of breathing increases; 2 additional muscles are used; *inspiration:* 3 increases size / volume of the thorax / chest cavity / lungs; 4 helped by sternocleidomastoid / scalenes / pectoralis minor; *expiration:* 5 pull ribcage quickly / powerfully downwards; 6 helped by internal intercostal muscles / rectus abdominus / abdominals;	**3**

(f)(ii)	4 marks for any 4 of: 1 cardiac hypertrophy; 2 bradycardia; 3 less oxygen used by heart – more available to muscles; 4 increased capillary density / more capillaries at alveoli and / or muscle; 5 increased blood flow to lungs / greater pulmonary diffusion gradient; 6 increased number / size / density of mitochondria; 7 increased myoglobin content; 8 increased oxidative enzyme activity; 9 increased glycogen / triglyceride stores; 10 increased maximal minute ventilation; 11 increased arterio-venous oxygen difference / VO_2 max.; 12 increased blood volume / more red blood cells / erythrocytes / haemoglobin; 13 delayed lactate threshold / OBLA;	**4**

2 - (9396/12_Winter_2017_Q1) - *Applied Anatomy And Physiology*

(a)	4 marks for 4 of: (sub-max. 1 mark) 1 shoulder – ball and socket <u>and</u> knee – hinge joint; (sub-max. 3 marks) 2 shoulder – greater / knee – lesser range of movement; 3 shoulder – moves in three planes (tri-axial) AND knee – moves in one plane (uni-axial); 4 shoulder – flexion / extension AND abduction / adduction AND rotation / circumduction AND knee – flexion / extension; 5 shoulder – less / knee – more stable; 6 shoulder – stabilised by muscles AND knee – stabilised by ligaments;	**4**
(b)	4 marks for 4 of: (sub-max. 2 marks) *structural:* 1 size – small / smaller in diameter / fewer fibres per motor neurone; 2 more myoglobin / red; 3 more mitochondria; 4 more fat / triglyceride stores; 5 type of myosin ATPase (slow); 6 high capillary density / high oxidative capacity; (sub-max. 2 marks) *functional:* 7 high aerobic / low anaerobic capacity; 8 slow contractile speed / contracts slowly; 9 high fatigue resistance / fatigue slowly; 10 low (motor unit) strength / less forceful contraction;	**4**
(c)	5 marks for: 1 concentric / isotonic; 2 (horizontal) flexion / adduction; 3 pectoralis major / deltoid; 4 (internal) rotation; 5 gluteus medius / gluteus minimus / semimembranosus / semitendinosus / gracilis;	**5**
(d)(i)	2 marks for: 1 increase in heart rate <u>before</u> exercise; 2 release of (nor)adrenaline / epinephrine;	**2**

(d)(ii)	4 marks for any 4 of: 1 chemoreceptors detect increased blood acidity / CO_2 / $[H^+]$ / decrease in pH; 2 proprioceptors / mechanoreceptors detect movement / muscular contractions; 3 baroreceptors detect a change in in blood pressure; 4 thermoreceptors detect increase in temperature; 5 information to cardiac control centre / medulla (oblongata); 6 increased nerve impulses to SA node; 7 via sympathetic nerve / cardiac accelerator nerve;	**4**
(e)	3 marks for: 1 6 – increases; 2 7 – decreases; 3 8 – decreases;	**3**
(f)	4 marks for any 4 of: 1 (leaving heart / left ventricle) blood pressure AND velocity high; 2 because of small cross-sectional area / large contractile force from cardiac muscle / heart beat; 3 (through arteries / arterioles / at capillaries) blood pressure AND velocity decrease; 4 because of large / increased cross-sectional area of vessels further away from heart / left ventricle; 5 because of friction between blood and blood vessel walls; 6 (returning to the heart) blood pressure continues to decrease; 7 but velocity increases due to venous return mechanism / reduced cross-sectional area in veins / venules;	**4**
(g)	4 marks for any 4 of: 1 low pO_2 / less oxygen at altitude; 2 reduced diffusion gradient between alveoli / lungs and air; 3 need to increase rate / depth of breathing to compensate; 4 reduced diffusion gradient between alveoli and blood / capillaries; 5 not as much oxygen diffuses into blood / capillaries; 6 haemoglobin not as fully saturated / reduced partial pressure of oxygen in blood; 7 less oxygen delivered to muscles; 8 reduced diffusion gradient between capillaries and muscles; 9 reduced aerobic performance / quicker onset of anaerobic respiration / increased oxygen debt / increased excess post exercise oxygen consumption (EPOC);	**4**

3 - (9396/13_Winter_2017_Q1) - *Applied Anatomy And Physiology*

(a)(i)	4 marks for 4 of: (sub-max. 2 marks) 1 pivot joint; 2 rotation; (sub-max. 2 marks) 3 cartilaginous / semi-moveable joint / slightly movable; 4 flexion / extension / rotation; (sub-max. 2 marks) 5 gliding joint; 6 flexion / extension / rotation / circumduction;	**4**
(a)(ii)	4 marks for: (external obliques) 1 cause trunk rotation / twisting; 2 an example of an activity using this type of movement; (erector spinae) 3 cause extension / hyperextension of the spine; 4 an example of an activity using this type of movement;	**4**
(b)	5 marks for: 1 concentric / isotonic; 2 extension; 3 gluteus maximus / biceps femoris / semimembranosus / semitendinosus; 4 (horizontal) adduction / extension; 5 trapezius / latissimus dorsi / deltoid / rotator cuff / infraspinatus / teres minor;	**5**
(c)(i)	2 marks for any 2 of: 1 during exercise – increased venous return; 2 increased diastolic filling / preload / increased stretch of cardiac muscle / elastic; 3 increased the force of contraction / stronger / powerful; 4 known as Starling's law; 5 higher percentage of blood ejected from heart per beat / increased ejection fraction / end systolic volume lower than at rest;	**2**

(c)(ii)	4 marks for any 4 of: 1 intrinsic / myogenic / heart controls own rate; 2 sinoatrial (SA) node / pacemaker sets (sinus) rhythm / heart rate / nervous impulses; 3 (sinoatrial (SA) node) impulses spread through (cardiac tissue in) atria, causes contraction / systole (of atria); 4 impulses picked up by atrioventricular (AV) node (delays impulse); 5 impulses to ventricle through bundle of His / AV bundle; 6 Purkyne / Purkinje fibres spread out impulses (ventricles contract / systole);	**4**
(d)	4 marks for 4 of: *First two mechanisms offered marked.* (sub-max. 2 marks) 1 the skeletal pump / muscle pump mechanism; 2 contraction of skeletal muscles compresses vein walls helping to force blood back to the heart; (sub-max. 2 marks) 3 the respiratory pump mechanism; 4 changes in pressure in the thoracic / chest cavity put pressure on the (abdominal) veins helping to force blood back to the heart; (sub-max. 2 marks) 5 venous tone / smooth muscle; 6 partial contraction of smooth muscle in the vein walls helps to force blood back to the heart; (sub-max. 2 marks) 7 gravity; 8 blood in veins above the heart helps force blood back to the heart; (sub-max. 2 marks) 9 suction pressure / pumping action of the heart; 10 pressure changes in atria causes reduced pressure in large veins which leads to blood being sucked into heart;	**4**

(e)	3 marks for 3 of: (sub-max. 2 marks) 1 in blood oxygen combines with haemoglobin / forms oxyhaemoglobin; 2 haemoglobin can carry up to four molecules of oxygen when fully saturated; 3 oxygen diffuses into the muscle cell because of the diffusion gradient / diffusion from high to low concentration / pressure; (sub-max. 2 marks) 4 myoglobin has higher affinity for oxygen than haemoglobin / haemoglobin has a lower affinity; 5 myoglobin acts as a temporary store / transporter of oxygen to the mitochondria / site of aerobic respiration;	**3**
(f)	4 marks for any 4 of: 1 lots of alveoli – increased surface area for diffusion; 2 layer of moisture in the alveoli – dissolves oxygen and aids diffusion; 3 thin / semi-permeable / one-cell thick walls of alveoli – increasing diffusion rate; 4 capillaries surround the alveoli – large contact area for diffusion of gases into blood stream; 5 surfactant within the alveoli – reduces the tendency of alveoli / lungs to collapse; 6 elastic fibres in alveolar walls – lungs can recoil (to change volume / aid ventilation); 7 small diameter of capillaries – slow transit time / compression of red blood cells;	**4**