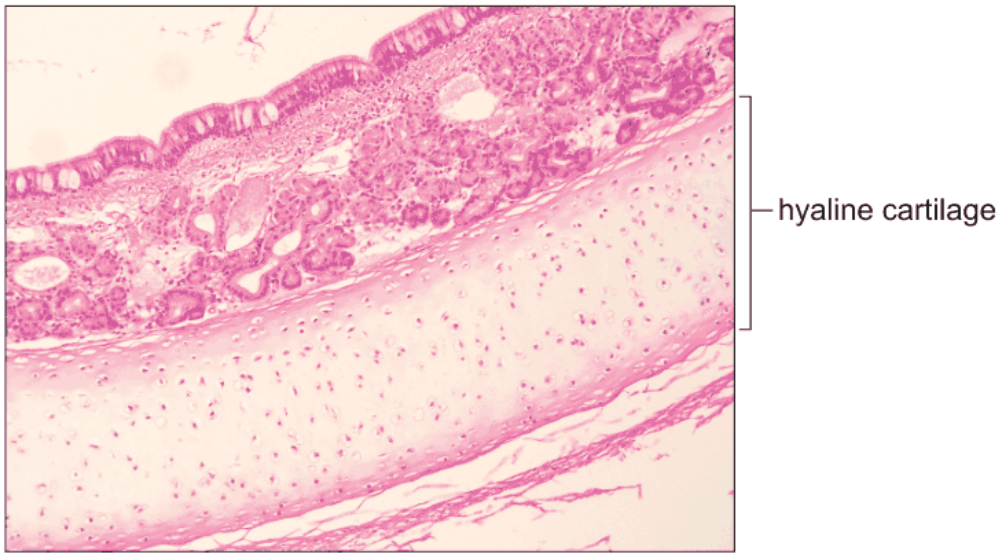
Skeletal Tissues (Option B1): Eduqas A Level Biology Exam Questions by Topic

20 questions · 46 marks · about 55 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Component 3 · June 2024 · Q8(a)(i) · 2 marks

8. **Image 8.1** shows a photomicrograph of a section taken from the trachea.

Image 8.1



(a) (i) Identify the cells present in the hyaline cartilage shown in **Image 8.1** and explain how nutrients and oxygen are supplied to these cells. [2]

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Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 2 · A level Component 3 · June 2022 · Q8(a)(i) · 2 marks

8. (a) Synovial joints enable movement of limbs and are composed of several tissues. **Image 8.1** shows a diagram of a section through a synovial joint.

Image 8.2 is a photomicrograph of the structure of the articular cartilage.

Image 8.1

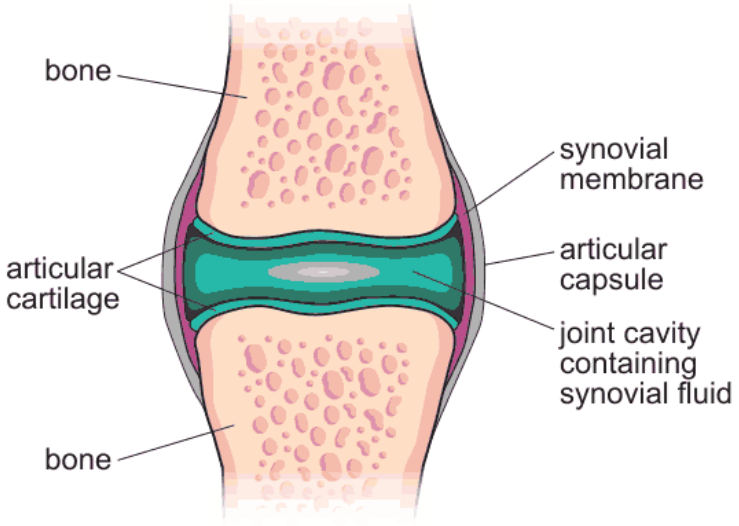
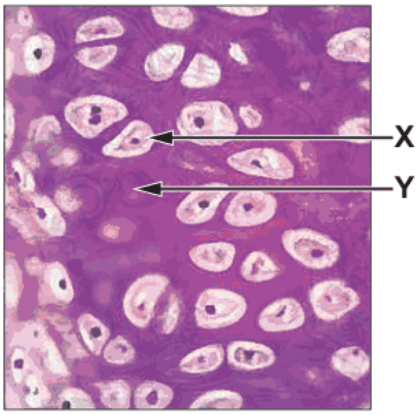


Image 8.2



(i) Name the type of cartilage that forms articular cartilage and state its function in a joint such as the knee. [2]

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Question 3 · A level Component 3 · June 2019 · Q9(a)(iii) · 3 marks

(iii) The external ear in mammals contains yellow elastic cartilage. Compare the structure of hyaline cartilage to yellow elastic cartilage. Explain the benefits of each type of cartilage. [3]

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Question 4 · A level Component 3 · Autumn 2020 · Q9(a)(iii) · 2 marks

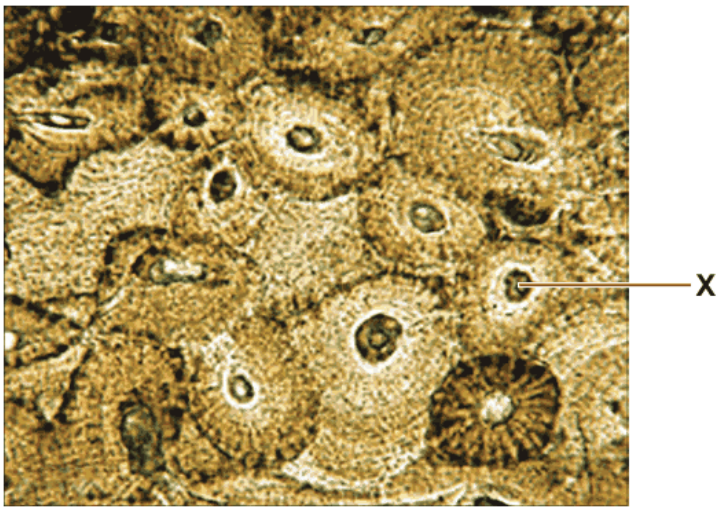
In the matrix, organic and inorganic compounds contribute to bone density and hardness.

(iii) Name **one** organic and **one** inorganic compound found in the matrix. [2]

Organic ..... Inorganic .....

Question 5 · A level Component 3 · June 2017 · Q8(a)(i) · 2 marks

8. Limb bones have a strong outer shell of compact bone, surrounding a softer, spongier core called trabecular bone making them light and strong. The electron micrograph shows a cross section through compact bone.



(a) (i) Name structure **X** and describe its role in bone. [2]

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Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 6 · information from earlier in the question

(ii) State the percentages of organic and inorganic material in compact bone. [1]

Organic ..... Inorganic .....

Bone mineral density (BMD) is a useful measure of bone health. Bones undergo continuous remodelling; through the daily removal of small amounts of bone mineral, and equal deposition of new mineral. This process must be balanced if bone strength is to be preserved.

As we age, the bone mineral balance tips toward excessive removal and bones weaken. Over time they can become brittle and prone to fracture, leading to a disease called osteoporosis.

The table below shows the effect of four osteoporosis treatments.

Drugs	Bone mineral density gain (%)	Fracture reduction (%)
Bisphosphonate	**3-5**	**30-45**
Denosumab	**3-6**	**55-70**
Oestrogen	**3-5**	**35**
Calcitonin	**1-1.5**	**20-30**

Data adapted from Department of Pharmacology, Al-Ameen College of Pharmacy, Bangalore-560027, India.

Question 6 · A level Component 3 · June 2017 · Q8(b) · 4 marks

(b) Denosumab is a drug that binds to receptors on osteoclasts and inhibits their activity. With reference to the mineral composition of compact bone and the cells found in the lacunae, describe how bone remodelling takes place in a healthy adult and suggest how Denosumab can be used as a treatment for osteoporosis. [4]

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Question 7 · A level Component 3 · Autumn 2020 · Q9(b)(iv) · 3 marks

(iv) Describe why running on a treadmill might be expected to increase bone density or reduce bone density loss in parts of bones such as the centrum of the vertebrae. Explain how osteocytes (bone cells) in the lacunae of compact bone reduce bone density loss as a result of an activity such as running. [3]

Question 8 · A level Component 3 · June 2022 · Q8(c)(i) · 3 marks

(c) Inorganic compounds, such as calcium phosphate, are deposited into bone tissue as it grows, a process known as mineralisation.

Osteomalacia is the result of a deficiency in bone mineralisation.

The X-ray photograph in **Image 8.5** shows the legs of a child suffering from rickets, a form of osteomalacia that results from a deficiency of vitamin D.

Image 8.5



(i) In bones affected by vitamin D deficiency, specific bone cells are unable to add inorganic calcium salts. State the name of these cells and explain why the tibia and fibula in **Image 8.5** have become bowed as a result. [3]

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Question 9 · A level Component 3 · June 2019 · Q9(b)(iv) · 1 mark

(iv) State the name that is given to the similar, milder condition seen in adults. Explain why it is a less serious condition in adults. [1]

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Question 10 · A level Component 3 · June 2018 · Q9(c)(i) · 2 marks

(c) The bones of the skeleton can fracture for a variety of reasons. The X-rays below show two such injuries:

C Lower right leg



D Left hip



X-ray **C** is taken from a healthy 19-year-old male with a displaced fracture of the fibula. X-ray **D** is from a 75-year-old woman, suffering from osteoporosis with a non-displaced fracture of the femur.

(i) Explain why the fracture shown in X-ray **C** is more likely to heal with the best chance of full recovery than the fracture shown in X-ray **D**. [2]

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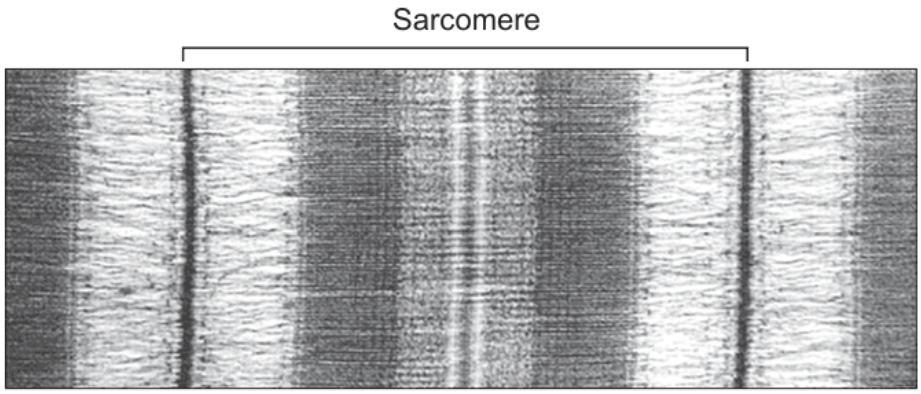
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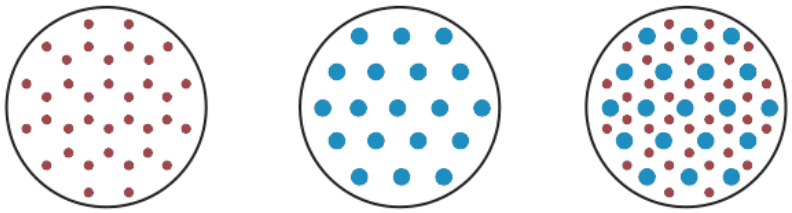
Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 11 · information from earlier in the question

9. Skeletal muscle is made up of bundles of fibres, which have a striated appearance. Each fibre contains numerous myofibrils. The image below shows a micrograph of a sarcomere.



The drawings below represent the same structure from different regions but in a different plane from the image above.



Question 11 · A level Component 3 · June 2018 · Q9(a)(ii) · 3 marks

(ii) With reference to the micrograph, for each of the circles state which region of the sarcomere they are taken from and explain your reasoning. [3]

A .....

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B .....

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C .....

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Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Image 9.6 shows a representation of the arrangement of proteins of an actin filament in a myofibril.

Image 9.6

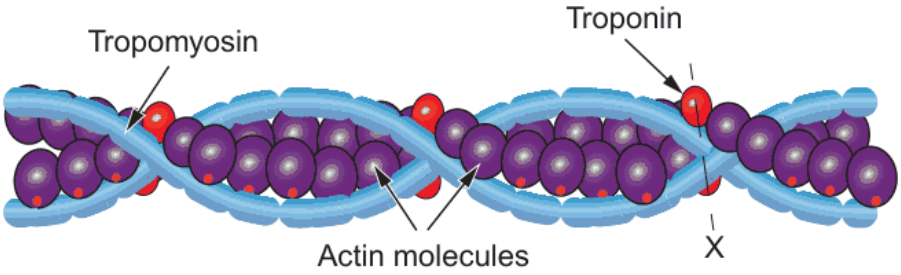
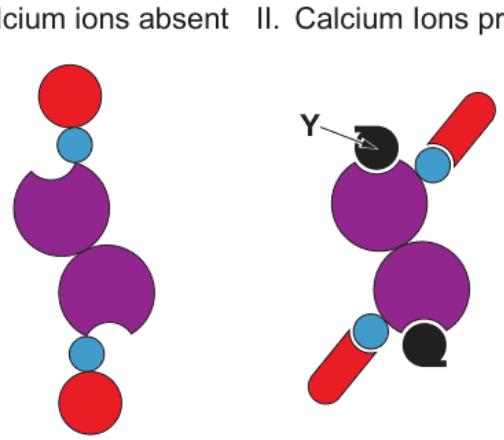


Image 9.7 shows a cross section through the structures of **Image 9.6** at the point marked **X**.

I. Represents their position when calcium ions are absent and

II. Represents their position when calcium ions are present.

Image 9.7



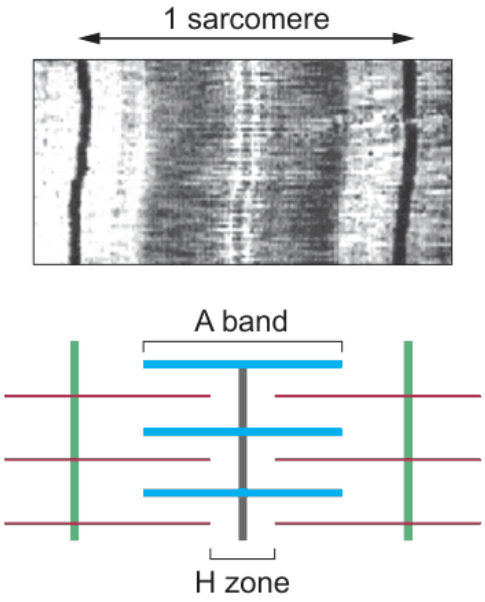
(iv) With reference to structures represented in **image 9.7** and using your knowledge of proteins in the myofibril, explain the relationship between the presence of calcium ions and the position of structure **Y** in the process of muscle contraction. [3]

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(b) Several groups of striated muscles cause movement at the knee joint.

In **Image 8.3** an electron micrograph and diagram show the arrangement of protein filaments in one sarcomere of a relaxed myofibril.

Image 8.3



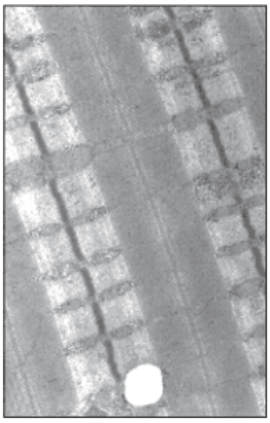
(i) Describe and explain the appearance of the H zone and the A band when the sarcomere is **contracted**. [2]

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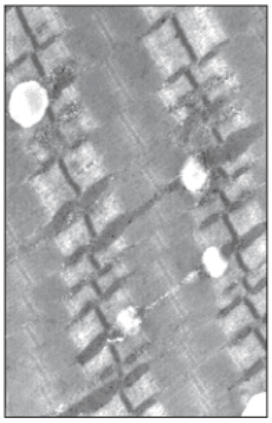
Question 14 · information from earlier in the question

(b) In 2016 Tim Peake was the first British astronaut to spend time on the International Space Station. Research has taken place on astronauts into the effect of prolonged space flight on muscle atrophy. During space flight, astronauts have to exercise, often spending several hours per day on a treadmill.
The images below show electron micrographs of muscle fibres obtained from the muscles of an astronaut before (**A**) and after (**B**) a 17-day space flight. The before flight fibres have wider myofibrils whereas myofibrils after flight are narrower, indicating atrophy.

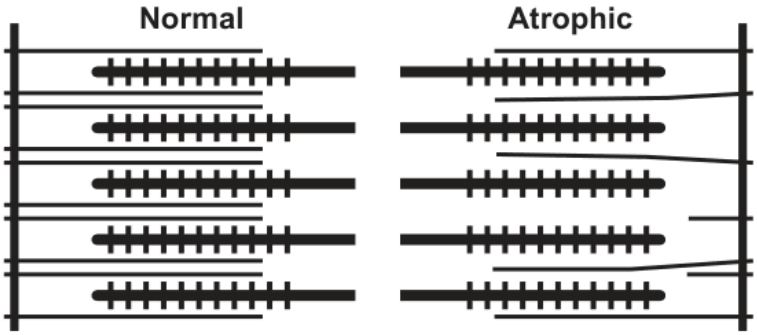
A before flight



B after flight



The diagram below represents the atrophy demonstrated in the protein fibres after flight when compared to normal protein fibres.



Question 14 · A level Component 3 · June 2018 · Q9(b)(ii) · 2 marks

(ii) Using the image and your knowledge of muscle contraction, conclude how spaceflight would affect the maximum force that the muscle could generate. [2]

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Question 15 · A level Component 3 · June 2025 · Q8(b)(ii) · 2 marks

(ii) Enzymes in lysosomes of muscle cells can lead to the breakdown of mitochondria in a process called autophagy.

Suggest how autophagy might affect muscle contraction. [2]

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(b) In the human skeleton, the arms are used predominantly for manipulation and gripping and the legs for locomotion and support.

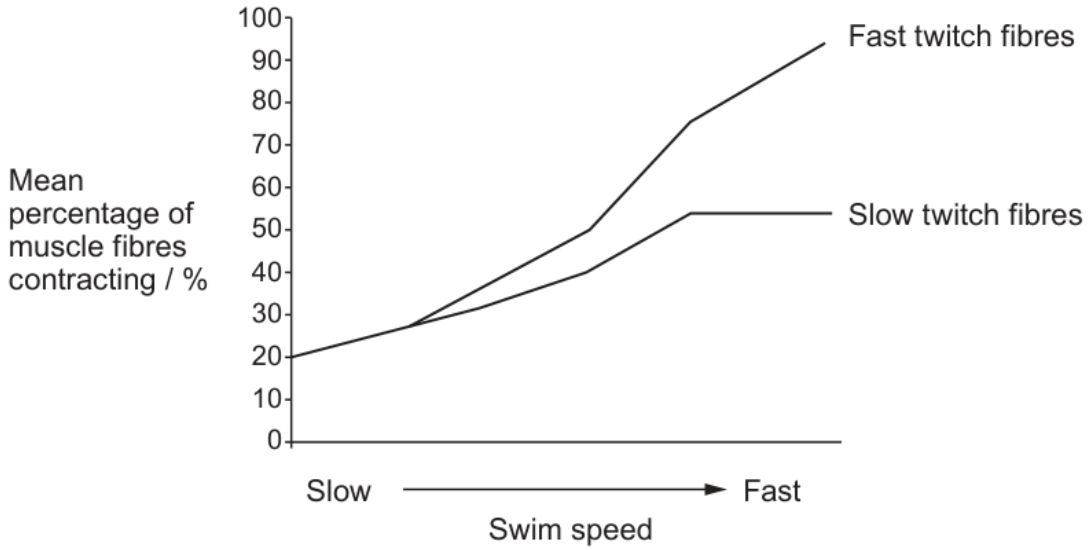
In swimming, however, both the arms and the legs are used for locomotion.

Swimmers carry out training to develop strength and stamina in the muscles of their arms and legs. Increased muscular effort results in increasing speed.

Muscles can have different proportions of contractile fibres known as fast twitch or slow twitch fibres.

Image 8.2 shows the mean percentage of fast and slow twitch muscle fibres that are contracting as speed increases in swimmers during training.

Image 8.2



(i) Explain how changes in the proportion of fast and slow twitch fibres contracting in the muscles enable swimmers to achieve greater speed. [2]

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(c) **Table 8.4** shows data on the percentage of slow twitch (ST) and fast twitch (FT) muscle fibres from groups of athletes and non-athletes. It also shows the ratio of slow twitch to fast twitch muscles in each group of athletes.

Table 8.4

Group	Proportion of slow twitch and fast twitch muscle fibres		
	Slow Twitch / %	Fast Twitch / %	Ratio ST : FT
marathon runners	82	18	4.6 : 1
swimmers	75	25	3.0 : 1
non-athlete	45	55	0.8 : 1
sprinters	37	63	0.6 : 1

(i) The ratio of ST : FT muscle fibres in marathon runners was 4.6 : 1.
Explain the advantage of this ratio to marathon runners. [1]

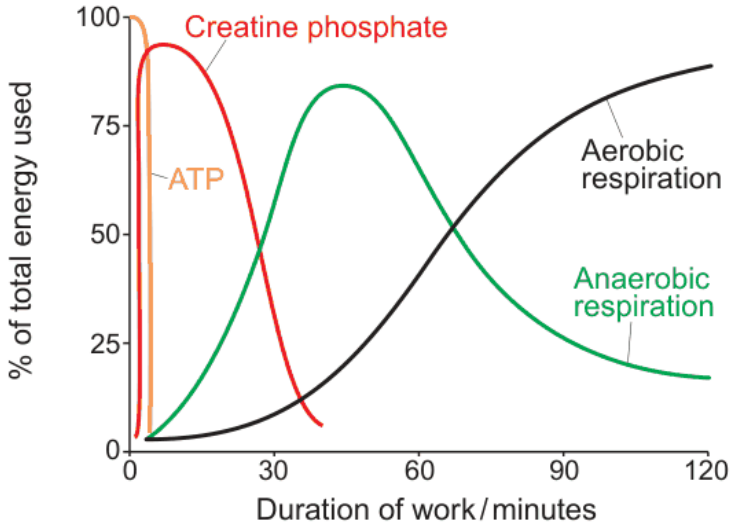
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(c) The percentages of energy used from different energy sources in the muscle of a runner during exercise are shown in figure 9.4:

Figure 9.4

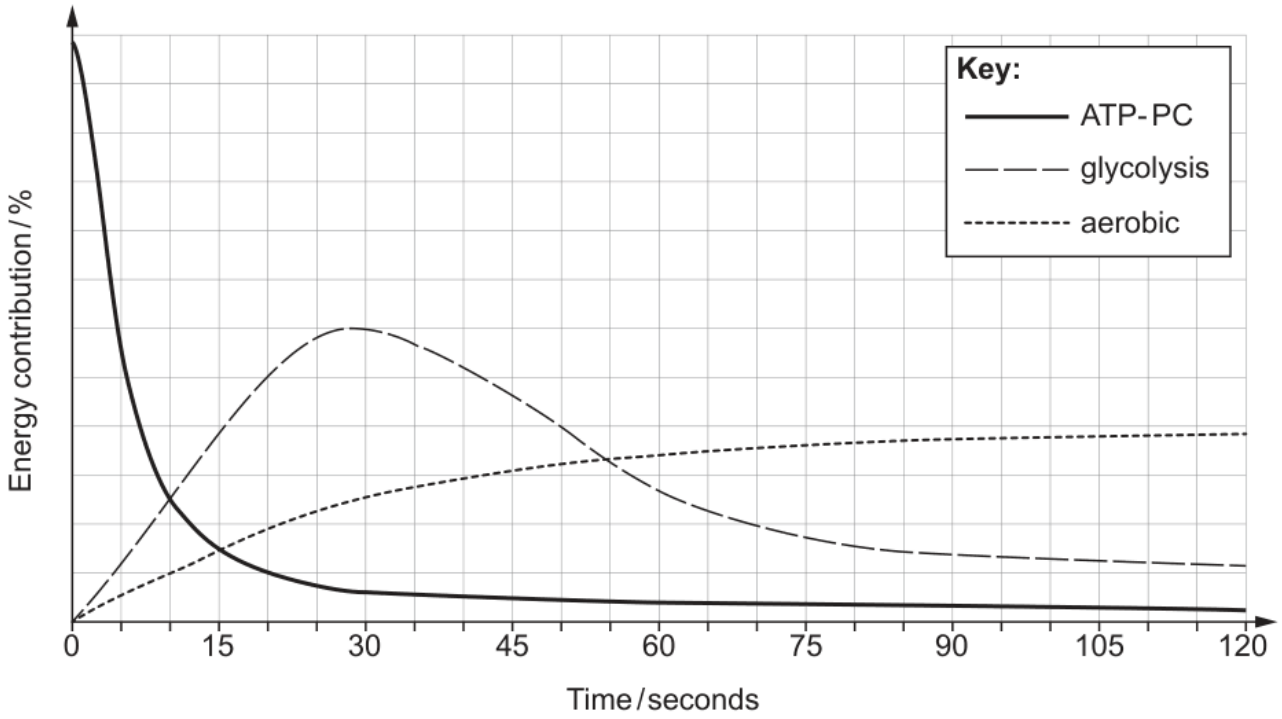


(i) Using figure 9.4 and your own knowledge, explain the shape of the graph for ATP and creatine phosphate and explain why aerobic respiration takes over from anaerobic respiration during sustained exercise. [3]

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

(d) The energy for muscle contraction may be obtained from one of three different energy systems as shown on **Graph 8.5**.

Graph 8.5



(i) With reference to **Graph 8.5**, suggest which of the three systems would provide the greatest percentage energy contribution in athletes performing each of the following activities. Explain your answers.

I. a 100-metre sprint; [2]

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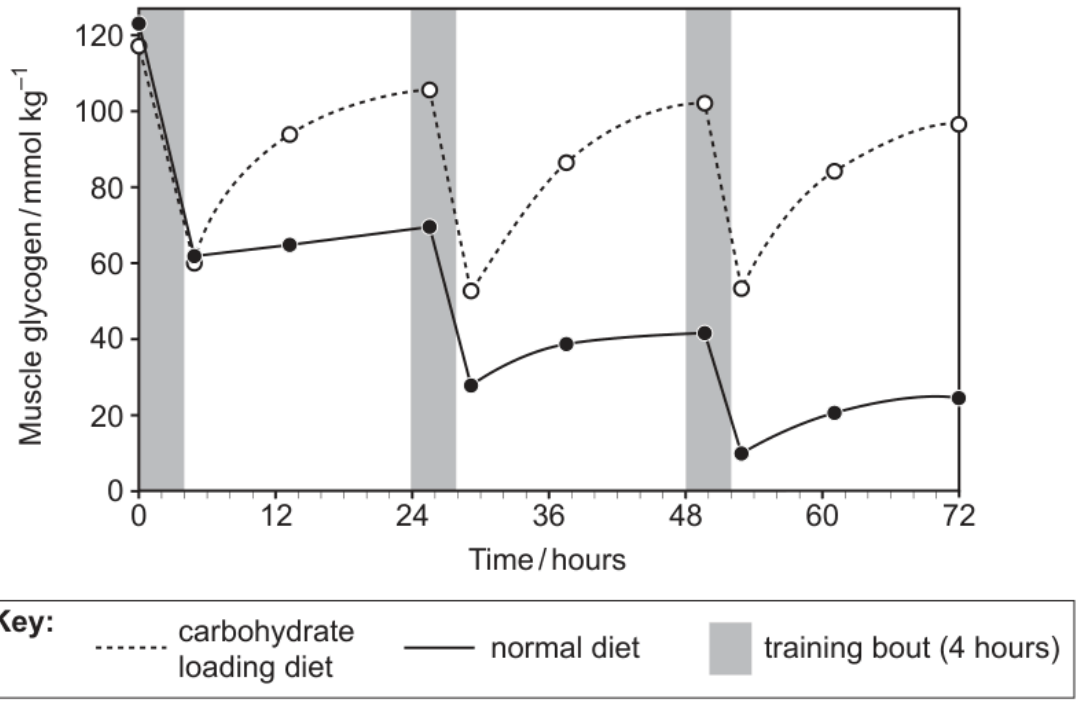
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Question 20 · information from earlier in the question

Glycogen is the main carbohydrate storage compound in muscle cells.
Graph 8.6 shows the results of an experiment where two athletes were given standard daily training bouts and their muscle glycogen levels were then measured regularly over 72 hours. One athlete was given a carbohydrate loading diet while the other was given a normal diet with no carbohydrate loading.

Graph 8.6



Question 20 · A level Component 3 · June 2024 · Q8(d)(iii) · 2 marks

(iii) With reference to **Graph 8.6** explain how carbohydrate loading might improve an athlete's performance. [2]

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Mark schemes

Question 1 · A level Component 3 · June 2024 · Q8(a)(i) · 2 marks

8	(a)	(i)	Chondrocyte (1) By diffusion through the matrix (1)	2	2

Question 2 · A level Component 3 · June 2022 · Q8(a)(i) · 2 marks

8	(a)	(i)	Hyaline cartilage. (1) Reduce friction/allow smooth movement of bones over each other. (1)	2	2	

Question 3 · A level Component 3 · June 2019 · Q9(a)(iii) · 3 marks

	(iii)	Hyaline cartilage has collagen fibres **and** yellow elastic cartilage has elastin fibres. (1) Yellow elastic cartilage {more flexible than hyaline cartilage / maintains shape} (1) Hyaline cartilage is firmer/ tougher and can withstand forces in the joint. (1)	1	2	3

Question 4 · A level Component 3 · Autumn 2020 · Q9(a)(iii) · 2 marks

(iii)	Organic – collagen; Inorganic – Hydroxyapatite/Calcium phosphate (2)	2	2

Question 5 · A level Component 3 · June 2017 · Q8(a)(i) · 2 marks

8	(a)	(i)	X = <u>Haversian canal</u> (1) O_2 delivery/ CO_2 removal / nutrients/ named nutrients(1) Accept reference to nerves and pain	2	2	1

Question 6 · A level Component 3 · June 2017 · Q8(b) · 4 marks

(b)	• osteoblast {lays down/ secrete} the matrix/ ossification of bone (1) Accept components of matrix	1 1	
	• osteoclasts break bone down (1)	1	
	• BMD increases with Denosumab/ less fractures with Denosumab (1)	1	4
	• therefore breakdown not taking place /osteoblasts more active than osteoclasts(1)		

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Question 7 · A level Component 3 · Autumn 2020 · Q9(b)(iv) · 3 marks

(iv)	Osteoblasts increase activity so more bone matrix produced than broken down (slows bone loss) (1) Any **two** (x1) from: Running increases (mechanical) stress on weight bearing bones (1) Osteoclasts resorb/ breakdown bone compounds in the compact bone/matrix (1) Osteoblasts deposit hydroxyapatite/calcium salts/named calcium salts (1)	2	1	3

Question 8 · A level Component 3 · June 2022 · Q8(c)(i) · 3 marks

(c)	(i)	Osteoblasts (1) Bones are {not hard enough/too soft /not strong enough} (1) (reject low bone density) So cannot support (increasing) body mass/weight (1)	3	3

Question 9 · A level Component 3 · June 2019 · Q9(b)(iv) · 1 mark

	(iv)	Osteomalacia **and** Adult bones have stopped growing	1		1

Question 10 · A level Component 3 · June 2018 · Q9(c)(i) · 2 marks

(c)	(i)	C because the patient is younger/ could be more active (1) D (has osteoporosis,) making new bone growth more difficult/ osteoblasts less active (1)	2	2

Question 11 · A level Component 3 · June 2018 · Q9(a)(ii) · 3 marks

	(ii)	A – {I band/ Actin only} as it only contains thin filaments B – {H zone/ myosin only} as it contains thick filaments only C - outer edge/dark region of A band as it shows overlap of thick and {thin filaments/ actin and myosin} Accept labelled on diagram for location	3	3

Question 12 · A level Component 3 · Autumn 2020 · Q9(c)(iv) · 3 marks

(iv)	Any **three** (x1) from:	2	1	3
	Calcium ions (accept Ca^{2+} but not Ca) bind to troponin, changing its shape (1) Causes tropomyosin to change position/tropomyosin pulled to one side (1) Myosin binding site is exposed on actin molecule (1) Structure Y is the Myosin head which forms a crossbridge with actin/enables actinomyosin crossbridge to form (1)			

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Question 13 · A level Component 3 · June 2022 · Q8(b)(i) · 2 marks

(b)	(i)	H zone becomes {smaller/disappears/ shortens} + A band remains the same (length/width) (1) **Any one (×1) from** {Thin filaments /actin filaments/Z line} move toward the centre of the sarcomere (reducing the distance between them) (1) The A band is the length of the {thick /myosin} filament (which does not change in length). (1)	1	1	2	

Question 14 · A level Component 3 · June 2018 · Q9(b)(ii) · 2 marks

(ii)	less force generated)(1) Any **one** (x1) from In post-flight muscle the actin and myosin have bigger spaces between them Actin has been broken down/less actin {Fewer cross bridges can form/ less myosin bound to actin}	1	1	2

Question 15 · A level Component 3 · June 2025 · Q8(b)(ii) · 2 marks

(ii)	**Any two (x1) from** (Fewer mitochondria) so less ATP / less energy (1) {Movement of myosin head / breaking of cross bridges / owtte} requires {energy / ATP} (1) Muscle remains contracted (1)				

	2		2		

Question 16 · A level Component 3 · Autumn 2021 · Q8(b)(i) · 2 marks

(b)	(i)	More fast twitch fibres contract SO **Any one (x1) from** Faster contraction time (1) Greater force generated (1) Greater tolerance to lactic acid/ anaerobic respiration/ lactate removed quickly. (1) **AND** **Any one (x1) from** Maximum number of slow twitch fibres contracting at slower swim speed (1) no more slow twitch fibres contract at faster swim speed. (1)	2	2

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Question 17 · A level Component 3 · June 2025 · Q8(c)(i) · 1 mark

(c)	(i)	fatigue slowly / muscles tire less easily / less build up of lactic acid (1)	1	1

Question 18 · A level Component 3 · June 2019 · Q9(c)(i) · 3 marks

	(c)	(i)	Limited ATP in muscle, ATP used first/ quickly. (1) Creatine phosphate then used to phosphorylate ADP to provide ATP/ replenish the store of ATP. (1) Aerobic respiration takes over from anaerobic respiration because lactate builds up/ produces more ATP. (1)		3	3

Question 19 · A level Component 3 · June 2024 · Q8(d)(i)I · 2 marks

(d)	(i)	I	ATP PC (1) Short activity and more energy released than by other systems in first 10 seconds (1)	2	2

Question 20 · A level Component 3 · June 2024 · Q8(d)(iii) · 2 marks

(iii)	**Any two (x1) from** Glycogen {replenished more/doesn't fall as low as normal diet / muscle has more} (Improved performance) {train harder / for longer / improves endurance} (1)	2	2

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