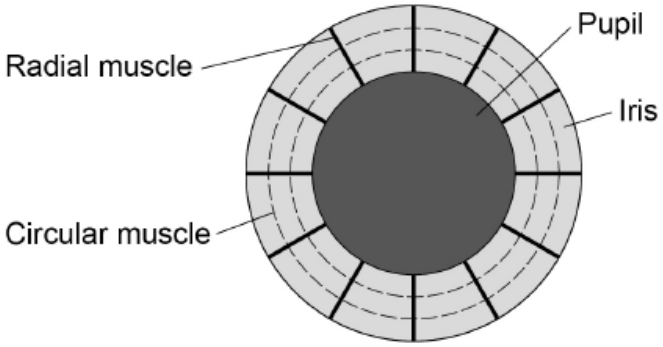
AQA – Organisms respond to changes in their internal and external environments – A2 Biology

1. June/2020/Paper_2/No.1

0 1 The iris in the human eye is a muscular structure. The iris changes the size of the pupil.

Figure 1 shows the muscles in the iris.

Figure 1



0 1 . 1 Suggest and explain how the interaction between the muscles labelled in **Figure 1** could cause the pupil to constrict (narrow).

[2 marks]

0 1 . 2 The fovea of the eye of an eagle has a high density of cones. An eagle focuses the image of its prey onto the fovea.

Explain how the fovea enables an eagle to see its prey in detail.

Do **not** refer to colour vision in your answer.

[3 marks]

0 1 . 3 The retina of the human eye has an area of approximately 1.094×10^3 mm^2

The circular fovea in a human eye has a diameter of 3×10^3 µm

Calculate the area of the fovea as a percentage of the area of the retina.

The area of a circle is πr^2. Use $\pi = 3.14$ in your calculation.

Show your working.

[2 marks]

Answer _____ %

0 1 . 4 The retina of an owl has a high density of rod cells.

Explain how this enables an owl to hunt its prey at night.

Do **not** refer to rhodopsin in your answer.

[3 marks]

2. June/2020/Paper_2/No.2

0 2 Testosterone is a steroid hormone that belongs to a group of male sex hormones called androgens.

0 2 . 1 Steroid hormones are hydrophobic.

Explain why steroid hormones can rapidly enter a cell by passing through its cell-surface membrane.

[2 marks]

0 2 . 2 In the cytoplasm, testosterone binds to a specific androgen receptor (AR). An AR is a protein.

Suggest and explain why testosterone binds to a specific AR.

[2 marks]

0 2 . 3 The binding of testosterone to an AR changes the shape of the AR. This AR molecule now enters the nucleus and stimulates gene expression.

Suggest how the AR could stimulate gene expression.

[2 marks]

The gene that codes for the AR has a variable number of CAG repeats.
Some studies have shown an association between the number of CAG repeats and the risk of developing prostate cancer.

Table 1 shows the results of a statistical test from one study.

Table 1

Number of CAG repeats in the *AR* gene	Probability (P) value
$\leqslant 16$	0.02
$\leqslant 17$	0.30
$\leqslant 18$	0.07
$\leqslant 19$	0.09
$\geqslant 20$	0.06

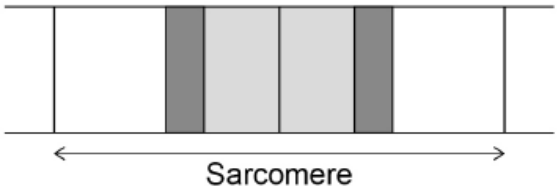
0 2 . 4 What can you conclude from the data in **Table 1**?

[3 marks]

3. June/2020/Paper_2/No.4

0 4 **Figure 3** shows the banding pattern of a single sarcomere.

Figure 3



0 4 . 1 Explain the banding pattern shown in **Figure 3**.

[3 marks]

Creatinine is produced in muscle tissues. Creatinine diffuses into the blood. The kidneys then excrete creatinine.

A calibration curve can be used to determine the concentration of creatinine in urine. One method of producing a calibration curve needs:

- creatinine solution of known concentration
- distilled water
- creatinine-detecting solution
- a colorimeter.

Creatinine-detecting solution reacts with creatinine to produce an orange colour.

0 4 . 2 Use the information provided to describe how you could produce a calibration curve for creatinine.

Do **not** include details on the use of glassware in your answer.

[4 marks]

0 4 . 3 Describe how you would determine the concentration of creatinine in a urine sample using your calibration curve.

[2 marks]

4. June/2020/Paper_2/No.5

0 5 Describe the sequence of events involved in transmission across a cholinergic synapse.

Do **not** include details on the breakdown of acetylcholine in your answer.

[5 marks]

5. June/2019/Paper_2/No.3

0 3 A student investigated the effects of indoleacetic acid (IAA) on the growth of oat seedlings (young plants).

The student:

- removed the shoot tip from each seedling and cut out a 10 mm length of shoot
- placed 10 lengths of shoot into each of 5 Petri dishes
- added to each Petri dish an identical volume of 5% glucose solution
- added to each Petri dish 40 cm^3 of a different concentration of IAA solution
- left the Petri dishes at 20 °C in the dark with their lids on for 5 days
- removed the shoots after 5 days and measured them
- determined the mean change in length of shoot at each concentration of IAA.

Table 1 shows her results.

Table 1

IAA concentration added to Petri dish / parts per million	10^{-5}	10^{-3}	10^{-1}	1	10
Mean change in length of shoot / mm	0.0	0.1	1.3	2.4	3.1

0 3 . 1 Explain why the student removed the shoot tip from each seedling.

[2 marks]

[Extra space]

0 3 . 2 Explain why the student added glucose solution to each Petri dish.

[2 marks]

0 3 . 3 Explain why the lids were kept on the Petri dishes.

[2 marks]

0 3 . 4 Describe and explain the results shown in **Table 1** and suggest how the results might have differed if lengths of **root** had been used.

[3 marks]

0 3 . 5 The student produced the different concentrations of IAA using a stock 1 g dm^{-3} solution of IAA (1 g dm^{-3} = 1 part per thousand) and distilled water.

Complete **Table 2** with the volumes of stock IAA solution and distilled water required to produce 40 cm^3 of 10 ppm (parts per million) IAA solution.

[1 mark]

Table 2

Concentration of IAA solution / parts per million	Volume of stock IAA solution / cm^3	Volume of distilled water / cm^3
10		

6. June/2019/Paper_2/No.4

0 4 Scientists investigated the effect of a decrease in pH on muscle contraction. The scientists did the investigation with four different preparations of isolated muscle tissue: **A**, **B**, **C** and **D**.

A - mouse muscle fibres at typical pH of mouse muscle tissue (control 1).

B - mouse muscle fibres at 0.5 pH units below typical pH.

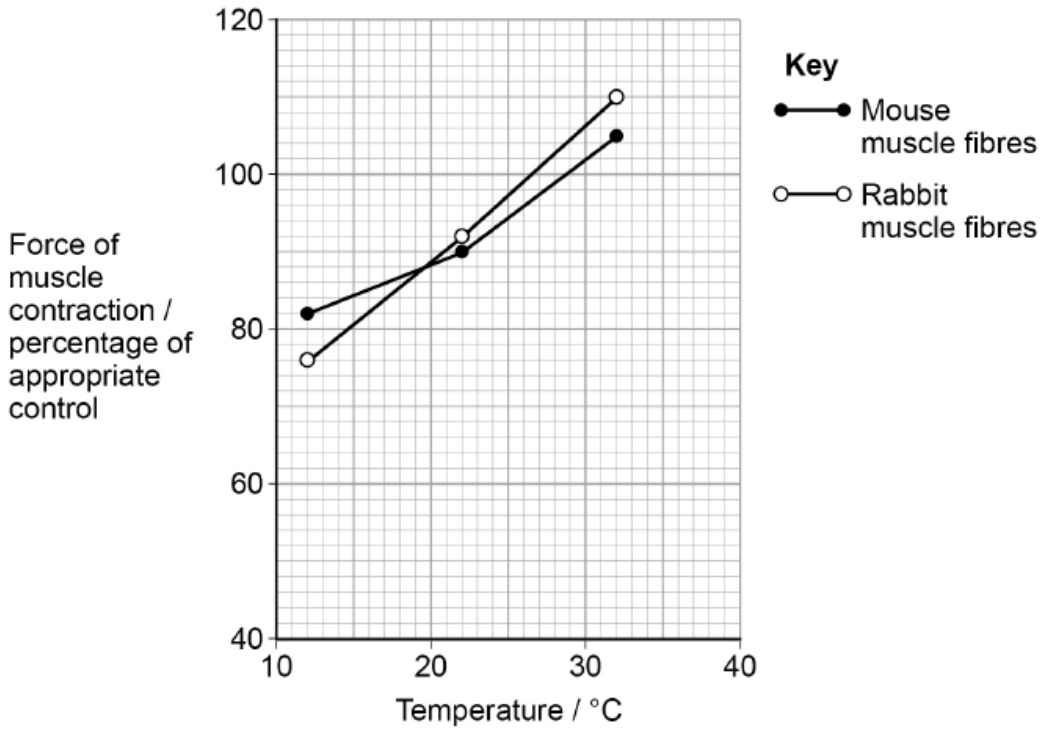
C - rabbit muscle fibres at typical pH of rabbit muscle tissue (control 2).

D - rabbit muscle fibres at 0.5 pH units below typical pH.

They measured the force of muscle contraction of the muscle fibres at 12 °C, 22 °C and 32 °C

Figure 3 shows the results the scientists obtained for **B** and **D** compared with the appropriate control.

Figure 3



0 4 . 1 A student looked at the results and concluded that a decrease in pH does cause a decrease in the force of muscle contraction.

Use **Figure 3** to evaluate this conclusion.

[4 marks]

[Extra space]

0 4 . 2 Another group of scientists suggested that a decrease in the force of muscle contraction is caused by an increase in the concentration of inorganic phosphate, Pi, in muscle tissues.

Their hypothesis is that an increase in the concentration of Pi prevents the release of calcium ions within muscle tissues.

Explain how a decrease in the concentration of calcium ions within muscle tissues could cause a decrease in the force of muscle contraction.

[3 marks]

0 4 . 3 In muscles, pyruvate is converted to lactate during prolonged exercise.

Explain why converting pyruvate to lactate allows the continued production of ATP by anaerobic respiration.

[2 marks]

7. June/2019/Paper_2/No.10

1 0 Guillain–Barré syndrome is a rare disease in which the immune system damages the myelin sheath of neurones. Myelin sheath damage can cause a range of symptoms, for example numbness, muscular weakness and muscular paralysis. Sometimes, neurones of the autonomic nervous system are affected, causing heart rate irregularities.

Huntington's disease is a disorder caused when a protein called huntingtin damages the brain. Huntingtin is produced because of a dominant, mutant allele.

The first successful drug trial to reduce concentrations of huntingtin in the human brain involved 46 patients. The patients received the drug for 4 months. The concentration of huntingtin was reduced in all the patients. The drug was injected at the base of the spine into the cerebrospinal fluid bathing the brain and spinal cord. The drug contains single-stranded DNA molecules. These single-stranded molecules inhibit the mRNA needed to produce huntingtin.

Symptoms of Huntington's disease can start at any time, but usually develop between 30 and 50 years of age. The likelihood and age when symptoms start are linked to the number of CAG base sequence repeats in the gene for Huntington's disease. However, recent studies have suggested that epigenetics may also affect the age when symptoms first start.

1 0 . 1 Damage to the myelin sheath of neurones can cause muscular paralysis (lines 2–4).

Explain how.

[3 marks]

1 0 . 2 Sometimes Guillain–Barré syndrome causes heart rate irregularities (lines 4–5).

Suggest and explain why.

[3 marks]

1 0 . 3 The first successful drug trial to reduce concentrations of huntingtin in the brain used single-stranded DNA molecules (lines 13–14).

Suggest and explain how this drug could cause a reduction in the concentration of the protein huntingtin.

[3 marks]

1 0 . 4 Scientists from the first successful drug trial to reduce concentrations of huntingtin (lines 9–11) reported that the drug is not a cure for Huntington's disease.

Suggest **two** reasons why the drug should **not** be considered a cure.
Do **not** include repeats of the drug trial in your answer.

[2 marks]

1 _____

_____

2 _____

_____

1 0 . 5 Suggest **two** reasons why people had the drug injected into the cerebrospinal fluid (lines 12–13) rather than taking a pill containing the drug.

[2 marks]

1 _____

_____

2 _____

_____

1 0 . 6 Suggest and explain **one** way epigenetics may affect the age when symptoms of Huntington's disease start.

[2 marks]

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