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Other names

Pearson
Edexcel GCE

Centre Number

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Candidate Number

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Biology

Advanced

Unit 5: Energy, Exercise and Coordination

Friday 20 June 2014 – Morning

Time: 1 hour 45 minutes

Paper Reference

6BI05/01R

You must have:

A copy of the scientific article adapted from The Immortal Life of Henrietta Lacks (enclosed)

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
– *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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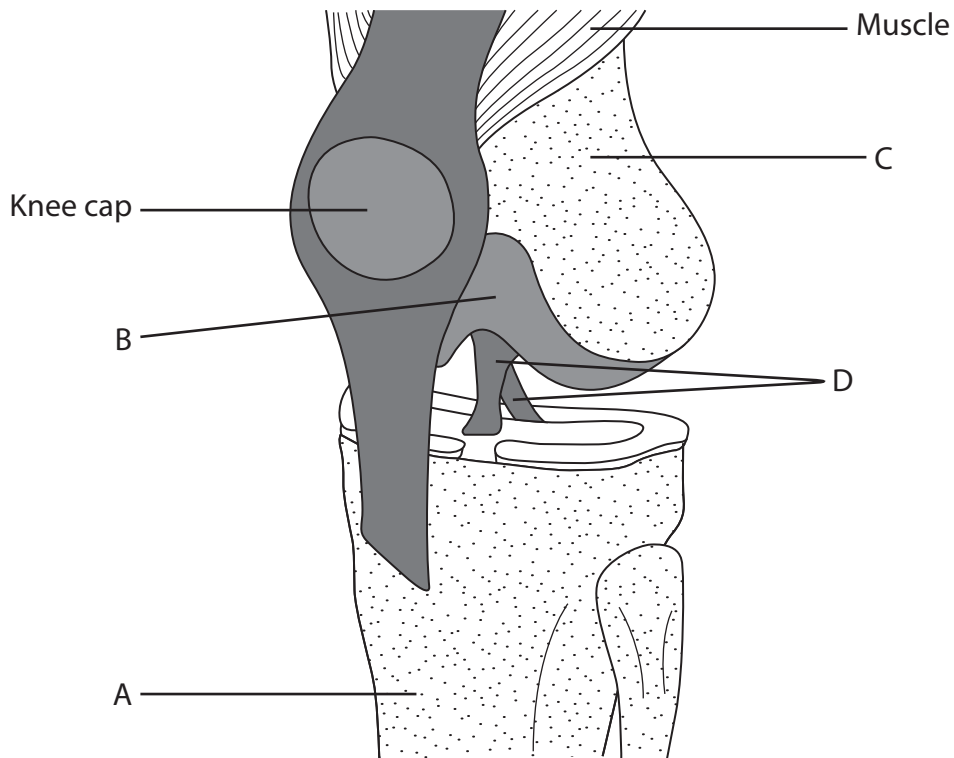
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Answer ALL questions.

Some questions must be answered with a cross . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

1 The diagram below shows part of a knee joint.

The knee is a hinge joint that may need surgery if damaged.



(a) Place a cross in the box to complete each of the following statements.

(i) The structure containing the most elastic tissue is

(1)

- A
- B
- C
- D



(ii) The part containing cartilage is (1)

A

B

C

D

(iii) The muscle shown attaches to part A by (1)

A an extensor

B a flexor

C a ligament

D a tendon

(b) A damaged cruciate ligament may require surgery.

(i) Explain the role of the cruciate ligament shown in the diagram. (3)

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(ii) Give **one** advantage to a patient of using keyhole surgery to repair a damaged cruciate ligament. (1)

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(Total for Question 1 = 7 marks)



2 The central nervous system (CNS) is made up of the brain and the spinal cord.

(a) The image below of a human head and neck shows part of the CNS.



Using the image and your knowledge, complete the table below.

(4)

Labelled structure	Name of structure	One function
A		
		Thermoregulation



(b) The structure involved in thermoregulation may cause sweat glands to release more sweat.

Explain how increased sweating is involved in the regulation of body temperature.

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- (c) The photograph below shows a California sea lion (*Zalophus californianus*), a large marine mammal.



Magnification $\times 0.005$

Domoic acid is a neurotoxin, produced by algae, that harms the brains of these mammals. This neurotoxin damages brain cells that release a neurotransmitter called glutamate.

- (i) Describe how a neurotransmitter, such as glutamate, is released from a brain cell.

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(ii) Scientists have used magnetic resonance imaging (MRI) to provide evidence that domoic acid may damage the brains of California sea lions.

Suggest how MRI can provide this evidence.

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(Total for Question 2 = 13 marks)



3 Dark chocolate contains a chemical called epicatechin.

An investigation was carried out to study the effect of epicatechin on mice.

Three groups of one-year-old male mice, group A, group B and group C, were used in an investigation lasting 15 days.

The table below shows how each group of mice was treated.

Group	Epicatechin added to drinking water	Extra exercise
A	Yes	No
B	No	No
C	No	Yes

All other variables were kept constant and after 15 days skeletal muscle from the mice in each group was studied.

- (a) The ability of the skeletal muscle to contract was compared. The time taken for the muscle to start to fatigue (fail to contract) was recorded.

The results are shown in the table below.

Group	Time taken for skeletal muscle to fatigue / seconds	
	Mean	Range
A	164	± 10
B	130	± 4
C	128	± 5



A statistical test was carried out on the results.

The test showed that the addition of epicatechin had a significant effect on the time taken for mouse skeletal muscle to fatigue. The test also showed that extra exercise had no significant effect.

Use the results table to supply evidence that the addition of epicatechin had a significant effect but extra exercise had no effect.

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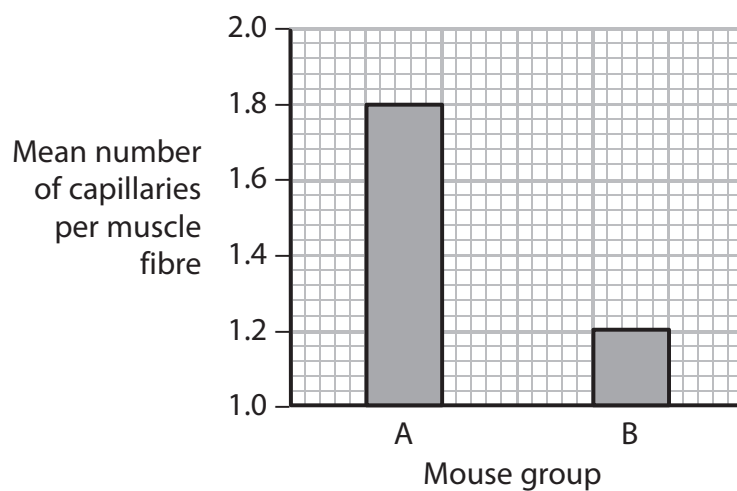
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(b) The mean number of capillaries per muscle fibre was found for the skeletal muscle from groups A and B.

The bar chart below shows the results.



(i) Use the information in the bar chart to describe the effect of epicatechin on the mean number of capillaries per muscle fibre.

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*(ii) Using your knowledge of respiration and the results table for groups A and B, suggest an explanation for the effect of the change in the numbers of capillaries on the time taken for the muscle to fatigue.

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(Total for Question 3 = 11 marks)



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4 Induced pluripotent stem cells (iPS cells) are a new type of stem cell.

(a) To produce iPS cells, four genes that code for different transcription factors are added to the genome of somatic (body) cells. The transcription factors produced cause the somatic cells to be converted into iPS cells.

(i) Suggest why it may be better to produce differentiated cells from iPS cells than from pluripotent stem cells.

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(ii) Explain how these transcription factors may cause the somatic cells to be converted into iPS cells.

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(b) In 2013, it was discovered that a mixture of seven chemicals could be added to somatic cells to cause them to develop into iPS cells rather than the need to add genes to their genome.

Suggest how a valid comparison of these two techniques could be carried out to discover which may be more effective for converting somatic cells into iPS cells.

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(Total for Question 4 = 9 marks)



5 Plants can respond to environmental cues using IAA (auxin) and photoreceptors.

- (a) A plant was kept in a cycle of 12 hours in the light and then 12 hours in the dark.
This plant did not flower.

It was then placed in an environment with 15 hours in the light and 9 hours in the dark. The plant then flowered.

Explain how this change in light conditions stimulated this plant to flower.

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- (b) IAA in the stem of the plant is involved in phototropism.

- (i) Give **three** similarities between IAA and animal hormones.

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(ii) Auxins can be used to kill unwanted plants such as weeds growing in grass. The auxin stimulate the weeds to grow rapidly.

Suggest an explanation for how auxins stimulate the weeds to grow rapidly but not the grass.

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(Total for Question 5 = 8 marks)



6 The nervous system is made up of many different neurones including those involved in reflex actions.

(a) The table below shows features of three types of neurone in a spinal reflex. Place a cross in the box if the feature is present in any of the named neurones.

(4)

Feature	Type of neurone		
	Sensory	Relay	Motor
Found only in the central nervous system	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Cell terminates at the effector	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Pre-synaptic membrane not found in the central nervous system	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Impulse stimulated by the receptor	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

(b) Rod cells and muscle cells in the eye both require ATP.

(i) Name the chemical reaction that occurs when ATP is broken down.

(1)

(ii) Describe the function of ATP in a rod cell soon after a person has moved from an area of bright light to an area of low light.

(2)



(iii) Describe the role of ATP in the contraction of a muscle fibre.

(5)

Area with horizontal dotted lines for writing the answer.

(Total for Question 6 = 12 marks)



7 The scientific article you have studied is adapted from the book called *The Immortal Life of Henrietta Lacks* by Rebecca Skloot, published by Pan Books in 2011.

(a) MPF triggering (paragraph 6) starts the process of mitosis. Suggest **three** events that occur at the beginning of mitosis in a plant cell that may be triggered by MPF.

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(b) The genome makes sure that cells 'do their jobs, whether that's controlling your heartbeat or helping your brain understand the words on this page' (paragraph 10).

Suggest how cells sensitive to pH are involved in controlling heart rate.

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(c) 'Like guinea pigs and mice, Henrietta's cells have become the standard laboratory workhorse' (paragraph 16).

Suggest **three** reasons why Henrietta's cells are used routinely in medical research.

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*(d) 'By the end of 1951, the world was in the midst of the biggest polio epidemic in history' (paragraph 19). This was caused by poliovirus which can lead to paralysis (paragraph 20).

The virus infects motor neurones which can stop skeletal muscles from working.

Explain how the structure of the cell surface membrane of a motor neurone is related to the conduction of a nerve impulse along its axon.

(6)

Dotted lines for writing an answer.



(e) Poliovirus, like Human Immunodeficiency Virus, is a retrovirus. Poliovirus was able to infect HeLa cells (paragraph 25).

Give **three** differences between the structure of the genetic material in poliovirus and the genetic material in HeLa cells.

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- (f) Scientists had studied genes by breeding animals 'then breeding their offspring to see how genetic traits are passed from one generation to the next' (paragraph 33).

When this was done using a brown mouse and a white mouse, it was found that in the F₂ generation (second generation of offspring), 75% of the mice were brown.

In the space below, draw genetic diagrams to describe and explain the genotypes of the parents and their offspring in the previous **two** generations.

(4)



(g) Monoclonal antibodies are produced by hybrid cells. These cells are made by fusing a lymphocyte with a cancer cell, such as HeLa (paragraph 37).

Suggest why cancer cells are used to form these hybrid cells.

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(h) Suggest what is meant by the term **genetic engineering** (paragraph 47).

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(i) Place a cross in the box that shows the number of cells present if one cell divided 50 times by mitosis (paragraph 58).

(1)

- A 2^5
- B 50^2
- C 5^{20}
- D 2^{50}



- (j) Scientists knew that 'there was a string of DNA at the end of each chromosome called a *telomere*' (paragraph 60) and they also knew that 'human cancer cells contain an enzyme called *telomerase*' (paragraph 61).

State **four** chemical elements found in both telomeres and telomerase.

(2)

(Total for Question 7 = 30 marks)

TOTAL FOR PAPER = 90 MARKS

