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Level 3 GCE

Biology A
(Salters-Nuffield)
Advanced
Paper 3: General and Practical Applications in Biology

Sample Assessment Material for first teaching September 2015 Time: 2 hours	Paper Reference 9BN0/03
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You may need a ruler, pencil and a calculator.	Total Marks
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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.
- Show your working in any calculation questions and include units in your answer where appropriate.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- You may use a scientific calculator.
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

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

Turn over ►

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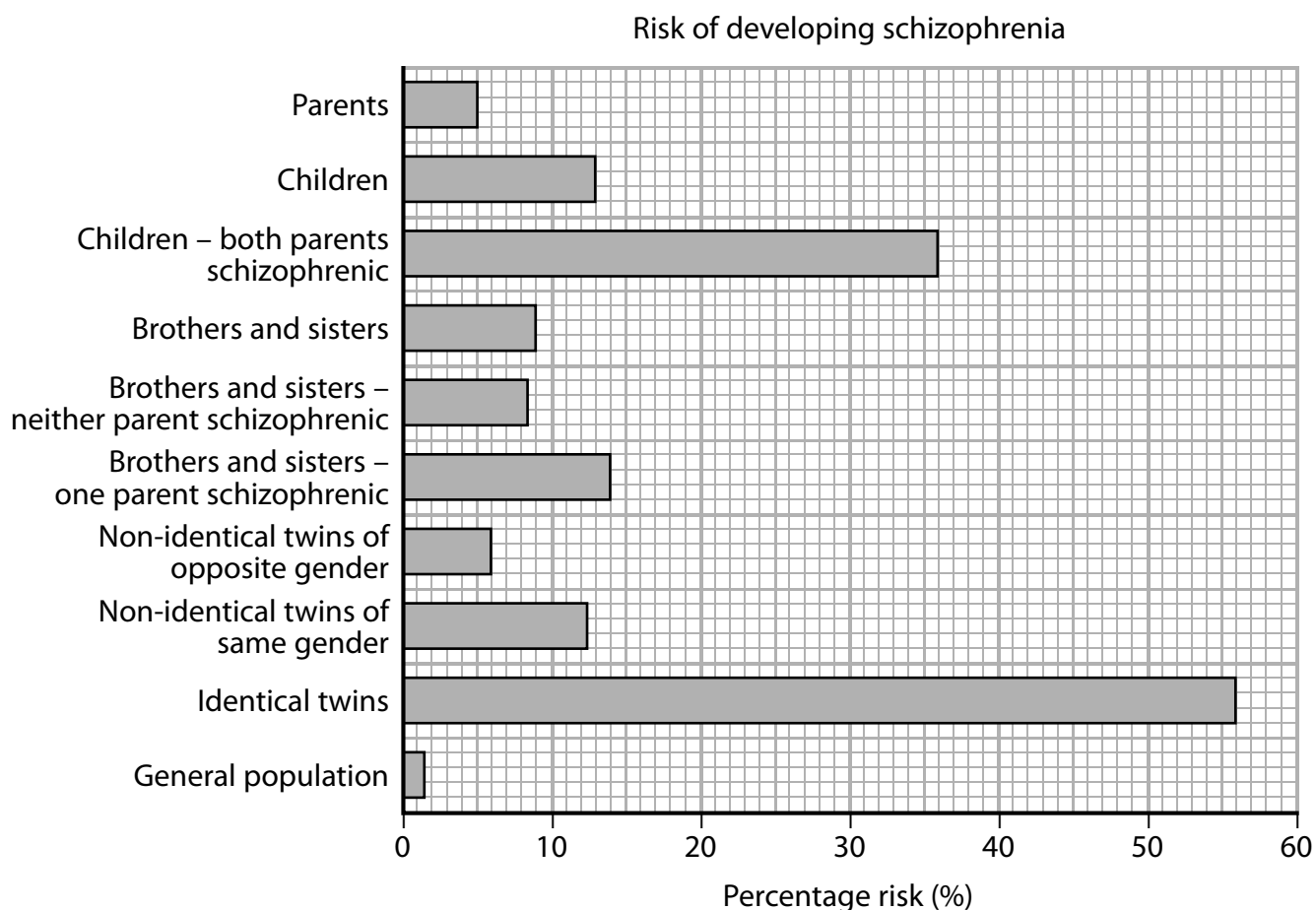
Answer ALL questions.

Write your answers in the spaces provided.

- 1** Schizophrenia is a disorder that affects brain structure and function and has a variety of symptoms.

The bar graph shows how the relationship to a family member suffering from schizophrenia affects the risk that the individual will also develop schizophrenia.

The percentage risk of schizophrenia in the general population is included for comparison.



© Courtesy of Dr. Debby Tsuang, University of Washington/VAPuget Sound Health Care System, Seattle, WA, USA.

- (a) Explain the difference between the percentage risks of developing schizophrenia in identical twins and non-identical twins of the same gender.

(2)

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(b) Some early studies of schizophrenia included identical twins raised in separate families.

(i) Explain how the design of these studies allows the influence of environmental factors on the development of schizophrenia to be investigated.

(2)

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(ii) The conclusions based on these early studies of identical twins raised in separate families are said to lack validity.

Give **two** reasons why these studies may lack validity.

(2)

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(c) Schizophrenia has been linked to abnormally high levels of a neurotransmitter in the brain.

Explain how the action of the drugs used to treat schizophrenia may lead some patients to experience symptoms similar to those of Parkinson's disease.

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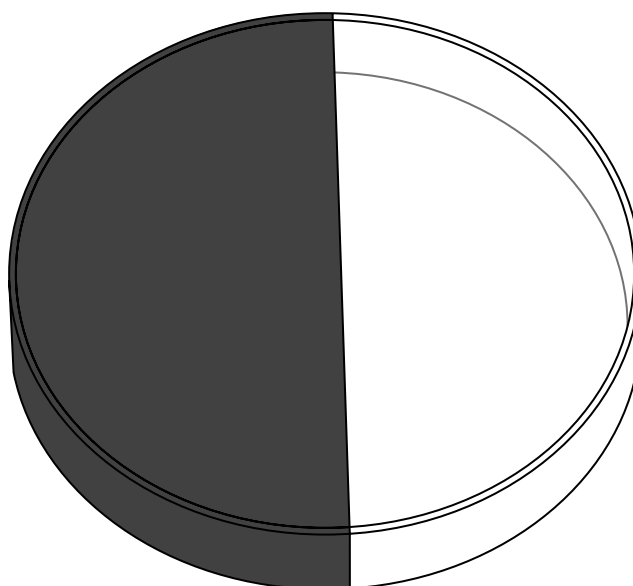
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(Total for Question 1 = 11 marks)

2 Blowfly larvae can be used by a forensic scientist to help determine the time of death of a body.

The diagram shows a Petri dish used by a student to investigate whether young and old blowfly larvae show a preference for light or dark conditions.



In the first trial, the left side was dark and the right side was light.

Five blowfly larvae were added to each side of the chamber.

After five minutes, the number of larvae on each side of the Petri dish was recorded.

In the second trial, the same experiment was repeated but this time the right side was dark and the left side was light.

The table shows the results of the trials.

Trial	Number of young blowfly larvae		Number of old blowfly larvae	
	Left side dark	Right side light	Left side dark	Right side light
1	9	1	2	8
2	2	8	9	1

(a) Give a null hypothesis for this investigation.

(1)

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(b) The Chi squared test can be used to determine whether the results of this investigation indicate a significant difference in the distribution of young larvae between the light and the dark side.

(i) Use the formula to calculate the Chi-squared value for young larvae.

(3)

$$\chi^2 = \sum \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}$$

Answer

(ii) The table below gives some critical values for Chi-squared.

p value			
0.15	0.1	0.05	0.025
2.07	2.71	3.84	5.02

Use your calculated value to determine whether the difference between the observed and expected results is significant.

(1)

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(c) Forensic scientists measure the length of larvae found in the tissues of a dead person to help them determine time of death. Older larvae are longer than younger larvae.

The growth of insect larvae can be affected by a number of factors including toxins.

Explain a procedure that you could use to find out if the presence of a toxin in a sample of dead tissue could affect the accuracy of estimating time of death.

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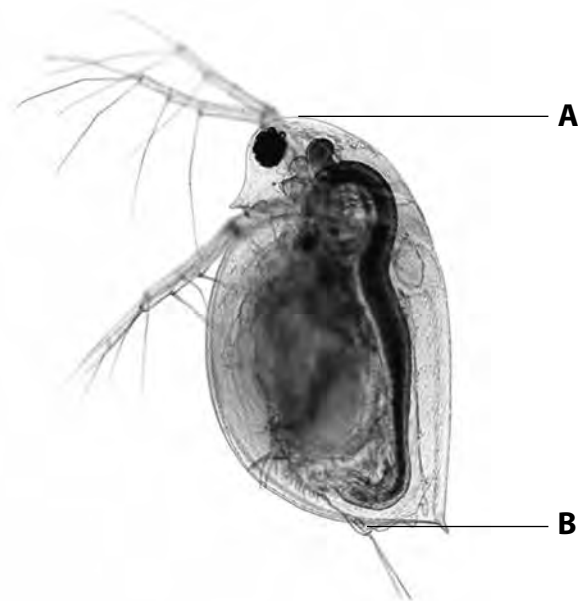
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(Total for Question 2 = 10 marks)

3 A student investigated the effect of temperature on the heart rate of *Daphnia*.



Magnification $\times 60$

(Source: <http://www.nature-education.org/water-life.html>)

(a) Use the lines A to B to calculate the actual length of this *Daphnia*.

(2)

Answer

(b) The student used five *Daphnia* in the investigation.

The *Daphnia*'s heartbeats were counted over a 20-second period.

A stopwatch was used and a pencil mark made on a piece of paper while observing the *Daphnia* through a low powered microscope.

The number of heartbeats was counted three times for each *Daphnia*.

This was repeated at five different temperatures using the same *Daphnia* each time.

This was then repeated using the four other *Daphnia*.

The results obtained are shown in the table below.

<i>Daphnia</i>	Heart rate / beats in 20 seconds														
	5°C			10°C			15°C			20°C			25°C		
1	20	18	19	30	26	29	36	35	36	42	45	44	53	47	53
2	22	23	19	36	32	29	36	39	34	42	46	42	50	51	63
3	16	18	20	26	30	27	35	33	36	39	41	40	58	52	50
4	19	22	21	30	32	35	38	36	37	45	46	42	62	62	58
5	20	25	21	35	32	34	36	39	38	44	48	42	52	55	59

(i) Explain why the number of heartbeats was measured in 20 seconds rather than in one minute.

(2)

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(ii) The mean heart rate at 5°C is 20.2 beats in 20 seconds. Calculate how many times faster the mean heart rate is at 25°C than at 5°C.

(2)

Answer

(iii) The student concluded that temperature increased the heart rate of *Daphnia*.

Analyse the data to explain how this investigation could be modified to improve the validity of this conclusion.

(3)

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(c) Discuss the ethical issues that might arise from the use of invertebrates in investigations.

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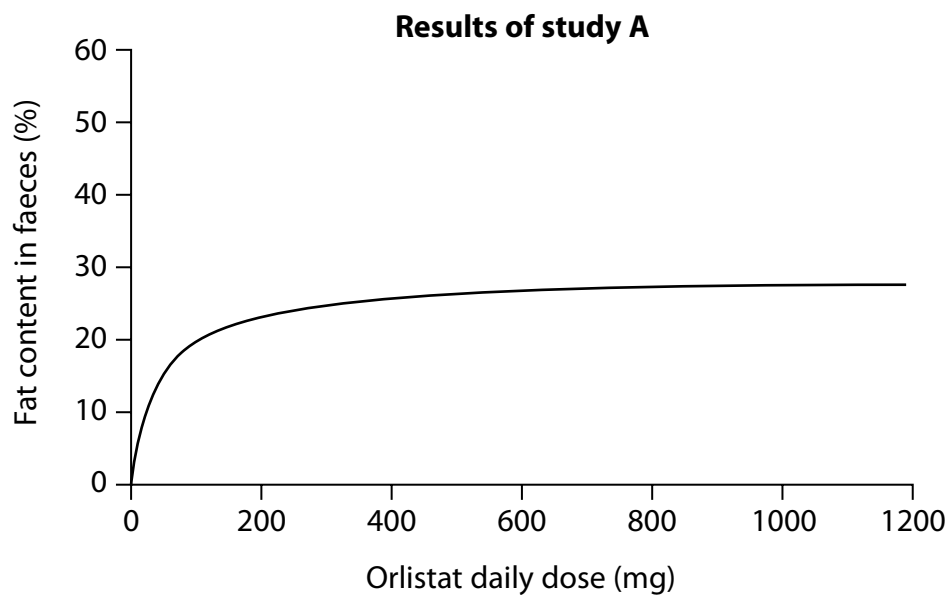
(Total for Question 3 = 13 marks)

4 Obesity is a risk to health.

There is a drug called Orlistat that can help obese people to lose weight. This drug works by permanently attaching to the enzyme lipase.

Two studies, A and B, were carried out to investigate the effectiveness of the drug.

In study A, 20 people were given different concentrations of the drug and the fat content of their faeces was measured. The graph below shows the results.



(a) Analyse the data in the graph to explain how the drug helps obese people to lose weight.

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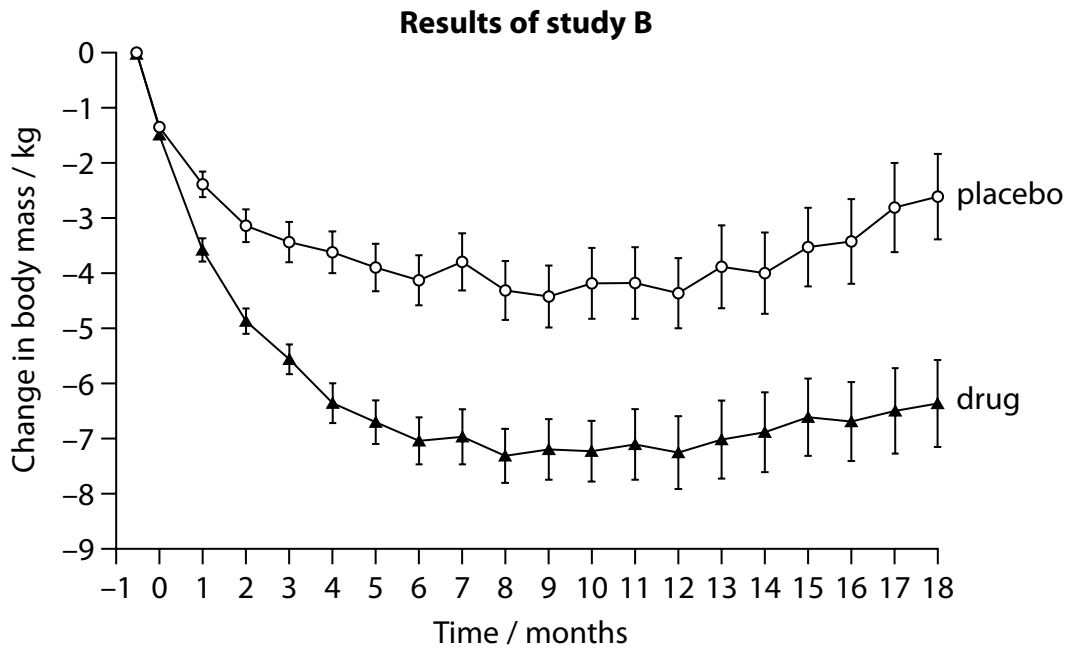
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(b) Study B was a placebo-controlled study. The change in body mass of 300 patients was measured over a period of 18 months. The graph below shows the results.



Explain how the data in study B show that the design of study B is better than the design of study A.

(4)

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(c) (i) A high body mass index (BMI) is an indicator of obesity. Use the formula for BMI to calculate the height of a person with a mass of 80 kg and a BMI of 31.25.

(3)

$$\text{BMI} = \frac{\text{mass in kg}}{(\text{height in m})^2}$$

Answer

(ii) The table shows the percentage decrease in the BMI of 350 people who took the placebo and a group of 350 people who took the drug daily for a period of 12 months.

Treatment	Percentage decrease in BMI (%)	Percentage decrease in body mass (%)
Drug	26.5	19.0
Placebo	15.7	11.7

Give **one** reason why the percentage of people with a decrease in BMI is higher than the percentage of people with a decrease in body mass.

(1)

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(iii) Explain the health risks of having a very high BMI.

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(Total for Question 4 = 18 marks)

- 5 There have been several studies into the relationship between cigarette smoking and deaths from lung cancer. The data in the table comes from a review of these studies.

Country	Size of study	Number of deaths from lung cancer	Ratio of smokers to non-smokers dying from lung cancer
UK	34 000 males	441	14.00
	6 194 females	27	5.00
Sweden	27 000 males	55	7.00
	28 000 females	8	4.50
Japan	122 000 males	940	3.76
	143 000 females	304	2.03
Canada	78 000 males	331	14.20
USA	358 000 males	2018	8.53
	483 000 females	439	3.58
USA	290 000 males	3126	11.28
USA	188 000 males	448	10.73
USA	68 000 males	368	7.61

- (a) Give **two** reasons why the ratios of smokers to non-smokers who die from lung cancer are different for males compared with females.

(2)

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(b) These studies suggest that there is a correlation between smoking and lung cancer.

State what is meant by correlation.

(1)

(c) Smoking tobacco can result in the development of a variety of other health problems including atherosclerosis.

Explain how smoking increases the risk of developing atherosclerosis.

(3)

- 6 The scientific article you have studied is adapted from 'How Performance-Enhancing Drugs Work.'

Use the information from the article and your own knowledge to answer the following questions.

- (a) (i) The population of the UK is 63 182 000 of which 49 182 000 are adults (paragraph 13).

Calculate the number of adults who have asthma.

(2)

Answer

- (ii) People with asthma sometimes have difficulty breathing (paragraph 13).

Explain how beta-2 agonists may help to relieve their symptoms.

(2)

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(iii) Explain how beta-2 agonists can increase the heart rate (paragraph 13).

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(b) Explain how human growth hormone (HGH) is able to stimulate cells to secrete IGF-1 (paragraphs 20 and 21).

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(c) Explain why it is difficult to identify athletes who are using banned substances such as HGH (paragraphs 17, 20 and 22).

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(d) Explain one benefit of using substances developed from perfluorocarbons (PFCs) to treat patients with breathing difficulties (paragraphs 30 and 31).

(2)

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(e) Local anaesthetics mask pain by binding to protein channels in the membranes of neurones (paragraph 38).

Explain how binding to protein channels will prevent pain being sensed by the pain centre of the brain.

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(f) Explain why diuretics are a prescribed drug for high blood pressure (paragraph 43).

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(g) A test for the T/E ratio can help to identify athletes who have injected testosterone into their body (paragraph 45).

Explain the limitation of this test.

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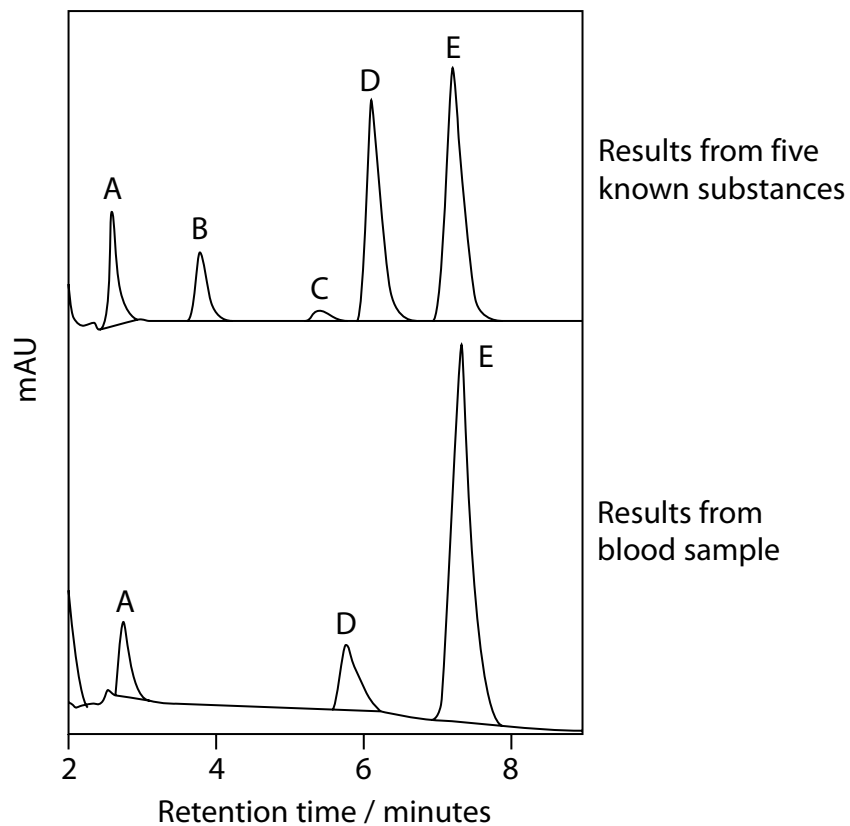
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(h) Gas chromatography (GC) can be used to detect athletes who have taken banned drugs (paragraph 48).

The chromatogram shows the GC results for five known banned substances, A, B, C, D and E.



Explain why the peak for drug E is different from the peak for drug A (paragraph 48).

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(i) Explain how the blood passport may result in more effective monitoring of athletes (paragraph 51).

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(j) Comment on the ethical viewpoints for and against the use of performance-enhancing drugs by athletes.

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(Total for Question 6 = 33 marks)

TOTAL FOR PAPER = 100 MARKS

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