HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

INTEGRATED SCIENCE PAPER 1

(Sample Paper)

Question-Answer Book

Time allowed : 2 hours
This paper must be answered in English.

INSTRUCTIONS

(1) This paper consists of questions set on the Compulsory Part of the curriculum. The weighting of this paper is 45% of the Subject Mark.

(2) Answer **ALL** questions. Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.

(3) Write your Candidate Number in the spaces indicated on the cover of this Question-Answer Book.

(4) Stick barcode labels in the spaces provided on Pages 1, 3, 5, 7 and 9.

(5) Supplementary answer sheets will be provided on request. Write your candidate number, fill in the question number and stick a barcode label on each sheet. Tie them loosely but securely with a string INSIDE this Question-Answer Book.

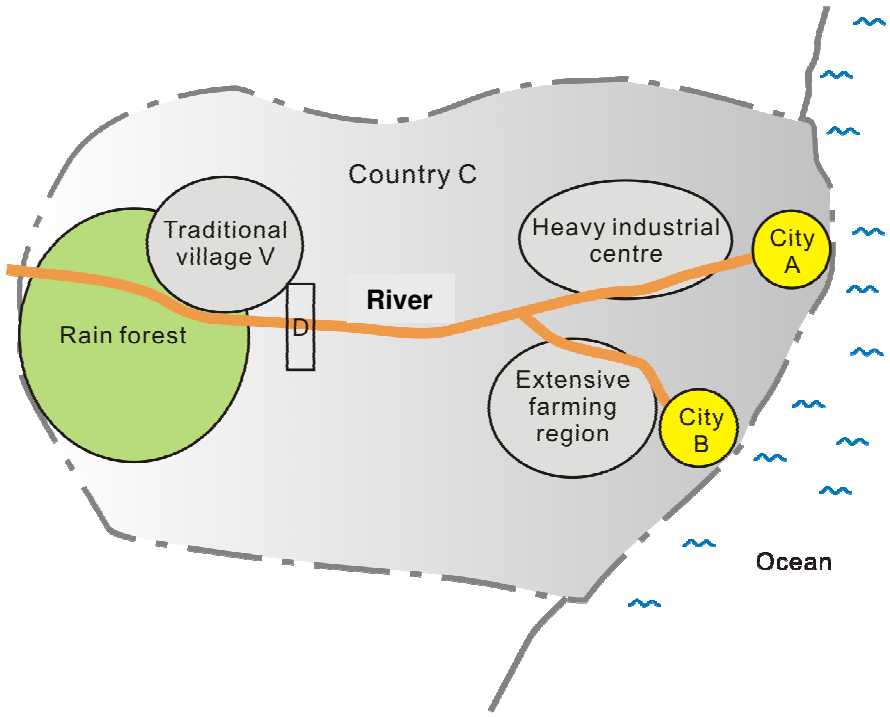
Please stick the barcode label here.

Candidate Number							

	Marker's Use Only		**Examiner's Use Only**	
	Marker No.		Examiner No.	
Question No.	Marks		Marks	
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Total				

Answer **ALL** questions. Write your answers in the spaces provided.

1. A simplified map of Country C is shown below. The river provides the major source of fresh water to this country.



(a) The Water Authority of the country noticed that the quality of fresh water supplied to City A and City B had worsened.

Which city would have high levels of cadmium and zinc, and which city would have a high level of the bacteria, *E. coli*, in the fresh water supplied to them ? Explain your answer in each case.

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(4 marks)

Answers written in the margins will not be marked.

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1. (b) The government of this country is debating whether hydroelectric power (HEP) should be developed as an alternative energy source. A proposal has been made to build a dam at site D for the provision of HEP.

(i) Give TWO advantages of using HEP over the combustion of fossil fuel in generating electricity.

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(ii) Referring to the map, discuss ONE ecological concern and ONE social concern regarding the proposal to build the dam at site D.

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(6 marks)

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2. It was a hot summer afternoon. The temperature was 35°C and the relative humidity was 75%. Peter just finished all his lessons. He passed by the basketball court and could not resist playing a game with his schoolmates before going home though the hot sun was shining on them. He finished the game at around 5:00 pm. Sweating heavily, he made his 10 minute-walk back home. When he arrived home, he put two cans of soft drinks into the –20°C freezer, turned on his bedroom air-conditioner, and headed for a cold shower. After the shower, he finished a whole can of the chilled soft drink and rested in the air-conditioned room.

(a) Explain why sweating can regulate Peter's body temperature.

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(2 marks)

(b) Identify TWO measures that Peter employed to cool his body down. In each case, briefly explain whether the measure is effective.

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(4 marks)

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2. (c) Peter's mother returned home and found her son unwell. Peter told her that he might have got heatstroke when playing basketball under the hot sun. Explain whether Peter's statement is correct or not.

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(2 marks)

(d) When Peter woke up the next morning, he went to the fridge and fetched the other can of soft drink in the freezer. 'Oh No!', said Peter. What do you think had happened to the can of soft drink ? Explain.

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(2 marks)

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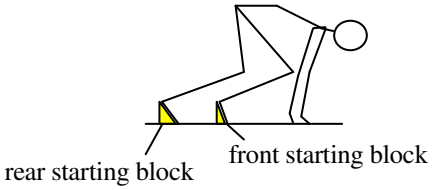
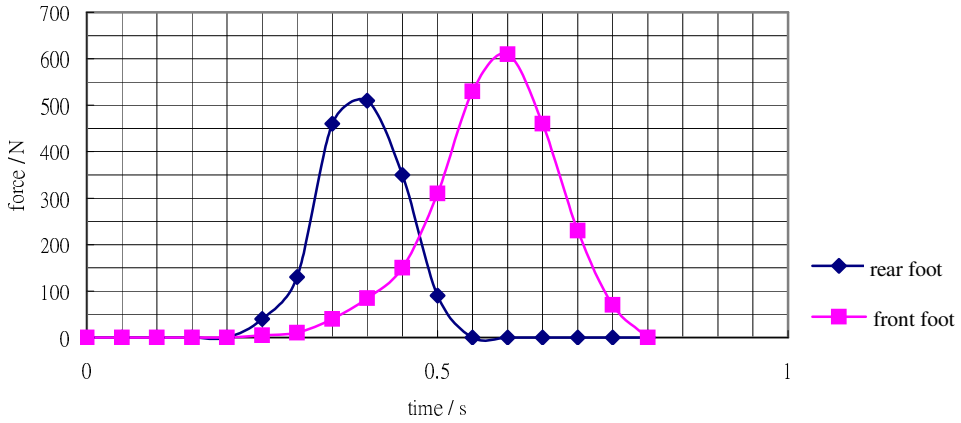
3. The diagram below shows a 100 m sprinter in a crouch start position with front and rear feet resting on the starting blocks.



The graph below shows the horizontal components of the forces acting on the front starting block and rear starting block after the starting signal.



(a) It is common nowadays to state Newton's Second Law of Motion in the form of $F = ma$, where F is the force acting on an object of mass m, and a is the acceleration. Newton stated, in his original work *Principia*, the Second Law in terms of change in momentum. Express the Second Law in this form.

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(1 mark)

(b) The impulse exerted by the sprinter's foot on the starting block is the change in momentum caused by the total force acting on the block during the time of contact.

Find, from the graph, the horizontal impulse exerted by the sprinter's foot on the front starting block. (You are required to show how you arrive at your answer.)

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(3 marks)

Answers written in the margins will not be marked.

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3. (c) Suppose that the mass of the sprinter is 60 kg and the horizontal impulse exerted by the sprinter's foot on the rear starting block is 77.5 Ns. Using your result in (b), calculate the horizontal velocity when the sprinter has just cleared off the starting blocks.

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(2 marks)

(d) Make TWO suggestions to the sprinter which can help improve his performance.

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(2 marks)

(e) Suggest the sources of energy for powering the muscle at different times of the 100 m race.

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(2 marks)

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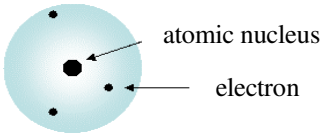
4. (a) In the early twentieth century, people believed that atoms were like a 'plum pudding' in which very tiny electrons were embedded in a diffused volume of positive charges. In 1910, Ernest Rutherford and his team carried out an experiment by firing a thin beam of α-particles at high speed onto a gold foil. They expected most of the α-particles to pass through the foil with little deflection. Out of their expectation, some of the α-particles were found to have deflected by angles greater than 90^{o} or even reflected.

(i) Sketch a labelled diagram to show the 'plum pudding' model of a lithium atom.

(ii) Based on the experimental results, Rutherford proposed another model of atom. The diagram below shows Rutherford's model of an atom:



Suggest why the above 'unexpected' experimental results can be explained using Rutherford's model.

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(6 marks)

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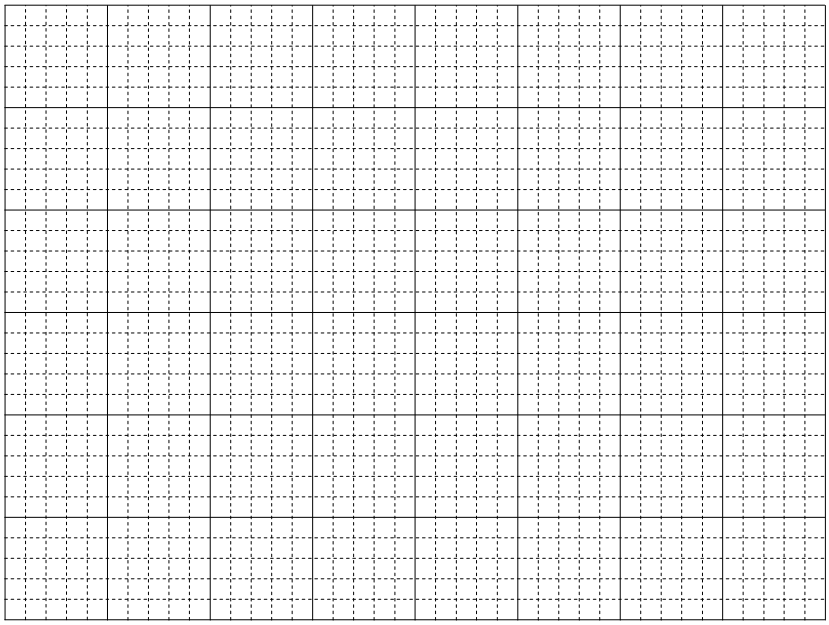
4. (b) Plotting the logarithm of the successive ionisation energies of an element against the order of removal of electrons can provide information about the electronic arrangement of atoms of the element. The table below lists the logarithmic values of the first eight ionisation energies of element **X** with atomic number less than 20.

Order of removal of electrons	1	2	3	4	5	6	7	8
$\log_{10}$ (ionisation energy)	2.87	3.18	3.89	4.02	4.13	4.26	4.34	4.41

(i) Plot, on the graph below, the logarithm of these eight ionisation energies of **X** against the order of removal of the electrons.



(ii) Deduce what element(s) may **X** be. Explain your answer.

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(6 marks)

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5. (a) State Ohm's law.

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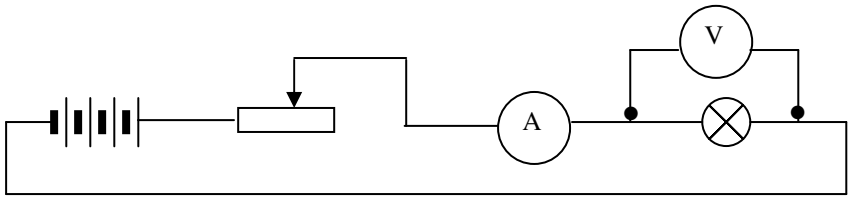
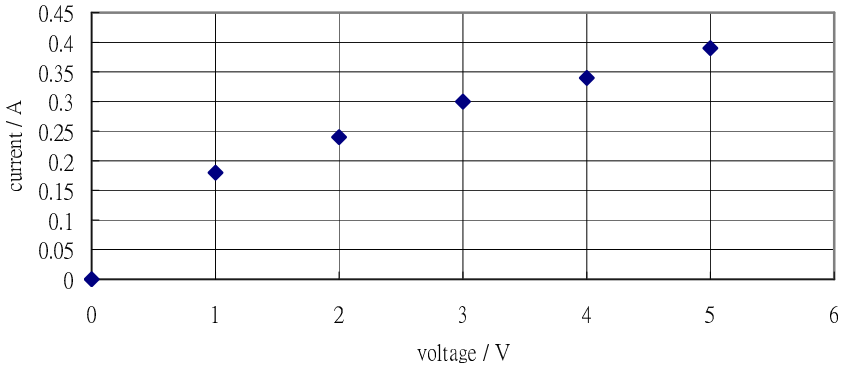
(1 mark)

(b) A student set up the circuit as shown below to investigate the voltage-current relationship across a light bulb.



The results of the investigation are tabulated, and these data are plotted in the graph below.

Voltage / V	0.0	1.0	2.0	3.0	4.0	5.0
Current / A	0.0	0.18	0.24	0.30	0.34	0.39



(i) State whether the above results are in agreement with Ohm's law. Justify your answer.

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5. (b) (ii) What advice would you give the student in taking measurements so that he would not miss out important information of the current-voltage characteristics of the light bulb ? Explain your answer.

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(iii) Find the resistance of the light bulb at 2 V and at 5 V. Propose an explanation for any difference in the results obtained.

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(7 marks)

(c) In a model to account for metal conductivity, a metal is considered to be consisting of positive ions arranged in fixed arrays and the electrons move freely inside the metal.

(i) Draw a diagram to illustrate this model.

(ii) On the basis of this model, account for the resistance of metals to current flow.

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(3 marks)

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6. Read the passage below and answer the questions that follow:

Ciguatoxin

Ciguatoxin is a fat-soluble toxic chemical produced by some algae found in the tropical and subtropical coral reef. When fish feed on the algae, they will get the toxin. The toxin is difficult to be broken down or excreted by the fish. If a human consumes the contaminated fish, ciguatera fish poisoning may result. The risk is greater if the contaminated fish consumed is of mass greater than 2 kg. The toxin can affect our nervous, digestive and/or cardiovascular systems.

(a) Explain why eating bigger fish is more likely to cause ciguatoxin poisoning than eating smaller fish.

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(3 marks)

(b) Suppose that the water where the ciguatoxin-producing algae live is moderately polluted with organic matters. Describe and explain the effect of such pollution on ciguatera fish poisoning.

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(3 marks)

Answers written in the margins will not be marked.

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For question 7, candidates are required to present their answers in essay form. 6 marks will be allocated to science knowledge, and 2 marks to logical presentation and clarity of expression.

7. With reference to the nature of ultraviolet radiation, discuss the health hazards associated with over exposure to the radiation and how its applications have improved our living.

(8 marks)

Answers written in the margins will not be marked.

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8. Trace amounts of $^{238}_{92}\text{U}$ are present in rocks. $^{238}_{92}\text{U}$ undergoes a series of α and β decays to give $^{222}_{86}\text{Rn}$. $^{222}_{86}\text{Rn}$ is a radioisotope of radon, which is a noble gas.

(a) Find the number of α particles and that of β particles emitted from $^{238}_{92}\text{U}$ to give $^{222}_{86}\text{Rn}$.

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(2 marks)

(b) Account for the difference in the penetrating power of α particles and β particles.

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(3 marks)

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8. (c) $^{222}_{86}Rn$ is an indoor pollutant and is considered as an 'invisible killer'. It undergoes α decay with a half-life of 3.8 days to give $^{218}_{84}Po$.

(i) Suggest TWO reasons why $^{222}_{86}Rn$ is so dangerous.

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(ii) Suggest ONE way to prevent the accumulation of indoor $^{222}_{86}Rn$.

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(3 marks)

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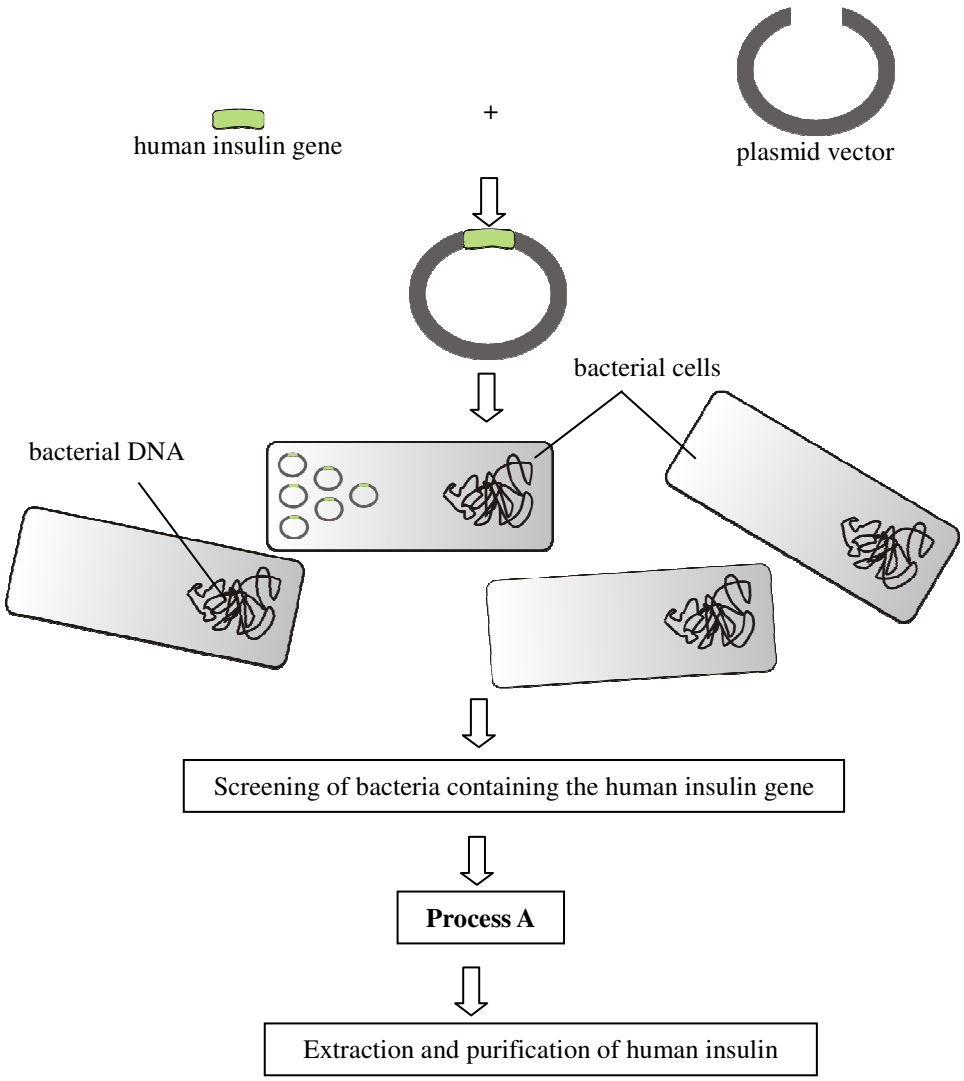
9. The flow-diagram below outlines the procedure of the production of human insulin using recombinant DNA technology:



(a) What is the role of the plasmid vector ?

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(1 mark)

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9. (b) What is **Process A** in the flow-diagram ?

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(1 mark)

(c) Insulin extracted from pig pancreas was once widely used in treating diabetes.

Give TWO advantages of using human insulin prepared from recombinant DNA technology outlined above over using insulin extracted from pigs.

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(2 marks)

(d) Some athletes inject insulin as an anabolic drug to enhance sport performance. If these athletes do not suffer from diabetes, explain the health risk that they will have in taking insulin.

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(3 marks)

Answers written in the margins will not be marked.

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10. A part of a DNA sequence coding for a protein and a codon usage table are shown below:

Start codon

(I) (II)

5′- GCC **ATG** GCC CTG TGG ATG -3′ (coding strand)

3′- CGG TAC CGG GAC ACC TAC -5′ (template strand)

Codon Usage Table

1st base	2nd base U		2nd base C		2nd base A		2nd base G		3rd base
U	UUU	**Phe**	UCU	**Ser**	UAU	**Tyr**	UGU	**Cys**	**U**
	UUC		UCC		UAC		UGC		**C**
	UUA	**Leu**	UCA		UAA	**Stop**	UGA	**Stop**	**A**
	UUG		UCG		UAG	**Stop**	UGG	**Trp**	**G**
C	CUU	**Leu**	CCU	**Pro**	CAU	**His**	CGU	**Arg**	**U**
	CUC		CCC		CAC		CGC		**C**
	CUA		CCA		CAA	**Glu**	CGA		**A**
	CUG		CCG		CAG		CGG		**G**
A	AUU	**Iso**	ACU	**Thr**	AAU	**Asp**	AGU	**Ser**	**U**
	AUC		ACC		AAC		AGC		**C**
	AUA		ACA		AAA	**Lys**	AGA	**Arg**	**A**
	AUG	**Met, Start**	ACG		AAG		AGG		**G**
G	GUU	**Val**	GCU	**Ala**	GAU	**Asp**	GGU	**Gly**	**U**
	GUC		GCC		GAC		GGC		**C**
	GUA		GCA		GAA	**Glu**	GGA		**A**
	GUG		GCG		GAG		GGG		**G**

(U, C, A and G stand for the 4 different bases in the nucleotide. The various amino acids are represented by their short forms.)

(a) Given that the direction of transcription is from 5' to 3', write the mRNA sequence after transcription.

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(2 marks)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

10. (b) With reference to the codon usage table, provide the amino acid sequence after translation.

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(2 marks)

(c) For each of the following cases, suggest how the amino acid sequence in (b) will change, if any, and explain whether it will affect the resulting protein to be translated.

(i) The 'CG' pair in position (I) is changed to 'AT' pair.

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(ii) The 'GC' pair in position (II) is changed to 'AT' pair.

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(4 marks)

END OF PAPER

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.