



**HKDSE Biology &  
Combined Science (Biology)  
Briefing Session on Practice Papers  
(22 / 25 Feb 2012)**

**Ms Grace YAU  
HKEAA**

# Programme Rundown



<b>2:00 – 2:10/ 9:30 – 9:40</b>	<b>Registration</b>
<b>2:10 – 2:30 / 9:40 – 10:00</b>	<b>Question paper requirements of the HKDSE Biology Examination</b>
<b>2:30 – 2:45 / 10:00 – 10:15</b>	<b>Students' performance on multiple-choice questions (Paper 1A)</b>
<b>2:45 – 3:30 / 10:15 – 11:00</b>	<b>Marking scheme interpretation (Paper 2) and students' performance</b>
<b>3:30 – 3:45 / 11:00 – 11:15</b>	<b>Break</b>
<b>3:45 – 4:30 / 11:15 – 12:00</b>	<b>Marking scheme interpretation (Paper 1B) and students' performance</b>
<b>4:30 – 5:00 / 12:00 – 12:30</b>	<b>Q&amp;A</b>

# Acknowledgements



- ❑ **Members of the Moderation Committee for the Practice Papers**
- ❑ **Schools participated in the piloting ( 7 schools and more than 300 students involved)**
- ❑ **CDI-HKEAA Committee on NSS Biology Education**
- ❑ **All those who has contributed to the successful implementation of HKDSE Biology and Combined Science (Biology)**

# Structure of DSE Biology Examination



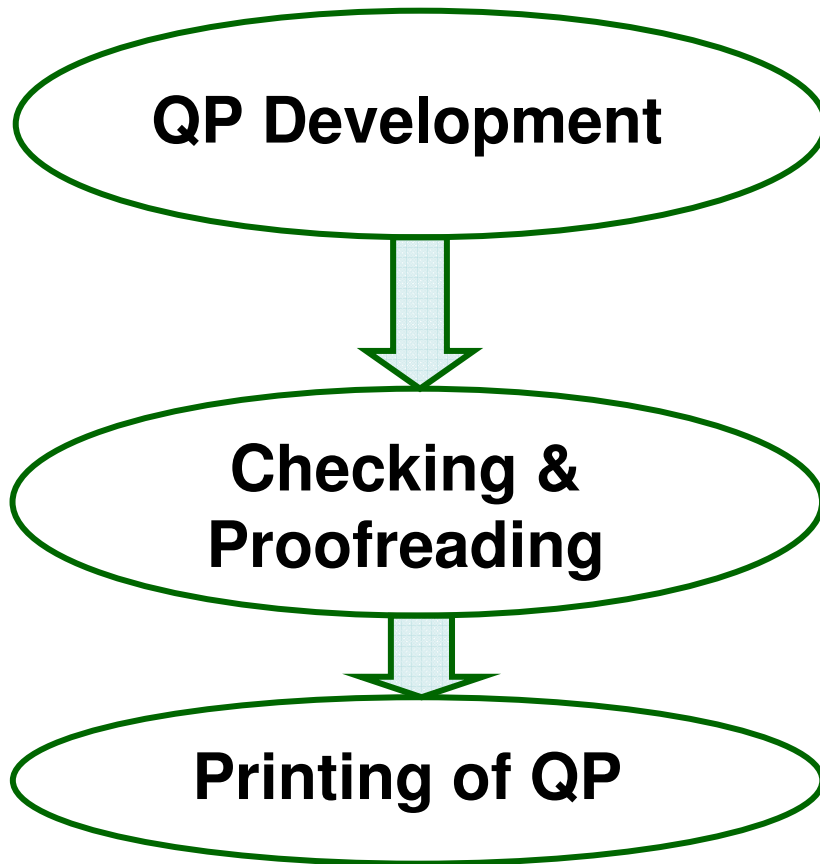
Paper	Section	Weighting	Other information
1	A	60%	36 MCQs
1	B		84 marks
2		20%	One question on each of the Elective
SBA		20%	

# Structure of DSE Combined Science (Biology) Examination



Paper	Weighting	Others
Written exam	40%	Section A: 24 MCQs Section B: 56 marks
SBA	10%	

# Development of Examination Papers (Pre-exam Work)



## **Moderation Committee**

- Chief Examiner(s)
- Moderators
- Setter(s)
- MC Contributor(s)

- Assessors
- Proofreaders

GLD Printing Unit

# Marking and Grading (Post-exam Work)



## Marking of scripts

- Examiners' Meeting
- Markers' Meeting
- Checkmarking of scripts

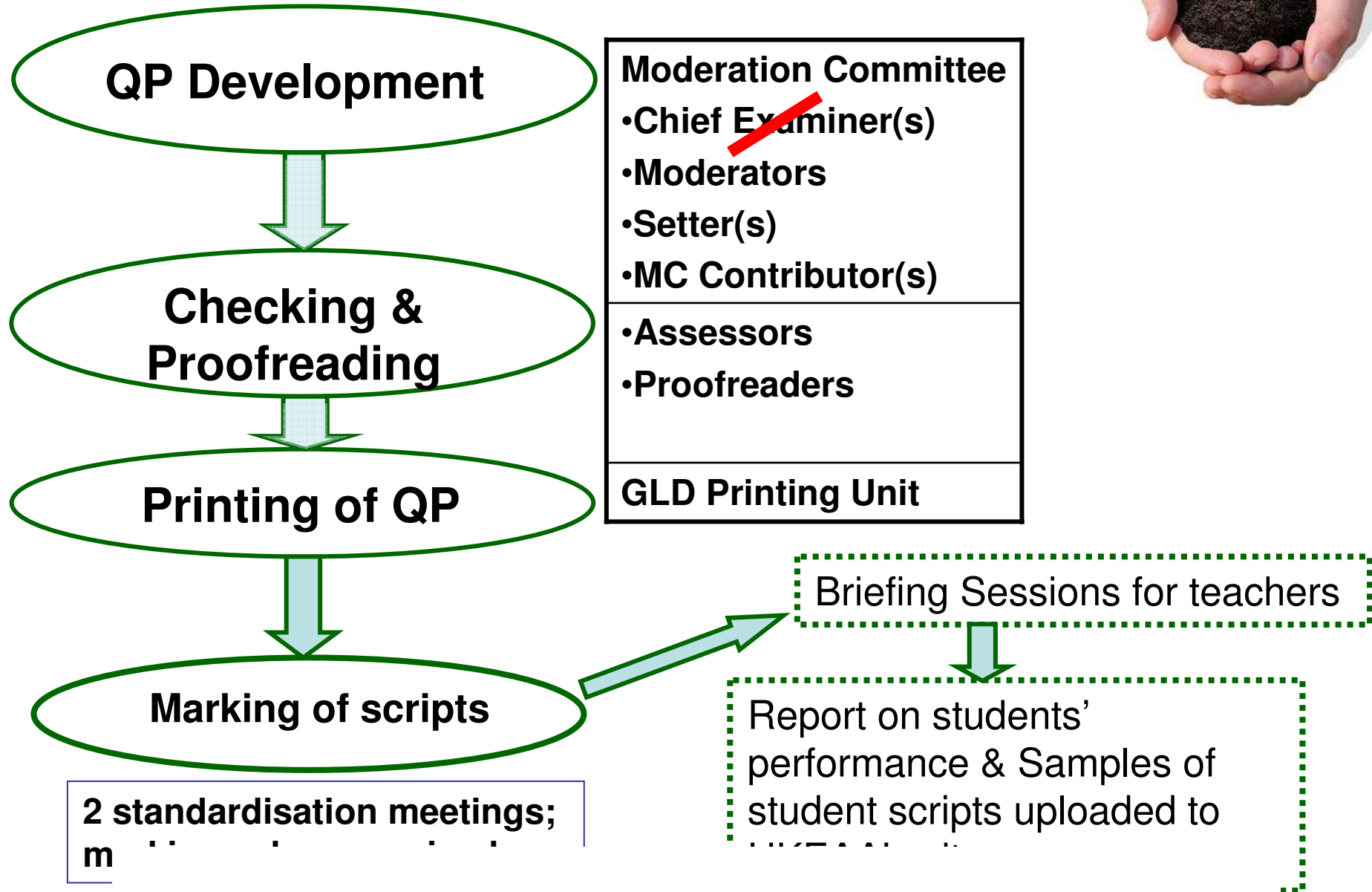
## Grading & Standards-referenced Reporting

## Appeal of examination results

- Rechecking and Remarking



# Development of Practice Papers







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Category A - HKDSE Elective Subjects:

Practice Papers

Marking Schemes (Provisional)

Report on Student Performance in the Practice Papers

Samples of Student Performance in the Practice Papers

Powerpoint Presentation of the Briefing Sessions

Available  
in March



## What can practice papers illustrate?

- ❑ Curriculum emphases
- ❑ Question types
- ❑ Level of difficulty
- ❑ Skills to be tested
- ❑ Relationship between Biology and Combined Science (Biology part)

# Relationship between Biology & Combined Science (Biology part)



- Section A  
24 MCQs = 21 common with Biology  
+ 3 (no. 3, 17 & 24)
- Section B  
56 marks = 39 common with Biology  
+ 17 (no. 4 & 7)
- 75% common with Biology Paper 1

# Relationship between Biology & Combined Science (Biology part)



- ❑ Similar topics /skills are assessed even the questions in CS(Bio) are different from those in Biology
- ❑ Example: the ability to design an experiment

## Biology 1B Q. 10(c)

- (c) When wheat grains are sown on a piece of farmland which has been frequently sprayed with a pesticide X, the germination rate is poor. Design an experiment to investigate whether pesticide X affects germination of the wheat grains. (4 marks)

- (iii) The following photographs show two potted plants, Q and R:

Plant Q



Plant R



**CS (Bio)  
BQ.7(b)(iii)**

Using hydrogencarbonate indicator solution, design an experiment to compare the compensation points of these two potted plants. Illustrate the set-up used with a labelled (marks)



## Example: effects of lifestyles (smoking)

### Biology 1B Q.7 (b)

- (b) The doctor advised Mr. Chan to quit smoking and to adopt a low-fat diet. With reference to Mr. Chan's health condition, give a reason for each piece of advice. (2 marks)
- (i) Quitting smoking

### CS (Bio) Q.4

4. Studies have shown that smoking is hazardous to health.
- (a) It is known that smoking causes low oxygenation of blood. With reference to a substance in the cigarette smoke, explain how it reduces oxygenation of the blood. (2 marks)



# **Biology Practice Papers**

## **Piloting Exercise**



# Practice papers piloting exercise

- ❑ 7 schools (300+ students) participated
- ❑ Exam / test using Biology practice papers on 16th Jan 2012
- ❑ Meetings conducted for
  - ❑ selecting student scripts for standardisation marking
  - ❑ revising the Marking Schemes
- ❑ Provide comments on students' performance





# Students' performance on multiple-choice questions (Paper 1A)

# Paper 1 Section A: Multiple-choice Questions



## Question type

- ❑ Single answer type
- ❑ Multiple-completion type

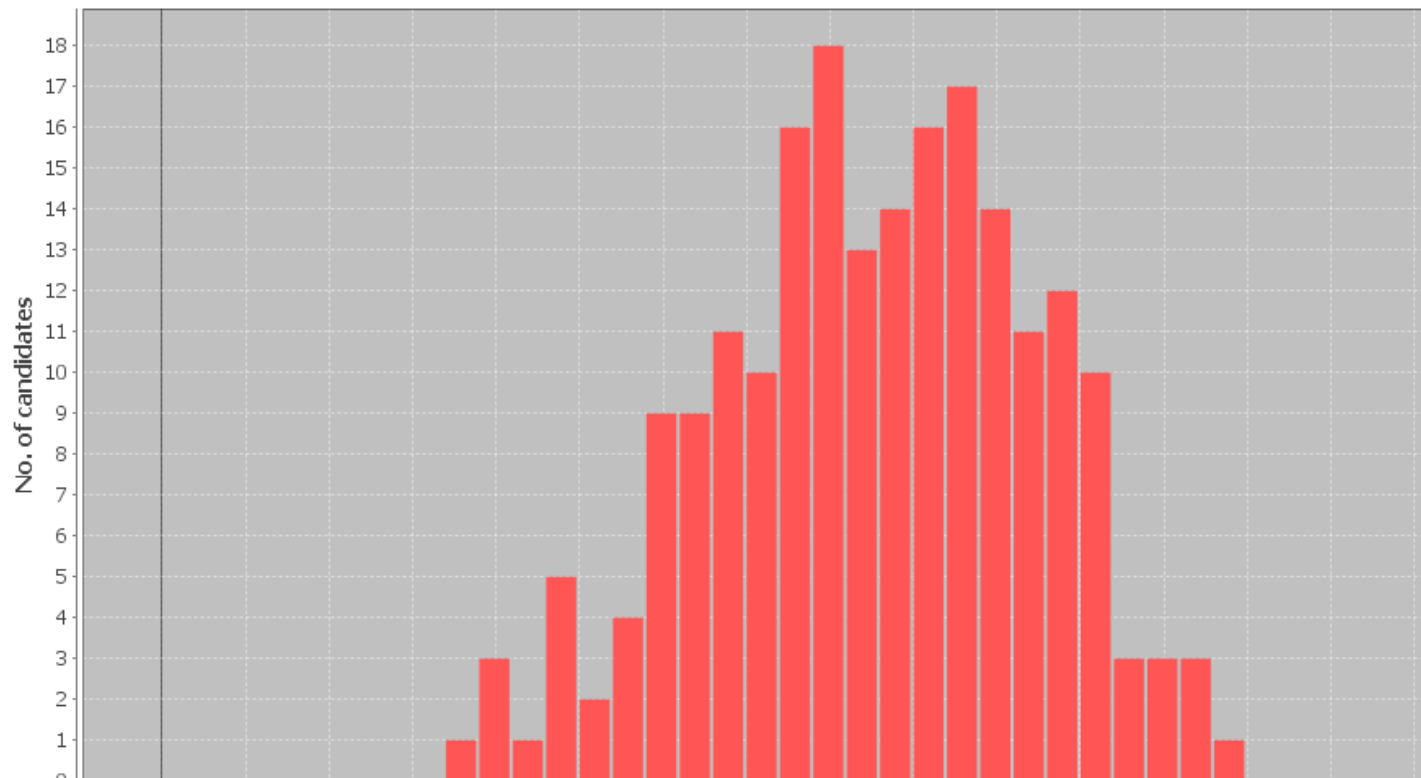
## Test students'

- ❑ understanding of biological knowledge & concepts
- ❑ ability of interpreting data / graph / diagram / photographs
- ❑ ability of applying knowledge in a daily life / an unfamiliar context

# Students' Performance in Piloting (Paper 1 Section A)



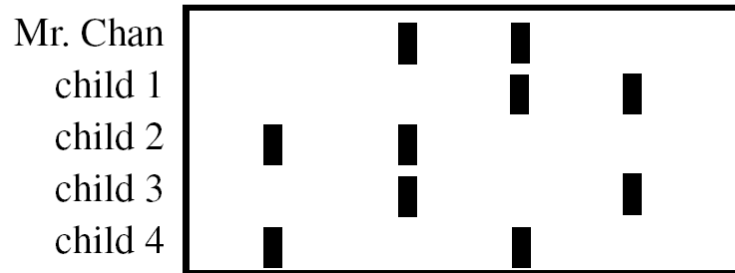
- Number of schools = 7
- No. of participating students = 206
- Mean = 21.4 (59.3%); S.D. = 4.8 (13.32%)





# Question best attempted: Q.14 (percentage correct = 94%)

Mr. Chan and Mrs. Chan are the biological parents of four children. The DNA profiles of Mr. Chan and the four children are shown below:



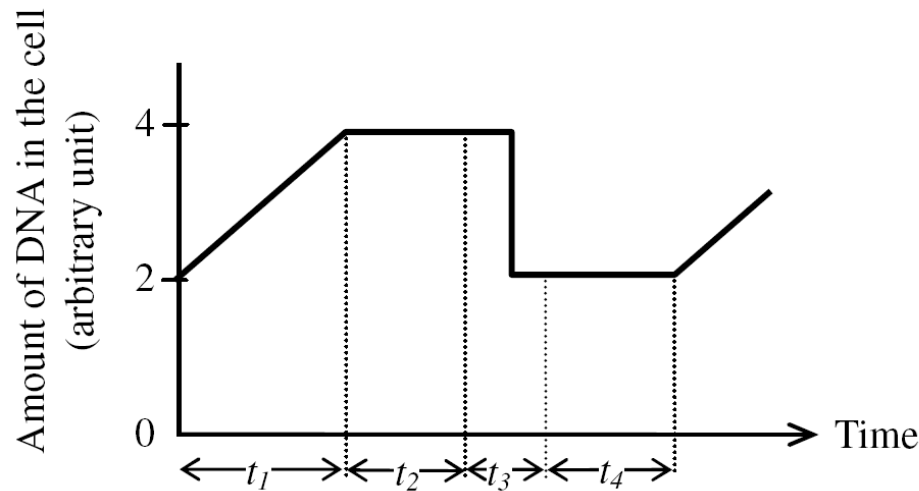
Which of the following is likely to be the DNA profile of Mrs. Chan?

- |      |   |   |   |   |        |
|------|---|---|---|---|--------|
| A.   |   | ■ |   | ■ | (1.5%) |
| * B. | ■ |   |   | ■ | (94%)  |
| C.   | ■ | ■ |   |   | (1%)   |
| D.   | ■ |   | ■ |   | (3.5%) |



# Question most poorly attempted: Q.2 (percentage correct = 21%)

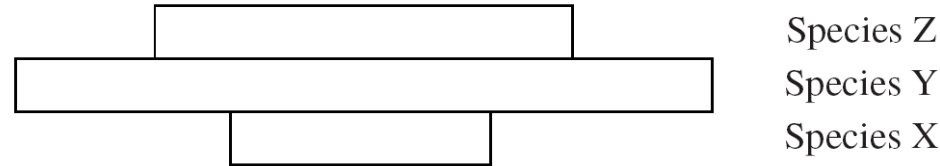
The graph below shows the change in the amount of DNA in a cell which is undergoing cell division:



Which of the following statements correctly describes the event that is taking place in the respective time period?

- A. During  $t_1$ , the nuclear membrane disappears. **(9%)**
- B. During  $t_2$ , the homologous chromosomes pair up. **(24%)**
- C. During  $t_3$ , the homologous chromosomes separate. **(46%)**

18. In an aquatic ecosystem, species X, Y and Z form a food chain. The following diagram shows the pyramid of biomass of this ecosystem:



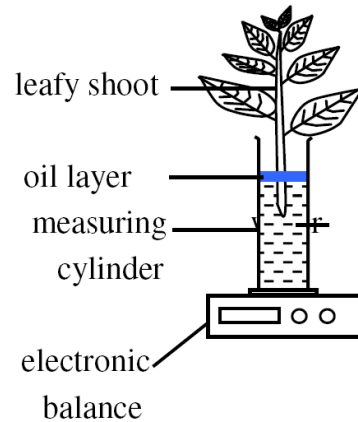
With reference to the above pyramid of biomass, which of the following statements are correct?

- (1) Species Z is the secondary consumer in this food chain.
- (2) The body size of species X is larger than that of species Y.
- (3) There is an energy loss when energy flows from species Y to species Z.

- A. (1) and (2) only (5%)
- \* B. (1) and (3) only (55%)
- C. (2) and (3) only (14%)
- D. (1), (2) and (3) (26%)

- ❑ **Application of biological knowledge in a pyramid of biomass which was unfamiliar**
- ❑ **45% of students did not realise that the body size of the organism has been taken into account in calculating the biomass at a particular trophic level**

27. The diagram below shows a weight potometer used in an experiment. The leafy shoot was left in a laboratory for 3 hours. The change in the reading of the electronic balance and the change in the volume of water in the measuring cylinder were recorded. The experiment was then repeated under the same environmental conditions with the upper surface of all the leaves of the shoot smeared with vaseline. The results are shown in the following table:



Treatment	Change in the reading of the balance (g)	Change in the volume of water in the measuring cylinder (mL)
(I) Leaves <b>not</b> smeared with vaseline	$p$	$r$
(II) Upper surface of all leaves smeared with vaseline	$q$	$s$

Note:

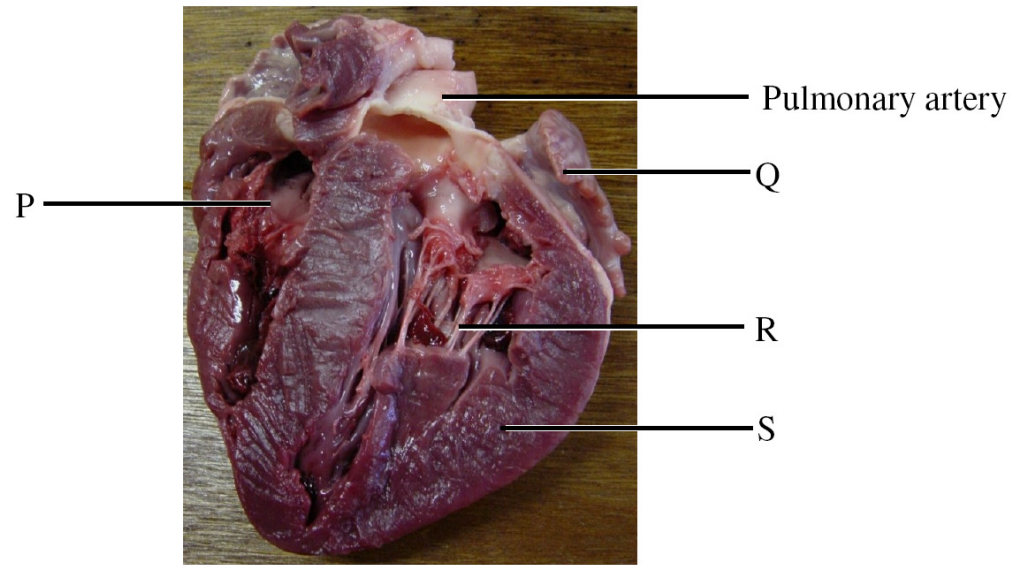
- $p, q, r$  and  $s$  are numerical values
- mass of 1 mL of water = 1 g

From the results of the experiment, we can calculate the amount of

- A. water absorbed by the shoot in Treatment (I) from  $p - r$ . (12%)
- B. water transpired by the shoot in Treatment (II) from  $r - s$ . (23%)
- \* C. water retained by the shoot in Treatment (II) from  $s - q$ . (30%)
- D. water transpired by the lower surface of the leaves of the shoot in 3 hours from  $p - q$ . (35%)

- **Require an understanding of the design of the experiment**
- **Change in the balance reading ( $p$  and  $q$ ) = amount of water transpired**
- **Change in the volume of water in the measuring cylinder ( $r$  and  $s$ ) = amount of water absorbed**
- **Smearing the upper surface of the leaves in treatment (II) allowed transpiration to take place in the lower surface only.**  
Hence,  $p - q$  = amount of water transpired by the upper surface of the

31. The following photograph shows a dissected pig's heart:



Which of the following descriptions of the labelled structures is correct?

- A. Structure P contracts to deliver blood to various parts of the body except the lungs. (5%)
- \* B. Structure Q receives blood from the pulmonary veins. (55%)
- C. Structure R controls the opening and closing of the valve. (23%)
- D. Structure S contracts to force the blood out of the heart through the pulmonary artery. (17%)

- ❑ **Ability to identify structures in a real heart & an understanding of their functions tested**
- ❑ **Heart strings are for preventing the valve from turning inside out, and not controlling the opening and closing of the valve**
- ❑ **Not able to recognise S as the left ventricular wall? Not able to recall that the ventricle is connected to the aorta?**





# Marking Paper 1B and 2

# Marking scheme interpretation and students' performance



- ❑ Preliminary and “final” marking schemes
- ❑ Suggested answers cannot be exhaustive (professional judgment)
- ❑ Marking criteria not indicative for future examinations





# The Marking Scheme

- Symbols used in the marking scheme

( )	Bracketed words, figures or ideas are not essential for the candidate to be awarded the point.
/	A single slash indicates an acceptable alternative within an answer.
+	A plus sign indicates that there are two pieces of information necessary to be awarded the point: the first piece of information comes before the plus sign and the second after.
*	Correct spelling required

- 3 marks for effective communication  
(Q.12 in Bio ; Q.9 in CS(Bio))
- Look for the knowledge / concepts required, not marking by keywords



# Standards Setting in 2012

# Cut scores for Biology



The panel of judges will set cut scores based on:

- ❑ Level descriptors
- ❑ Selected marked live scripts
- ❑ Statistical data - Group Ability Index (GAI) to reflect overall performance (ability) in the core subjects for all candidates taking a subject (group)
- ❑ Markers' feedbacks on the level of difficulty
- ❑ Students samples from SRR Information Package
- ❑ HKAL 2011 and HKCE 2010 library scripts



## Cut scores for Combined Science

- ❑ Cut scores of each half-elective to be determined with reference to the cut scores of the corresponding full-elective subjects using a statistical method that serves to equate the standard between the two
- ❑ Cut scores of the two half-elective subjects to be added up to form the cut score of Combined Science
- ❑ Overall subject level and levels for the two chosen components will be reported



## Levels 5\* and 5\*\*

- Level 5\*\* will be awarded to the highest-achieving 10% (approximately) of Level 5 candidates
- Level 5\* will be awarded to the next highest-achieving 30% (approximately) of Level 5 candidates



THANK YOU!!





**HKDSE Biology  
& Combined Science (Biology)  
Briefing Session on Practice Papers**

**Biology Practice Paper 1B  
Students' Performance**

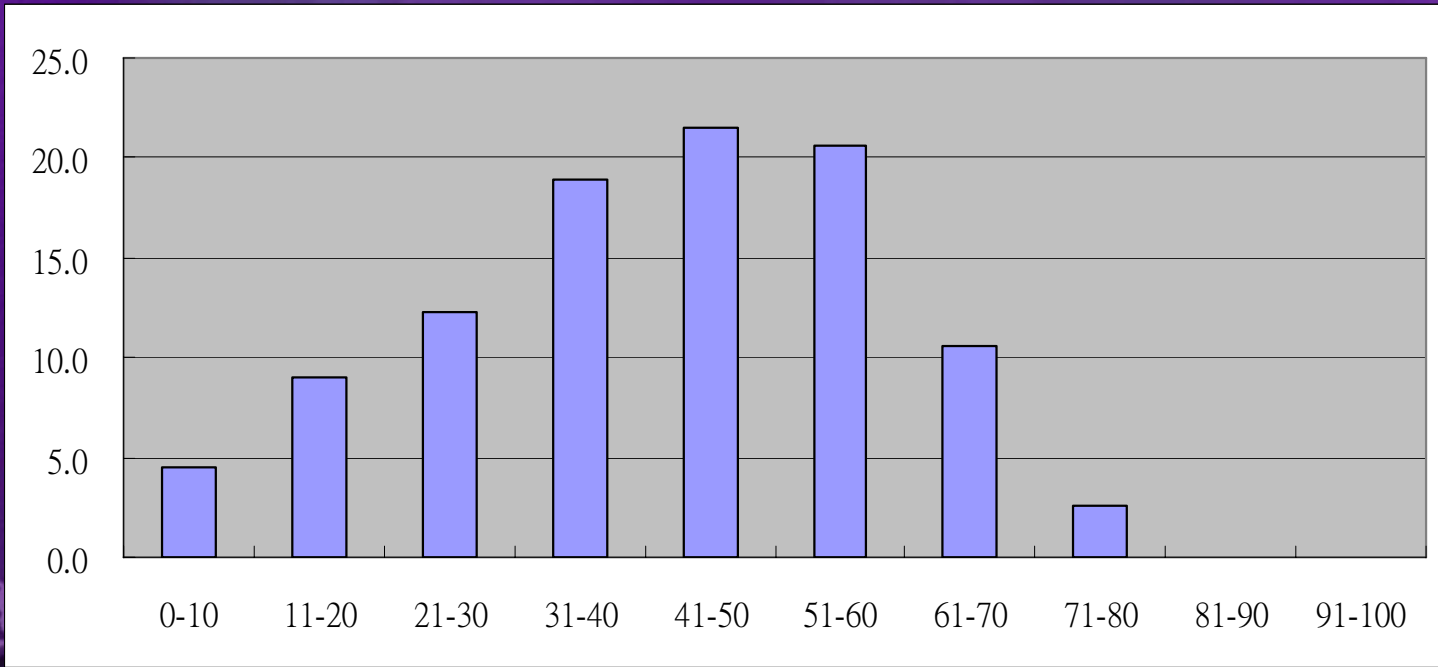
22 & 25 Feb 2012



## Section 1B (12 Questions, total marks = 84)

- No. of scripts marked = 311 (from 7 schools)
- Highest score = 65 marks (77.4% of total marks)
- Lowest score = 2 marks (2.4% of total marks)
- Mean score = 34.7 marks (41.3% of total marks)
- Standard deviation = 14.2 marks (16.9% of total marks)

% students



% of total marks

# Students' Performance on Q.1 to Q.7



1. For each of the infectious diseases listed in Column 1, select **one** of the methods listed in Column 2 that helps to protect people from contracting the disease. Put the appropriate letter in the space provided. (2 marks)

**Column 1**

**Column 2**

Cholera

.....

Dengue fever

.....

- A. using serving chopsticks and spoons at meal times
- B. boiling water before drinking
- C. wrapping up rubbish properly before disposal
- D. wearing a face mask in crowded places
- E. getting rid of stagnant water

- ◆ Performance was good in general.
- ◆ Some students might not be familiar with the disease 'dengue fever' and wrongly matched 'wrapping rubbish properly before disposal' to it.



(a) Some students gave 'eukaryotic cell' or 'plant cell' as the answer and did not point out the specific type of cell found in the leaf.

The following shows an electronmicrograph of a cell taken from a leaf:



(a) Name the type of cell shown in the electronmicrograph. (1 mark)

(b) Using the letters in the electronmicrograph, fill in the table below to show the structures in which ATP is synthesised. State the process by which ATP is synthesised in each structure. (4 marks)

Structure	Process of ATP synthesis



(b)

- ◆ Most could identify the site where ATP is synthesized
- ◆ Quite a number of students stated 'respiration' or 'photosynthesis' and did not give the specific process

2. The following shows an electronmicrograph of a cell taken from a leaf:



(a) Name the type of cell shown in the electronmicrograph. (1 mark)

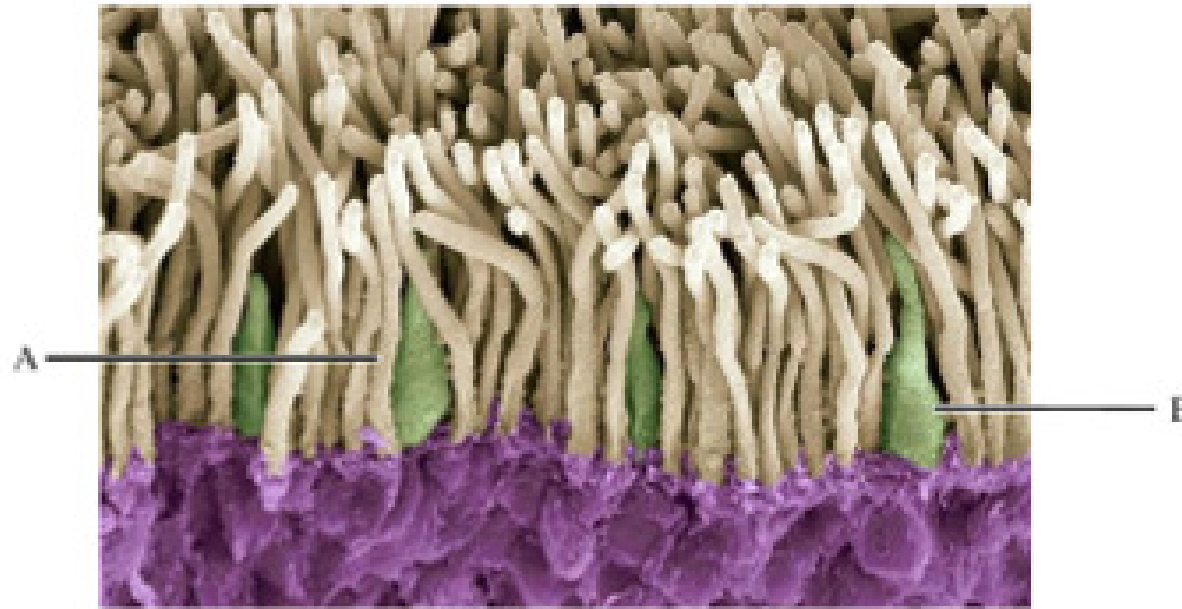
(b) Using the letters in the electronmicrograph, fill in the table below to show the structures in which ATP is synthesised. State the process by which ATP is synthesised in each structure. (4 marks)

Structure	Process of ATP synthesis



- (a) Performance was quite good.
- ◆ A few students wrongly gave 'yellow spot' as the answer
  - ◆ A number of students wrongly wrote '視網膜' as '視網膜'.

The electronmicrograph below shows two types of photoreceptors in the human eye:

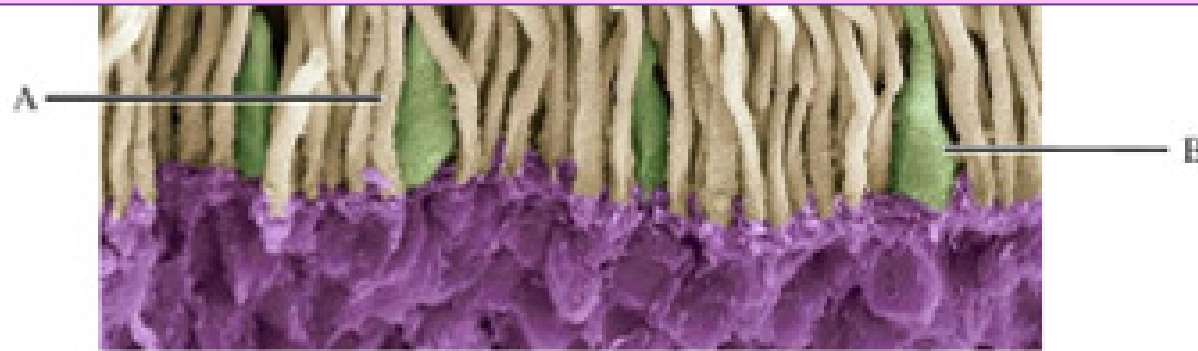


(a) Name the part of the human eye where the photoreceptors are found. (1 mark)

(b) A coloured object is perceived as being more colourful in bright light than in dim light. Explain this with respect to the functioning of photoreceptors A and B. (2 marks)

(b)

- ◆ Weak in interpreting the electronmicrograph and could not identify the photoreceptors
- ◆ Some may not realise that the naming of the photoreceptors is related to their shapes
- ◆ Some did not attempt to identify the photoreceptors and just recall the differences between rods and cones
- ◆ Students knew very well that cones are responsible for colour vision; but did not realise that more cones will be stimulated in bright light

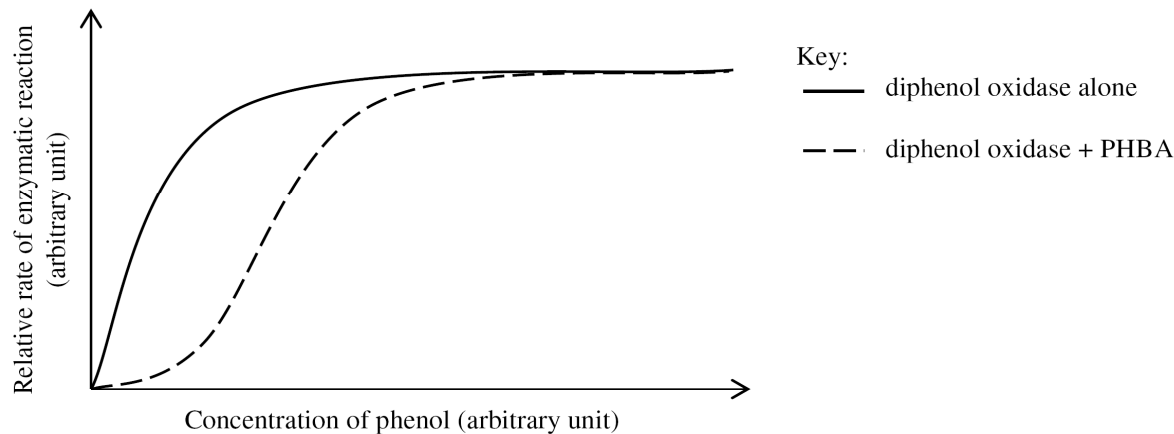


(a) Name the part of the human eye where the photoreceptors are found. (1 mark)

(b) A coloured object is perceived as being more colourful in bright light than in dim light. Explain



4. When a slice of apple is exposed to air, it quickly turns brown. This is because the enzyme diphenol oxidase catalyzes the oxidation of phenols in the apple to dark-coloured products. In an experiment, the effect of a chemical, PHBA, on the rate of this enzymatic reaction was investigated. The experiment was carried out at the same temperature and the same concentration of diphenol oxidase was used. The results are shown in the graph below:

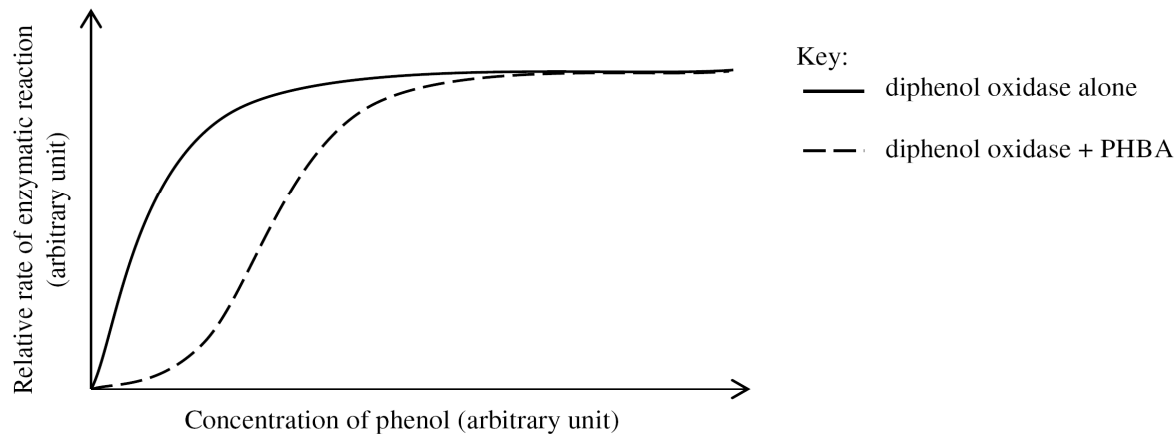


(a) Deduce the relationship between PHBA and diphenol oxidase. (3 marks)

(a)

- ◆ Some described each of the two curves instead of utilising the differences observed in deducing the relationship between PHBA and diphenol oxidase
- ◆ Some could not clearly express the concept that the degree of inhibition is reduced with an increase in the substrate concentration (e.g. stating that ‘an increase in the substrate concentration increases the rate of reaction’)

4. When a slice of apple is exposed to air, it quickly turns brown. This is because the enzyme diphenol oxidase catalyzes the oxidation of phenols in the apple to dark-coloured products. In an experiment, the effect of a chemical, PHBA, on the rate of this enzymatic reaction was investigated. The experiment was carried out at the same temperature and the same concentration of diphenol oxidase was used. The results are shown in the graph below:



**(b) Performance was very good.**

**(c)**

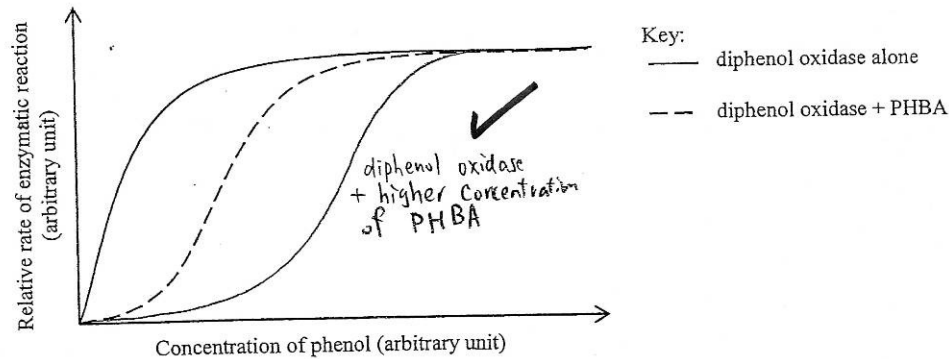
- ◆ A number of students did not read the question carefully (i.e. the experiment was carried out at the *same temperature* and the *same concentration of diphenol oxidase* was used) and still stated 'temperature' or 'concentration of enzyme'
- ◆ Many did not go on to explain why a denatured enzyme / a change in the active site will lower the reaction rate

(b) Draw a curve in the above graph to show the effect of PHBA on the rate of enzymatic reaction if a higher concentration of PHBA had been used. (1 mark)

(c) Suggest one other factor that should be kept constant in this experiment. Explain how this factor

# Sample 1

(a) The point 'the original rate is reached with an increase in substrate concentration' was not mentioned



(a) Deduce the relationship between PHBA and diphenol oxidase. (3 marks)

PHBA is a competitive inhibitor to diphenol oxidase. It is because when diphenol oxidase is used alone, the relative rate of enzymatic rate is high. However, when PHBA is added to diphenol oxidase, the rate of enzymatic reaction is decreased.

(b) Draw a curve in the above graph to show the effect of PHBA on the rate of enzymatic reaction if a higher concentration of PHBA had been used. (1 mark)

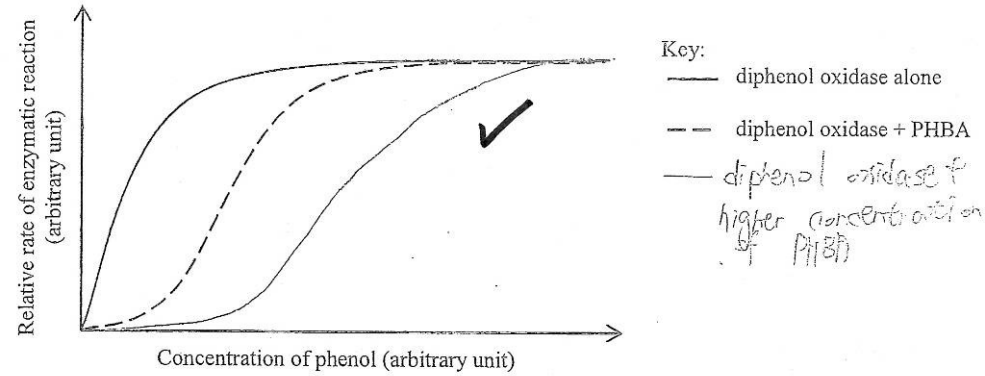
(c) Suggest ~~one other~~ factor that should be kept constant in this experiment. Explain ~~how~~ this factor may affect the activity of the enzyme. (3 marks)

Temperature. When the temperature is low, the enzyme is inactive, and enzymatic rate is low. The chance of forming enzyme-substrate complex is low. However, with an increase in temperature, the particles can gain more kinetic energy and collide against each other more frequently <sup>thus</sup> and the chance of forming enzyme-substrate complex is high.

Answers written in the margins will not be marked.



# Sample 2



Answers written in the margins will not be marked.

- (a) Deduce the relationship between PHBA and diphenol oxidase. (3 marks)

PHBA should be a competitive inhibitor ✓ of diphenol oxidase. This is because at the same concentration of phenol the rate of enzymatic reaction in presence of PHBA is lower than that in the absence of PHBA. However, at increasing concentration of phenol, rate of enzymatic reaction in presence of PHBA increases, showing an increase in concentration of substrate can overcome the inhibitory effect of PHBA. ✓

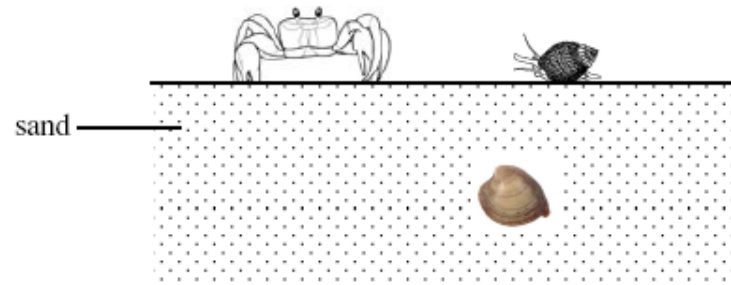
- (b) Draw a curve in the above graph to show the effect of PHBA on the rate of enzymatic reaction if a higher concentration of PHBA had been used. (1 mark)
- (c) Suggest one other factor that should be kept constant in this experiment. Explain how this factor may affect the activity of the enzyme. inhibitor. (3 marks)

The pH ✓ of the reaction mixture should be kept constant. which means enzymatic activity is highest in this pH. The enzyme works best at optimal pH value. At extreme pH values, the enzyme is denatured that shape of its active site is changed. The substrate molecules (phenol) can no longer bind to the active site of the enzyme ✓ so the enzymatic activity is lower.

Answers written in the margins will not be marked.



5. A sandy shore community has three species: a burrowing clam, a snail, and a crab.

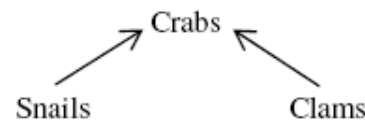


(a) To determine the relative abundance of these species, a student placed a quadrat on the shore and collected all the individuals on the sediment surface inside the quadrat. After counting the number of individuals of each species collected from this quadrat, he determined their relative abundance. Give **three** reasons why the student's sampling method may not reflect the actual relative abundance of these organisms. (3 marks)

(a) Most students could point out one to two reasons. However, some of them:

- ◆ did not read the question carefully; e.g. they put 'not digging deep enough to find the clams' as the reason
- ◆ did not realise that quadrat method is not suitable for 'fast moving' organisms, not unsuitable for 'moving' organisms.

(b) The feeding relationship of these three species is shown below:

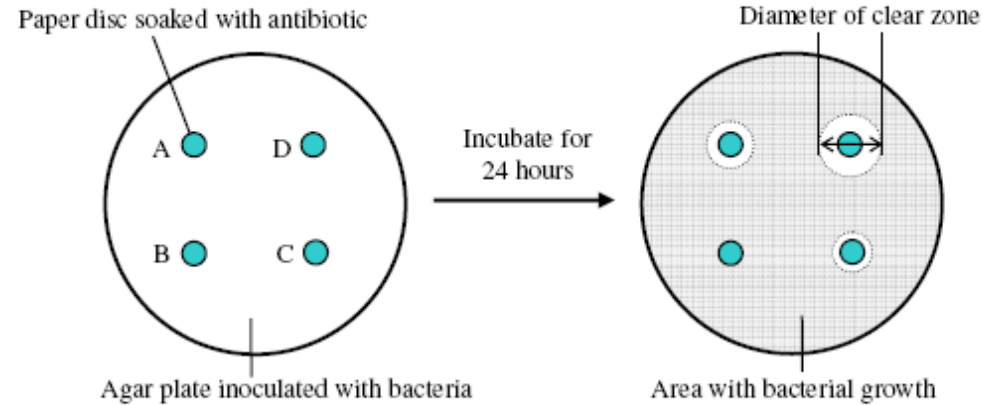


(b) Performance was good.

Suggest the effect on the population of crabs if a large number of clams are harvested by visitors

- (a) Performance was satisfactory
- Some wrote '37°C is the optimal temperature for bacterial growth' without relating this to the condition in human body where the bacteria were isolated.

A test was carried out to investigate the effects of four antibiotics against a species of bacteria isolated from a patient. The bacteria were inoculated on the surface of an agar plate. Four filter-paper discs (each with a diameter of 5 mm) soaked with different antibiotics A, B, C and D were placed on the surface of the agar. The agar plate was then incubated to allow the growth of the bacteria. If bacterial growth is inhibited by an antibiotic, a clear zone surrounding the filter-paper disc soaked with the antibiotic will be observed after 24 hours. The results of the test are shown below:



The following table shows the diameter of the clear zone measured in each of the filter-paper discs:

Antibiotic	Diameter of the clear zone (mm)
A	13
B	5
C	10
D	21

- (a) Explain why the agar plate should be incubated at 37°C. (1 mark)

(b) (i) Well answered.

- (b) (i) Based on the results, arrange the four antibiotics in descending order of effectiveness at inhibiting bacterial growth. (1 mark)

(ii) Explain your reasoning in determining the order in (i).

(3 marks)

(b)(ii)

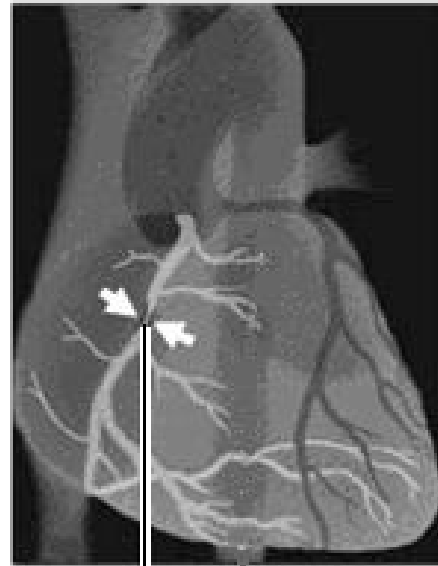
Most students just reiterated that 'a larger clear zone indicates that the antibiotic is more effective'. They did not explain why a more effective antibiotic will give a larger clear zone so that the size of a clear zone can be used for measuring an antibiotic's effectiveness.

(c) Antibiotic B has been commonly used. It was the most effective antibiotic against the same bacteria a few years ago. Explain the result of antibiotic B in this test. (4 marks)

(c) Performance was satisfactory.

- ◆ Many did not show an understanding of the mechanism of the development of the resistance and wrongly attributed the existence of resistant strain in a bacteria population to 'mutation' of the bacteria caused by the use of antibiotic
- ◆ A few thought that 'some bacteria produce antibodies to counteract the action of the antibiotic'.

Mr. Chan has been a smoker for more than 25 years. He has excessive rapid breathing and experiences chest pain during vigorous exercise. When consulting the doctor, he was advised to undertake an imaging of his heart for diagnosis. The image taken is shown below:



Narrowed artery X

(a) (i) Identify artery X.

(a)

(i) Well answered. A few wrongly identified the artery as aorta or pulmonary artery

(ii) Performance was quite satisfactory.

- ◆ Quite a number of students stated that there was a reduced blood supply to the 'heart', instead of the 'heart muscle cells'
- ◆ Some missed the point that an heart attack is associated with the death of the heart cells

(ii) Based on the condition shown in the above image, explain why Mr. Chan may suffer from a heart attack during vigorous exercise. (3 marks)



(b) The doctor advised Mr. Chan to quit smoking and to adopt a low-fat diet. With reference to Mr. Chan's health condition, give a reason for each piece of advice. (2 marks)

(i) Quitting smoking

---

---

(ii) Adopting a low-fat diet

---

---

(i) Satisfactory performance.

- ◆ some mixed up the effects of carbon monoxide, nicotine and tar in their explanation (e.g. wrongly stated that 'nicotine reduces oxygen carrying capacity', 'tar increases heart beat rate').

(ii) Performance was very good.

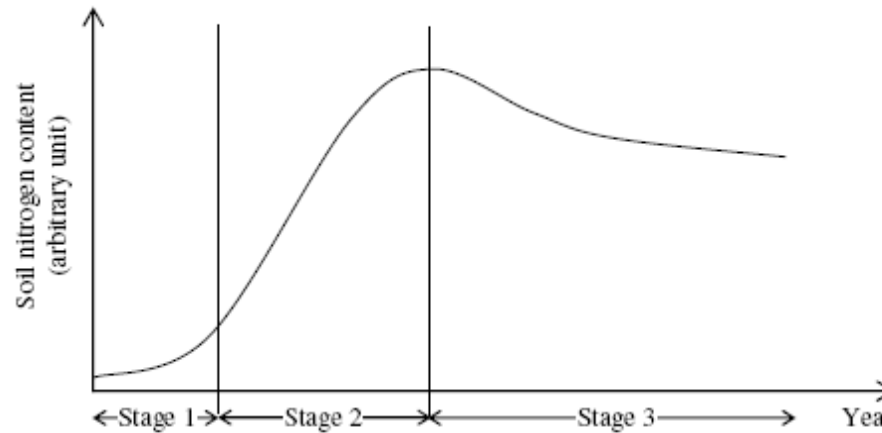


# Students' Performance on Q.8 to Q.12



(a) Quite a number of students wrongly regarded the change in relative abundance was due to the process of 'natural selection'

8. Graph 1 shows the change in the soil nitrogen content in an area over 200 years. At the beginning of Stage 1, the area was without vegetation. Table 1 shows the relative abundance of three plant species found in this area at the different stages:



Graph 1

Plant species	Relative abundance of the plant species at the end of each stage (%)		
	Stage 1	Stage 2	Stage 3
A	95	10	5
B	5	85	20
C	0	5	65

Table 1

- (a) With reference to Table 1, state the process that accounts for the change in the relative abundance of the plant species in this area. (1 mark)
- 
- (b) (i) The bacteria living symbiotically with plant species A and species B played an important role in causing the increase in the soil nitrogen content in Stages 1 and 2.
- (1) Name the symbiotic bacteria living in plant species A and B. (1 mark)

(b) (i) (1) Many students overlooked the clue 'living symbiotically' and

(2) Describe how the symbiotic bacteria and the two plant species caused the increase in the soil nitrogen content in Stages 1 and 2. (3 marks)

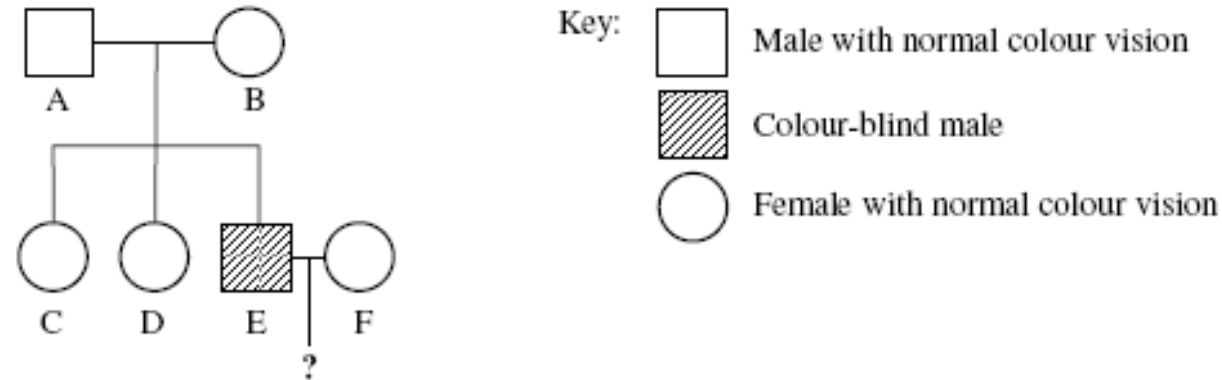
(2)

- ◆ A lot of students stated that the atmospheric nitrogen is fixed directly into nitrate in the soil
- ◆ Quite a number of students did not realise that the ammonium compounds obtained from nitrogen fixation were utilised by the plants for making proteins, and that the proteins in the plants could become the nitrates in the soil by the decomposition and nitrification actions of other soil microbes after the plant died.

(ii) Species C was absent in Stage 1 but became the dominant species in Stage 3. Explain the change in its relative abundance from Stage 1 to Stage 3. (3 marks)

(ii) Some students put down the typical process of primary succession without referring to the context in the question. Some students could not associate the dominance of species C in Stage 3 with competition.

A couple (A and B) does not have any family history of Down syndrome, but the female (B) has a family history of colour blindness. The two daughters of this couple do not have colour blindness, but one of them (C) has Down syndrome. The son (E) has colour blindness. The pedigree of this family is shown in the following diagram:



- (a) Normal people have 23 pairs of chromosomes in the cell nucleus, but people with Down syndrome have an extra chromosome in the 21<sup>st</sup> pair of chromosomes. Explain how this couple could give birth to a Down syndrome child (C). (2 marks)

(a)

- ◆ Students could not relate the appearance of an extra chromosome in the gamete to the failure of separation of the chromosomes during gamete formation.
- ◆ Some gave very vague answers such as 'meiosis went wrong'.

- (b) (i) In humans, colour blindness is a sex-linked trait. Based on the above pedigree, deduce the genotype of the mother (B) with respect to colour vision. (Marks will **not** be awarded for genetic diagrams.) (5 marks)

# Sample 1

margins will not be marked.

During the formation of female gametes, the 21<sup>st</sup> pair of chromosomes failed to separate in metaphase II. As a result, one of the gametes contains a pair of 21<sup>st</sup> chromosomes.

After the fusion of male and female gametes in fertilization, the zygote results in three chromosomes in the 21<sup>st</sup> pair chromosome.

(b) (i) In humans, colour blindness is a sex-linked trait. Based on the above pedigree, deduce the

margins will not be marked.

Separation of the chromosomes does not take place at metaphase

# Sample 2

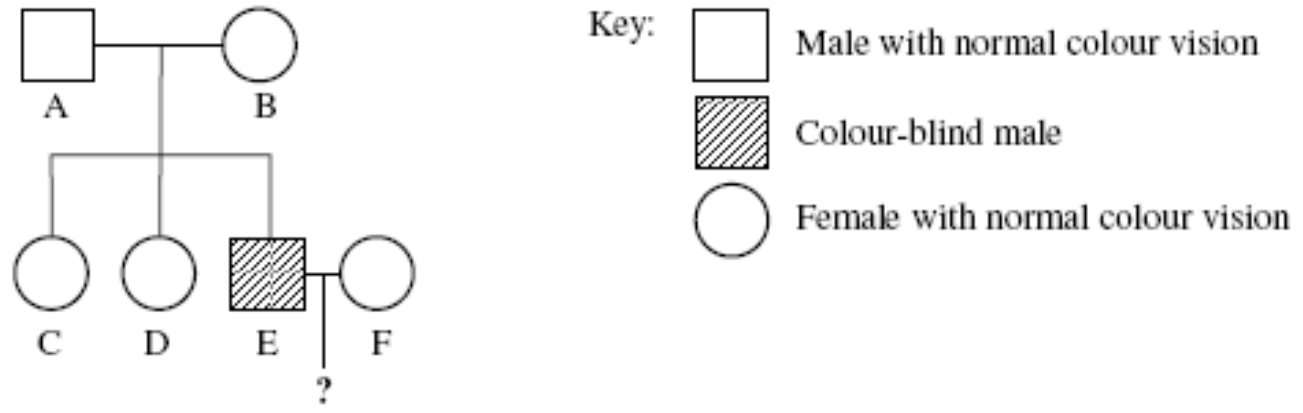
margins will not be marked.

when the male gamete with one extra chromosome 21 fuse with a normal female gamete or when the female gamete with one extra ~~extra~~ chromosome 21 fuse with a normal male gamete. In both <sup>case</sup> ~~cases~~ zygote has one extra chromosome 21.

margins will not be marked.

Did not explain the appearance of the extra chromosome in the gamete

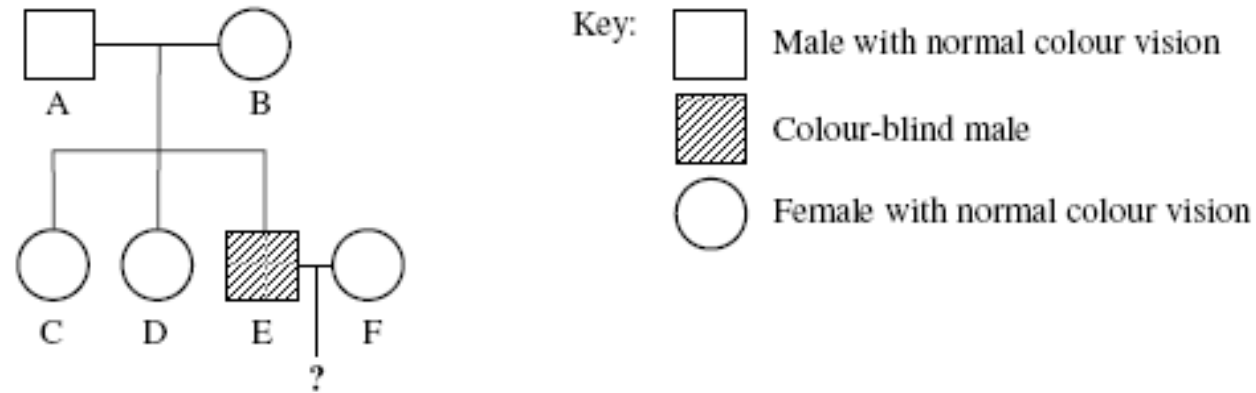
A couple (A and B) does not have any family history of Down syndrome, but the female (B) has a family history of colour blindness. The two daughters of this couple do not have colour blindness, but one of them (C) has Down syndrome. The son (E) has colour blindness. The pedigree of this family is shown in the following diagram:



(b) (i) In humans, colour blindness is a sex-linked trait. Based on the above pedigree, deduce the genotype of the mother (B) with respect to colour vision. (Marks will not be awarded for genetic diagrams.) (5 marks)

- ◆ Students showed confusion in the use of genetic terms in their answers (e.g. using the term ‘genes’ when they were referring to ‘alleles’)
- ◆ Generally weak in presenting the deduction
- ◆ Some students ignored that the trait in the question was sex-linked. They put down a typical answer for deducing the genotype of an individual in a typical cross of monohybrid inheritance without due reference to the fact that the alleles concerned were located on the X chromosome

A couple (A and B) does not have any family history of Down syndrome, but the female (B) has a family history of colour blindness. The two daughters of this couple do not have colour blindness, but one of them (C) has Down syndrome. The son (E) has colour blindness. The pedigree of this family is shown in the following diagram:



(ii) F is a carrier of the colour blindness allele. With the aid of a genetic diagram, find the probability of E and F giving birth to a colour-blind daughter. (5 marks)

- ◆ Most could work out the probability correctly
- ◆ A large number of students could not define the alleles correctly with appropriate symbols, e.g.
  - ◆ wrongly use 'Xb' to represent the allele for colour blindness, which should be a symbol for 'an X chromosome bearing an allele for colour blindness'
  - ◆ used different letters in defining the alleles for normal vision and colour blindness (e.g. N and b)
- ◆ Some students used a genetic diagram



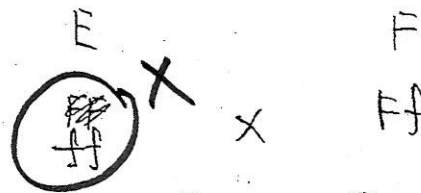
# Sample 1

This student did not show an understanding that the alleles for the trait are found on the X chromosome

- (ii) F is a carrier of the colour blindness allele. With the aid of a genetic diagram, find the probability of E and F giving birth to a colour-blind daughter. (5 marks)

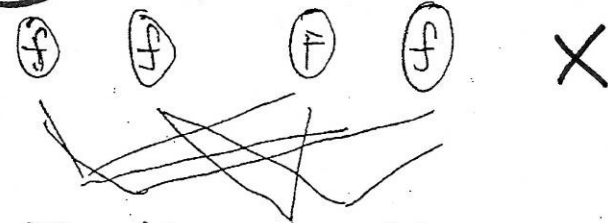
Genetic diagram:

Parent



F: is the allele of normal  
Colour vision  
f: is the allele of colour blind

gamete



f<sub>1</sub>



The ratio is 1 : 1 : 1 : 1  
Colour-blind : Normal Colour vision  
is 1/2

Probability of E and F giving birth to a colour-blind daughter: 1/2 X

written in the margins will not be marked.

# Sample 2

(ii) F is a carrier of the colour blindness allele. With the aid of a genetic diagram, find the probability of E and F giving birth to a colour-blind daughter. (5 marks)

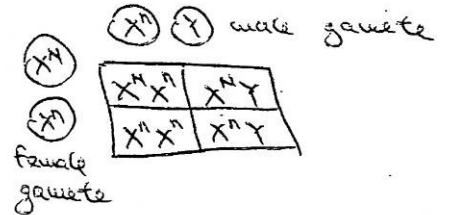
Genetic diagram:

let  $X^N$  be ~~normal~~ X chromosome with allele for normal vision  
 $X^n$  be X chromosome with allele for colour blind.  
 $Y$  be Y chromosome with no such allele for colour blind

phenotype of parent colour blind x normal  
 genotype of parent  $X^nY$  x  $X^NX^n$

gamete  $(X^n) (Y)$   $(X^N) (X^n)$

fertilization



genotypic ratio  $X^NX^n : X^nX^n : X^NY : X^nY$

phenotypic ratio normal female : colour blinded female : normal male : colour blinded male

Probability of E and F giving birth to a colour-blind daughter: 25%

1 mark deducted for 'format of the genetic diagram' (F -1) for not indicating the offspring

Answers written in the margins will

Answers written in the margins will not be marked.

(F-1)

(a) Photograph 1 shows two groups of wheat flowers and Photograph 2 shows an enlarged wheat flower.

- ◆ Some students were careless in reading the question and gave 'wind pollination' instead of 'wind' as the pollinating agent.
- ◆ Some student did not realise that the structure shown in photograph 2 was anther and gave a wrong answer.



Photograph 1



Photograph 2

Suggest the agent for pollination of the wheat. Support your answer with reference to an observable feature in the above photographs.

(2 marks)

(b) Explain the importance of soaking wheat grains in water for germination. (2 marks)

- ◆ Some answers were quite vague (e.g. water is important for growth) and could not point out the important role of water in germination.
- ◆ Some students wrongly used terms like 'epidermis' when they were referring to the seed coat.
- ◆ Some students erroneously stated that water is important for dissolving the stored food.

(c) When wheat grains are sown on a piece of farmland which has been frequently sprayed with a pesticide X, the germination rate is poor. Design an experiment to investigate whether pesticide X affects germination of the wheat grains. (4 marks)

- ◆ Most students could design a workable experiment with due consideration on setting up a proper control and keeping the controlled variables constant for a fair experiment.
- ◆ Some students overlooked the importance of using a sufficient number of seeds for the experiment and some did not state how the effect could be measured (i.e. by comparing the germination rate).

Q.

Digested food is absorbed into the epithelial cells of the villi.

(a) With reference to the structure of the cell membrane as illustrated by the fluid mosaic model of cell membrane, explain the following:

(i) Fatty acids (non-polar molecules) can diffuse across the cell membrane into the epithelial cell. (2 marks)

(i)

- ◆ Most students could point out that the fatty acids diffuse through the phospholipid bilayer but not many of them could explain this with reference to the fact that fatty acids are fat soluble.
- ◆ Some did not make reference to 'the structure of the cell membrane as illustrated by the fluid mosaic model' as required in the question.

---

(ii) Amino acids (polar molecules) can be taken up from the intestinal lumen into the epithelial cell but cannot diffuse across the epithelial cell membrane back to the lumen. (3 marks)

Digested food is absorbed into the epithelial cells of the villi.

(a) With reference to the structure of the cell membrane as illustrated by the fluid mosaic model of cell membrane, explain the following:

(i) Fatty acids (non-polar molecules) can diffuse across the cell membrane into the epithelial cell. (2 marks)

(ii)

- ◆ Students generally were aware that amino acids were transported across the membrane by / via the membrane proteins.
- ◆ Most of them did not explain why the polar nature of the amino acids prevents them from diffusing across the membrane.

(ii) Amino acids (polar molecules) can be taken up from the intestinal lumen into the epithelial cell but cannot diffuse across the epithelial cell membrane back to the lumen. (3 marks)

Q.

- (b) Name a mechanism for transporting glucose across the cell membrane. State a difference between this mechanism and diffusion. (2 marks)

Well answered. Some students, however, wrongly stated 'osmosis' as the mechanism for transport of glucose across the membrane and hence gave a wrong comparison.



Q.

For question 12, candidates are required to present their answers in essay form. 7 marks will be allocated to biological knowledge, and 3 marks to logical presentation and clarity of expression.

12. Being able to respond to external stimuli is very important for the survival of organisms. Illustrate this with reference to **one** tropic response in flowering plants. Contrast the nature and process of this type of response with that involved in reflex action in humans. (10 marks)

- ◆ Many put down 'phototropism' without specifying the part (e.g. shoot or root), nor did they specify whether the response is positive or negative. Hence, they could not illustrate the importance of the phototropic response of the specific part of the plant for its survival.
- ◆ Some gave wrong examples ; e.g. 'the flowers are positively phototropic'.
- ◆ Many students wrote a lengthy account of the mechanism of phototropic response (i.e. how the phototropic response was brought about by the redistribution of auxins under the influence of unilateral light)
- ◆ Instead of contrasting the nature and process of tropic response and reflex action, a lot of students gave a separate account of each of them without any comparison.



Q.

For question 12, candidates are required to present their answers in essay form. 7 marks will be allocated to biological knowledge, and 3 marks to logical presentation and clarity of expression.

12. Being able to respond to external stimuli is very important for the survival of organisms. Illustrate this with reference to **one** tropic response in flowering plants. Contrast the nature and process of this type of response with that involved in reflex action in humans. (10 marks)

- For students who gave a comparative account of the nature of tropic response and reflex action, the performance was satisfactory.
- The performance on contrasting the process of the two responses was quite poor. Common weaknesses include:
  - ◆ not able to express their ideas using appropriate terms or precise wording;
  - ◆ elaborated at length for a particular point (e.g. tropic response being mediated by auxins and that reflex is mediated by nerve impulses) with little relevance to the question (e.g. giving a detail description of the origin of auxins and how an impulse is set up);
  - ◆ few could present their answers in an organised way.

THANK YOU !  
(Q & A)



**HKDSE Biology  
& Combined Science (Biology)  
Briefing Session on Practice Papers**

**Biology Practice Paper 2  
Students' Performance**

22 & 25 Feb 2012



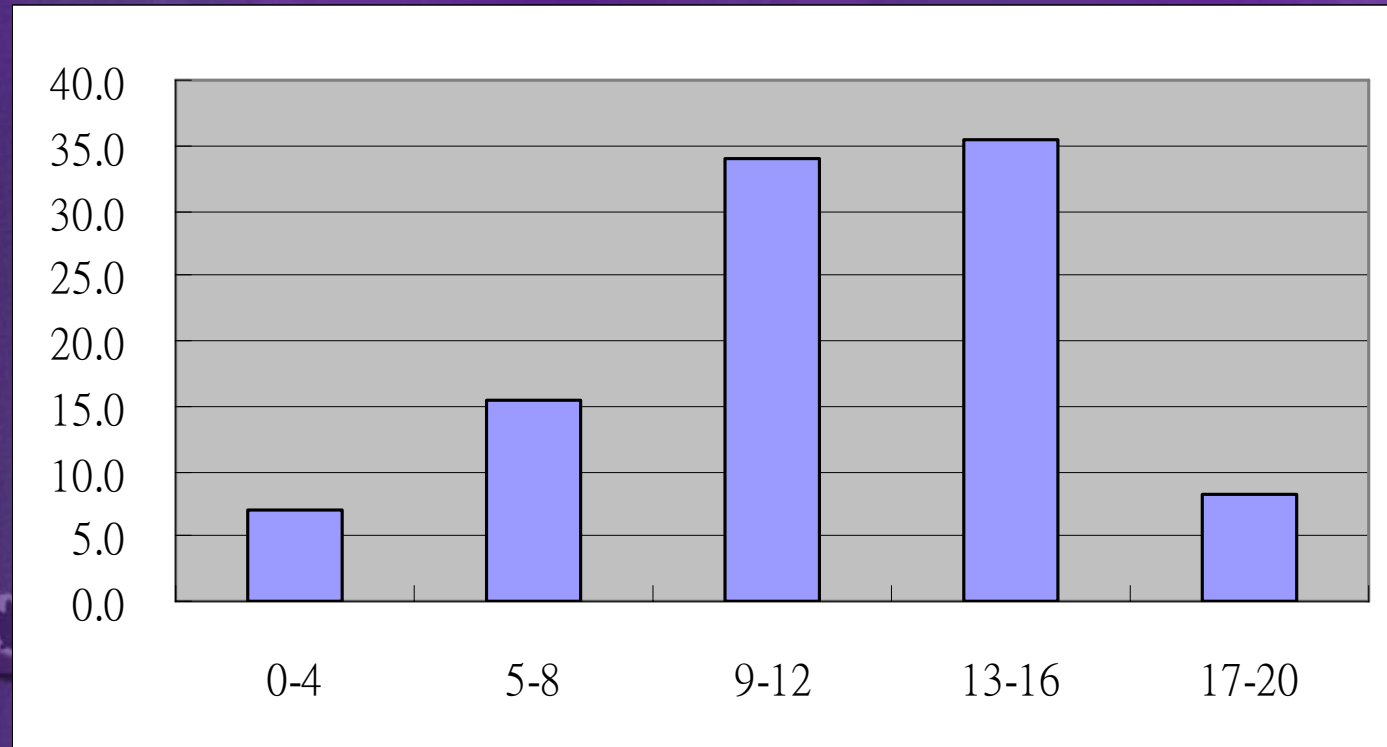
# Questions 1 and 2



# Q.1 : Human Physiology

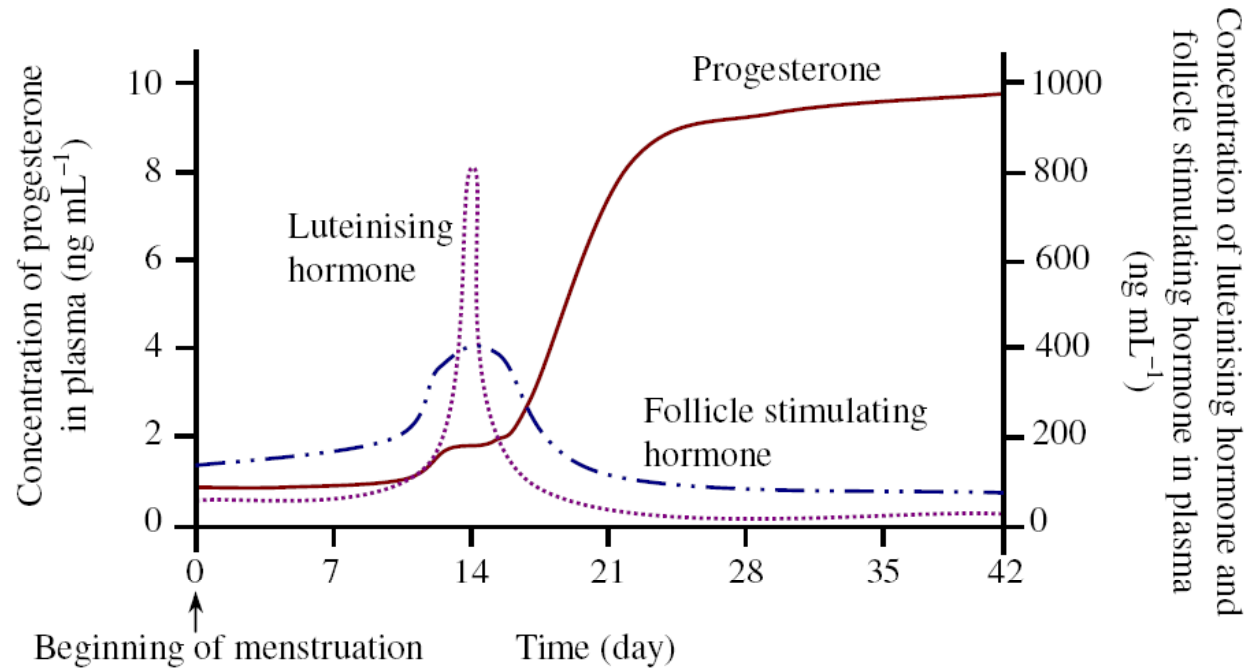
- Scripts collected = 291
- Mean = 11.3 marks
- SD = 4 marks

% of students



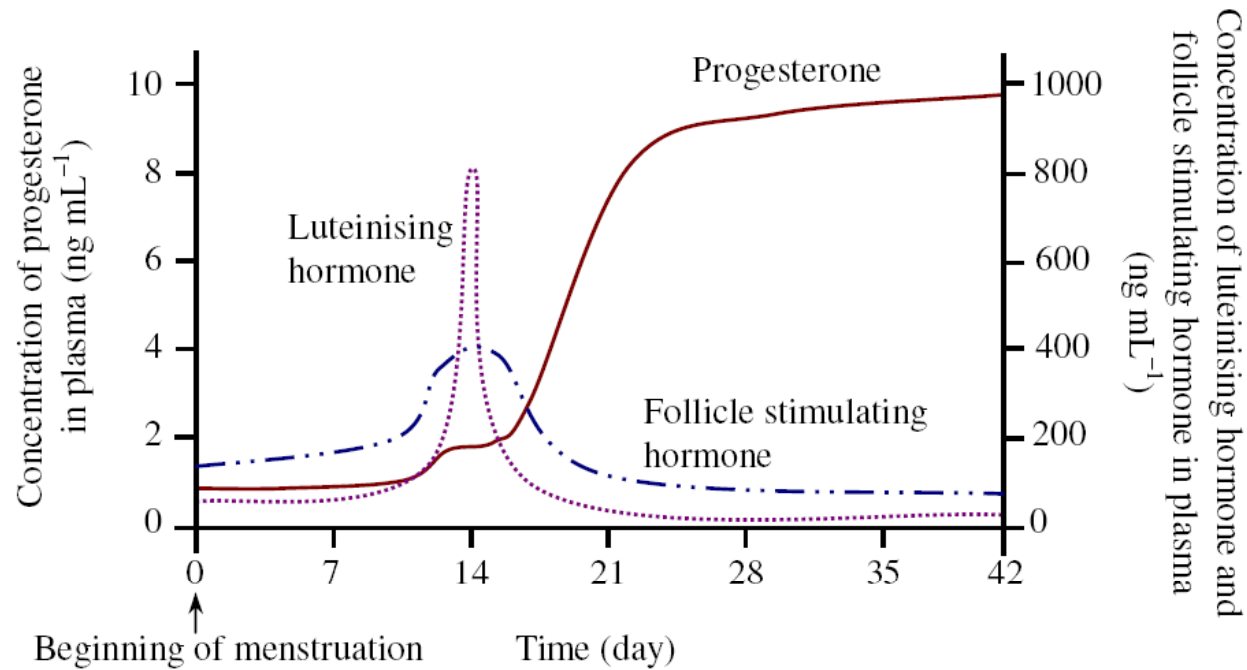
Mark range

(a) The following graph shows the plasma concentrations of progesterone, luteinising hormone and follicle stimulating hormone of a woman over a period of time:



- (i) Name the process that took place in the ovary on day 14. (1 mark)
- (ii) Account for the change in the plasma concentration of progesterone from day 14 to day 42. (3 marks)
- (iii) What would happen to the woman if the progesterone level dropped significantly on day 35? (1 mark)
- (iv) With reference to the changes in the concentration of the hormones shown in the above graph, explain why progesterone can be used as a drug for contraception. (3 marks)

(a) The following graph shows the plasma concentrations of progesterone, luteinising hormone and follicle stimulating hormone of a woman over a period of time:

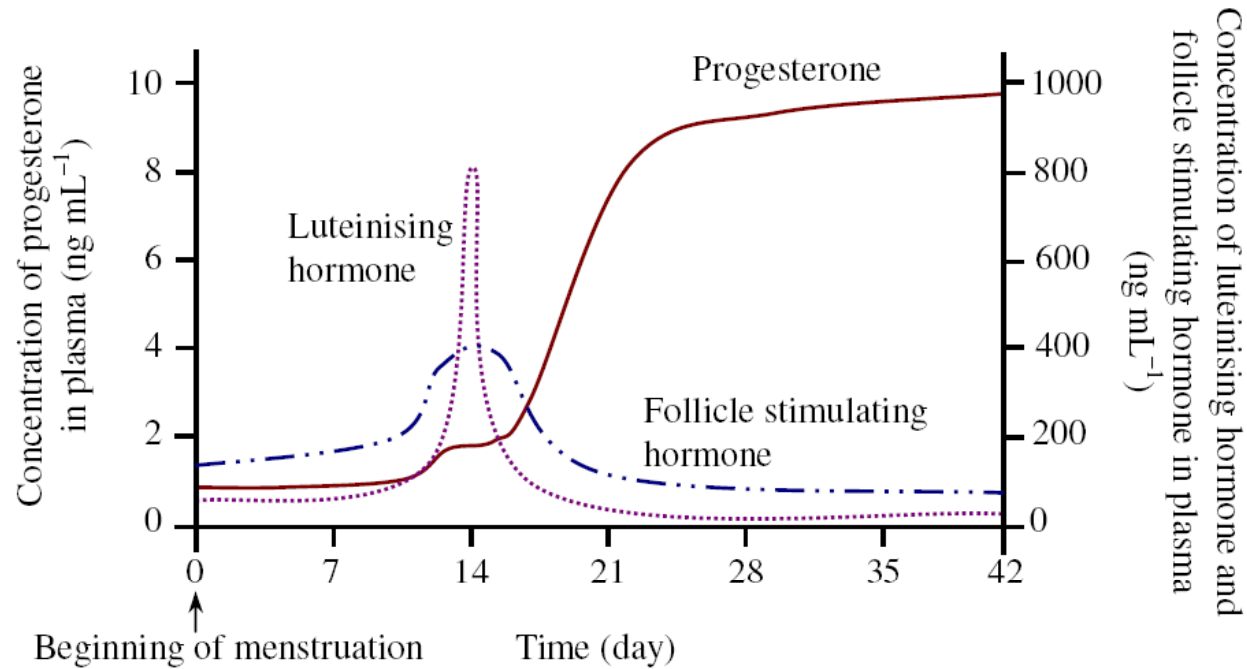


- (i) Name the process that took place in the ovary on day 14. (1 mark)
- (ii) Account for the change in the plasma concentration of progesterone from day 14 to day 42. (3 marks)

(ii)

- ◆ Most could explain the rise in progesterone after day 14
- ◆ Not many realised that the woman was pregnant and the

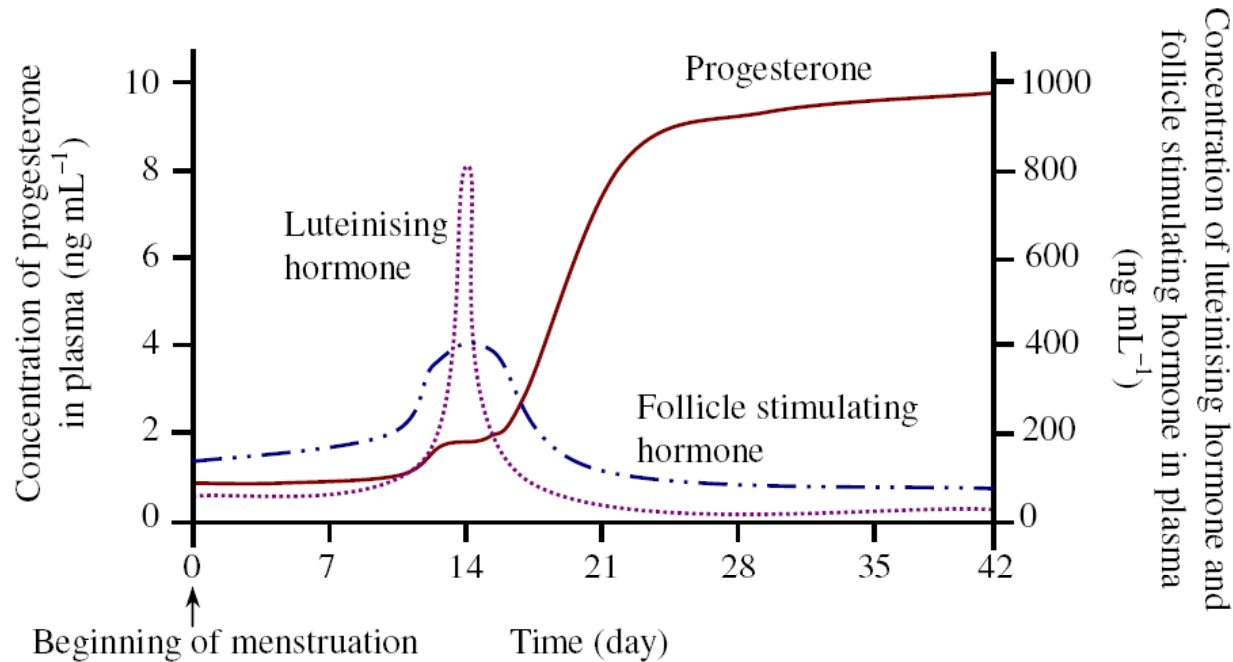
(a) The following graph shows the plasma concentrations of progesterone, luteinising hormone and follicle stimulating hormone of a woman over a period of time:



- (i) Name the process that took place in the ovary on day 14. (1 mark)
- (ii) Account for the change in the plasma concentration of progesterone from day 14 to day 42. (3 marks)
- (iii) What would happen to the woman if the progesterone level dropped significantly on day 35? (1 mark)
- (iv) With reference to the changes in the concentration of the hormones shown in the above graph, explain why progesterone can be used as a drug for contraception. (3 marks)



(a) The following graph shows the plasma concentrations of progesterone, luteinising hormone and follicle stimulating hormone of a woman over a period of time:



- ◆ Some described the effect of progesterone level on secretion of LH and FSH by recall without making reference to the graph
- ◆ Some students, instead of stating that ‘the high progesterone level inhibits the *secretion* of both LH and FSH’, stated that ‘the high progesterone levels inhibits both LH and FSH’

(iv) With reference to the changes in the concentration of the hormones shown in the above graph, explain why progesterone can be used as a drug for contraception. (3 marks)

(b) The table below shows the data of some parameters of the cardiovascular and respiratory systems of a healthy untrained person at rest, during light exercise and during vigorous exercise:

	At rest	Light exercise	Vigorous exercise
Heart rate (beats / min)	75	145	190
Stroke volume (dm <sup>3</sup> )	0.07	0.09	0.11
Breathing rate (breaths / min)	14	24	40
Tidal volume (dm <sup>3</sup> )	0.86	1.67	2.50

- (i) Using the data provided, calculate the cardiac output (dm<sup>3</sup> / min) and ventilation rate (dm<sup>3</sup> / min) of this person when he is at rest, when he is doing light exercise and when he is doing vigorous exercise respectively. (2 marks)
- (ii) State the changes in this person's cardiac output and ventilation rate with the increasing level of exercise. What is the importance of these changes? (4 marks)

(i) Well answered.

(ii) Most students could explain the importance of the changes.

Some did not specify that more nutrients and oxygen were supplied to the 'muscle cells', and stated 'to the body'

# Sample 1

(ii) 隨着人的運動量上升，其心輸出量和換氣率都不斷上升至高水平。✓	1
因為只有較大的心輸出量才能使心臟泵出足夠多的血液以及足夠的氧氣給全身細胞及肌肉細胞。✓ 肌肉細胞才能用更多的氧進行呼吸作用釋放能量，以便肌肉收縮。	1
同時，換氣率高才能及時排出由肌肉細胞呼吸作用產生的大量 $CO_2$ ，使血液中的 $CO_2$ 水平及血液 pH 值維持穩定，以便體內的酶正常運作，維持體內平衡。	1



## Sample 2

(bii)

When the level of exercise increases, both the cardiac output and the ventilation rate increase. ✓

The ventilation rate increase because the more rapid gas exchange can provide more oxygen for respiration for releasing energy ✓ and carry out more carbon dioxide out of the body faster. ✓

The cardiac output rises as the more and faster blood circulation through out the body, the body cell can be more richly supplied with oxygen and nutrients for carry out respiration to release energy. Besides, the the waste of the cells can be carried away more rapidly.

Please do not write in the

1

1  
1

(b) The table below shows the data of some parameters of the cardiovascular and respiratory system of a healthy untrained person at rest, during light exercise and during vigorous exercise:

	At rest	Light exercise	Vigorous exercise
Heart rate (beats / min)	75	145	190
Stroke volume (dm <sup>3</sup> )	0.07	0.09	0.11
Breathing rate (breaths / min)	14	24	40
Tidal volume (dm <sup>3</sup> )	0.86	1.67	2.50

(iii) A number of students described the changes instead of describing how the activity of the sympathetic nerve brought about the changes. Although students knew that the sympathetic nerve innervates the SA node, they failed to point out that the SA node was stimulated by the increased output of the sympathetic nerve.

(iii) Describe how the person's sympathetic nerve brings about the change in the cardiac output during exercise. (2 marks)

(iv) Explain why the volume of urine produced by this person after vigorous exercise is less than usual. (4 marks)

(b) The table below shows the data of some parameters of the cardiovascular and respiratory systems of a healthy untrained person at rest, during light exercise and during vigorous exercise:

	At rest	Light exercise	Vigorous exercise
Heart rate (beats / min)	75	145	190
Stroke volume (dm <sup>3</sup> )	0.07	0.09	0.11
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Tidal volume (dm <sup>3</sup> )	0.86	1.67	2.50

(i) Using the data provided, calculate the cardiac output (dm<sup>3</sup> / min) and ventilation rate (dm<sup>3</sup> / min) of this person when he is at rest, when he is doing light exercise and when he is doing vigorous exercise.

(iv)

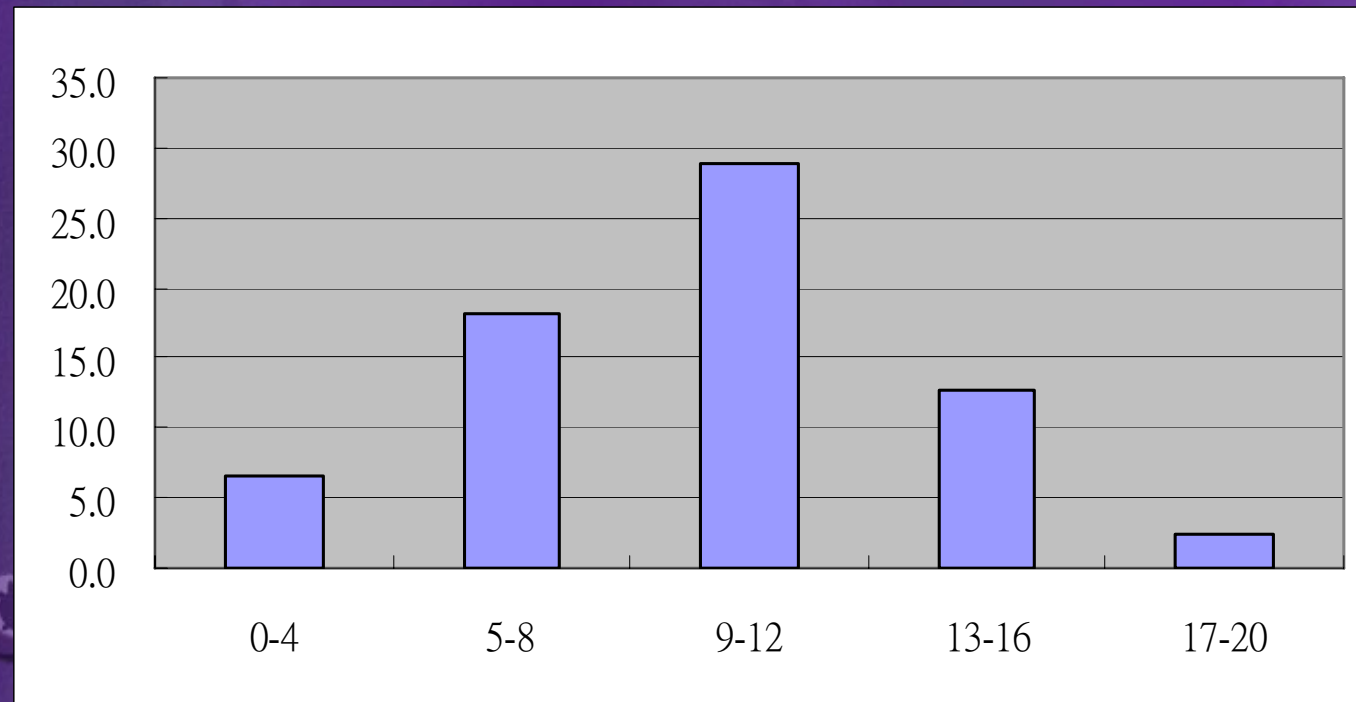
- ◆ Most students could give a correct explanation.
- ◆ Some could not express their ideas clearly; e.g. wrote 'water content in the body' instead of 'water potential of the blood'

(iv) Explain why the volume of urine produced by this person after vigorous exercise is less than usual. (4 marks)

## Q.2 : Applied Ecology

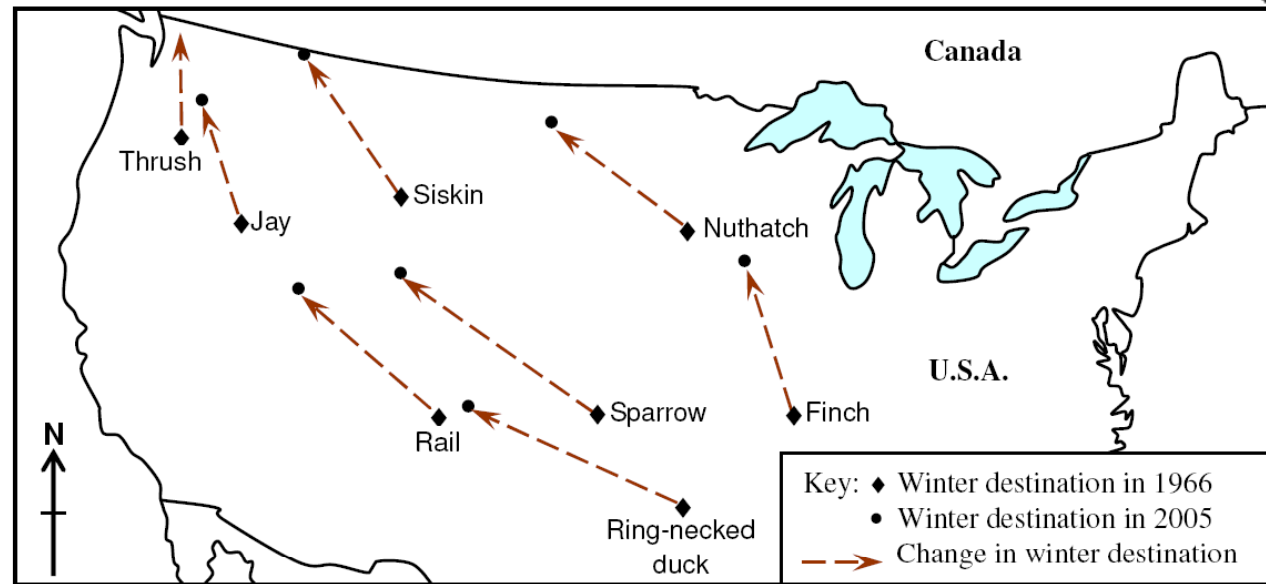
- Scripts collected = 200
- Mean = 9.6marks
- SD = 3.8 marks

% of students



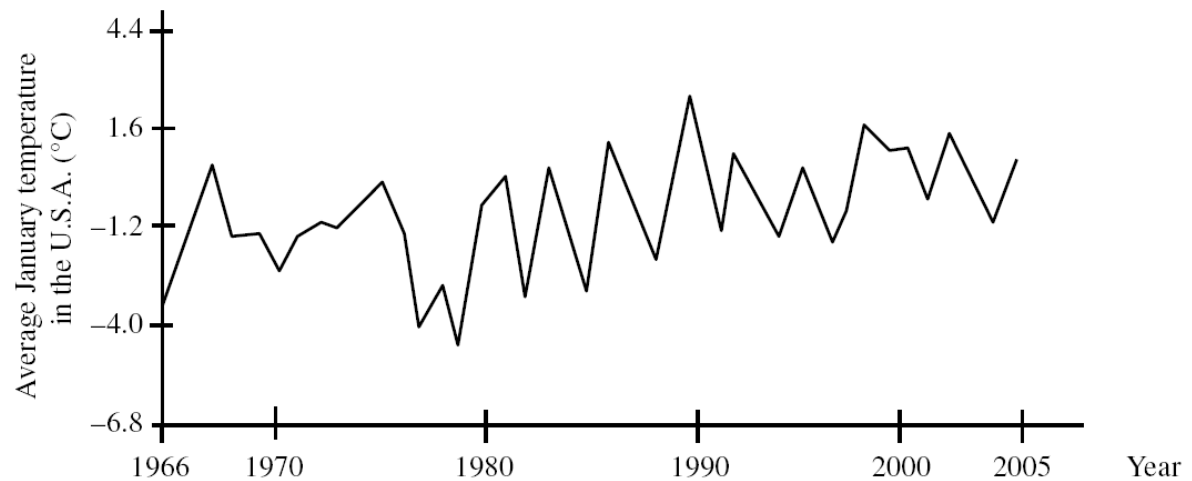
Mark range

(a) Many bird species living in Canada migrate southwards to the U.S.A. to spend the winter. The map below shows the destinations of some of these bird species in the U.S.A. in the winters of 1966 and 2005.



(i) Most could suggest a workable method

The average January temperatures in the U.S.A. from 1966 to 2005 are shown in the following graph:



(1 mark)



- ◆ Performance was generally satisfactory on parts (1) and (3)

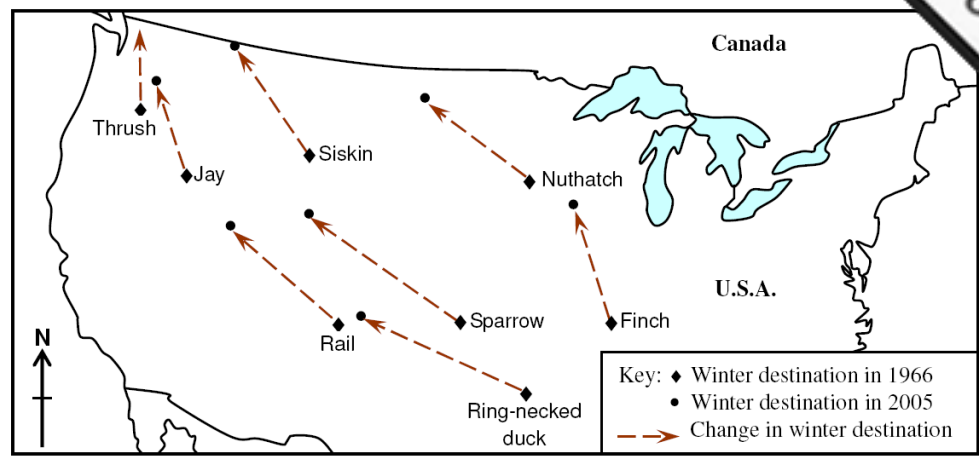
(2)

- ◆ Most could state the change in wintering destination
- ◆ Some wrongly interpreted the arrows; thought that the birds migrated from south to north
- ◆ Many could not suggest an ecological reason for the change in wintering ground

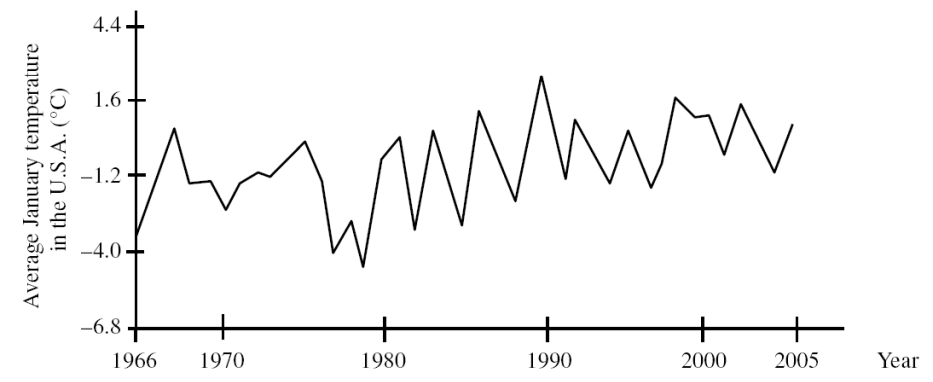
(4)

- ◆ Most could state the type of human activity and the gas that caused the trend
- ◆ Few could explain clearly how an increased amount of greenhouse gases caused a rise

(a) Many bird species living in Canada migrate southwards to the U.S.A. to spend the winter. The map below shows the destinations of some of these bird species in the U.S.A. in the winters of 1966 and 2005.



The average January temperatures in the U.S.A. from 1966 to 2005 are shown in the following graph:



- Suggest one way which can be used to track the migration route of birds. (1 mark)
- State the general trend shown in the average January temperature in the U.S.A. from 1966 to 2005. (1 mark)
  - Relate the change in the winter destination of bird species in the U.S.A. with the change in average January temperature in the U.S.A. from 1966 to 2005. Suggest, from an ecological point of view, a reason for the change in the winter destination. (2 marks)
  - Suggest **two** possible effects caused by the change in the winter destination of these migratory bird species on native bird species. (2 marks)

J.S.A. is due to end. (4 marks)

(b) Forests provide humans with valuable resources. Proper forest management is needed when exploring new uses of forests to ensure sustainable forestry.

(i) The combustion of fossil fuel releases acidic gases which may cause acid rain. State and explain **two** environmental impacts of acid rain. (4 marks)

- ◆ Most could state the cause leading to an impact (e.g. acid rain reduces the pH of the soil and hence affects plant growth), but they could not state the impact on the environment (e.g. reducing the population size of the plant species)
- ◆ Some included 'causing corrosion of buildings' as an environmental impact



- (ii) Some scientists are exploring the use of forest woody biomass to replace the fossil fuel used in power plants. Trees are logged from two forests, A and B, for this research and other uses. The table below shows the distribution of the inorganic nutrients nitrogen and magnesium in these two forests:

	Forest A		Forest B	
	Nitrogen (%)	Magnesium (%)	Nitrogen (%)	Magnesium (%)
Biomass above forest floor	35	70	5	25
Biomass on forest floor	5	5	5	5
Biomass below forest floor	60	25	90	70
Total	100	100	100	100

Based on the difference in the distribution of inorganic nutrients of the two forests, explain which forest will reestablish itself more quickly after logging. (3 marks)

Few realised that logging removed only the biomass above the forest floor.

ii) 森林B ✓		1
因為森林B的地面之下的無機營養素含量較森林A為多，而地面之		1
上的無機營養物則較A少，所以森林B的無機營養素主要分		
佈在地面一下，伐林后，仍有較大部分的無機營養物留在土地，		
即土地上的無機營養素濃度較高，樹根與土壤的無機營養物有		
較大的濃度梯度，所以樹根可以較快地將無機營養素吸收，用		

(iii) Over-exploitation of forest resources leads to a decrease in biodiversity.

(1) Provide **one** reason why biodiversity is important. (1 mark)

(2) Reforestation is a way to restore a forest. In earlier years, reforestation depended mainly on exotic tree species imported from other countries and most of the plantations were formed by a single exotic tree species. State **one criterion** when choosing an appropriate exotic tree species for reforestation. Give **one disadvantage** of forming a plantation using a single tree species. (2 marks)

Well answered. In part (2), some students missed the focus of 'using a single tree species for reforestation' and gave answers like 'increasing the competition between local and introduced exotic species'.

(2) The ~~criteria~~ <sup>is</sup> that the tree species should be able to provide food and shelter to local animals living in the <sup>suitable</sup> forest. One disadvantage of forming a plantation using a single tree species is that ~~the~~ some minerals in the soil, which the trees take up for growth, may soon be depleted. One <sup>when choosing an exotic tree species</sup> ~~criteria~~ <sup>is</sup> that the trees will not attract or provide

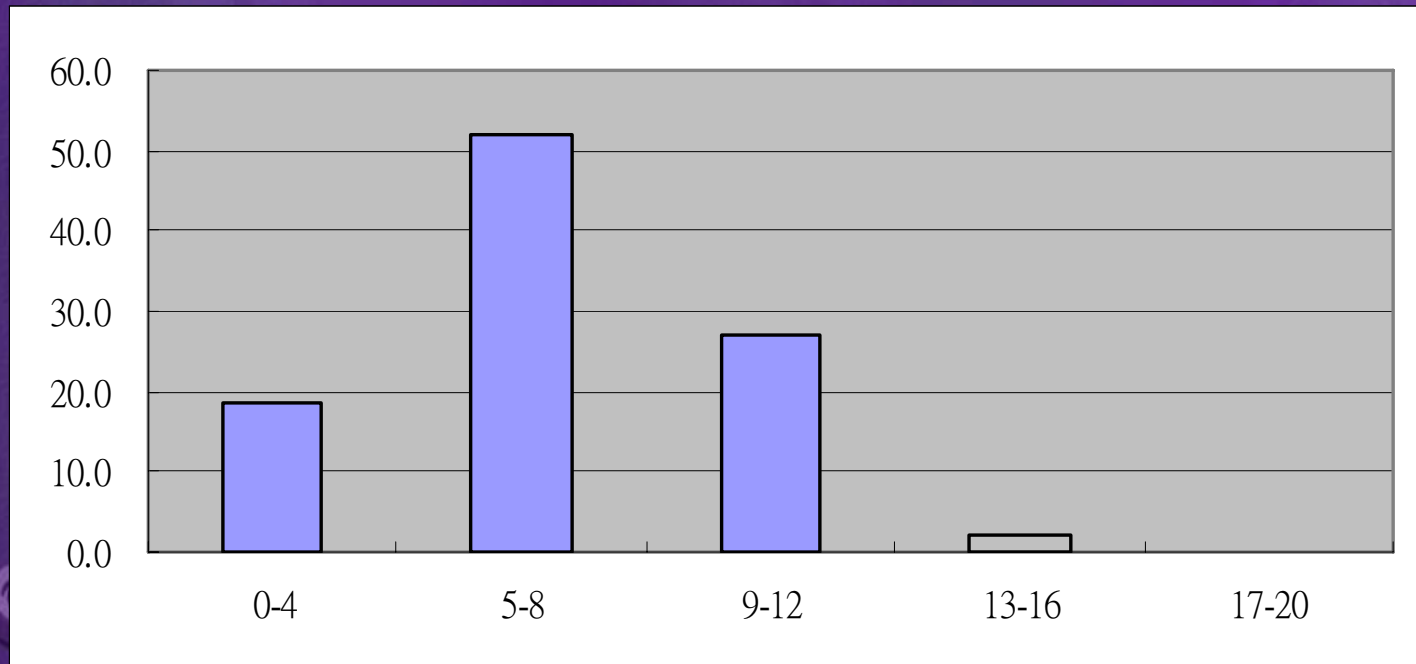
# Questions 3 and 4



# Q.3 : Microbiology

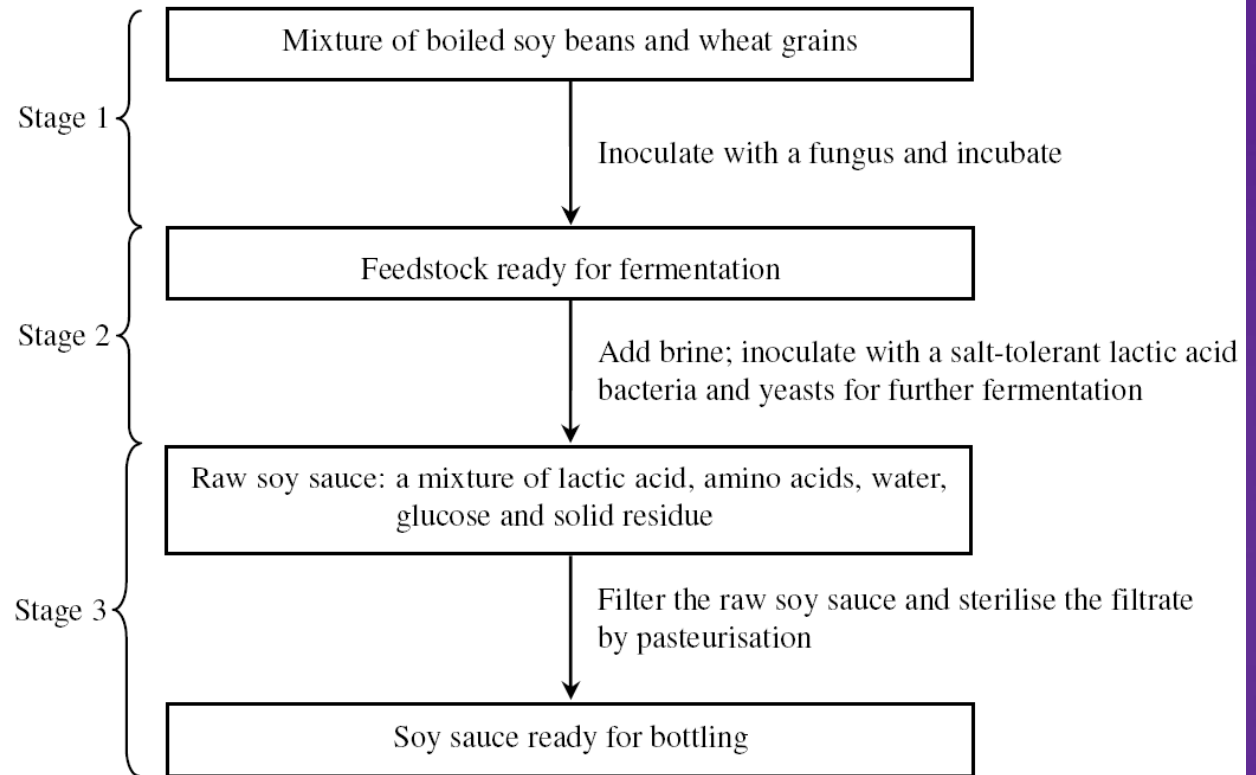
- Scripts collected = 48
- Mean = 7.1 marks
- SD = 2.5 marks

% of students



Mark range

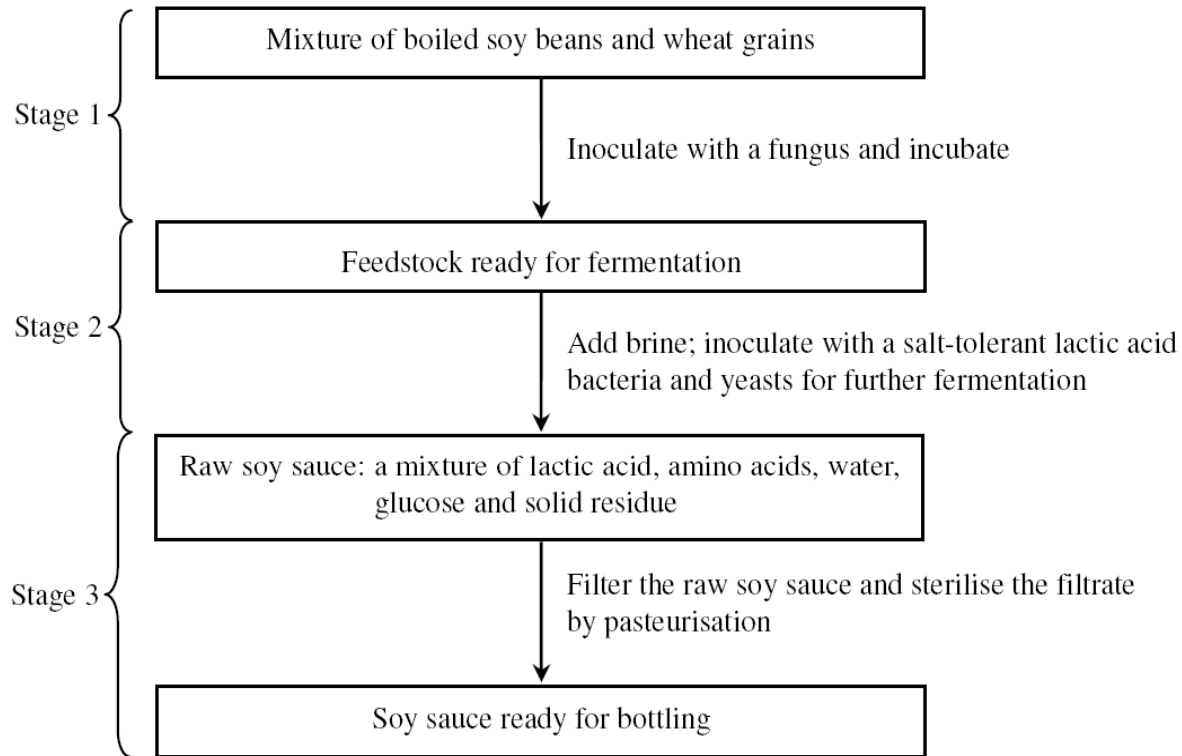
(a) Soy sauce is made by fermentation of a combination of soy beans, wheat grains, water and salt. The production of soy sauce consists of three stages: incubating boiled soy beans and wheat grains with a fungus to produce the feedstock, fermenting the feedstock in the brine added, and pasteurising the raw soy sauce for bottling. An outline of the manufacturing process is given in the flow chart below:



(i) Students generally realise that Stage 1 was essential for providing the substrates for use in Stage 2, but they missed the point that the substrates are from the digestion of soy beans by the enzymes from the fungus

- (i) Explain why Stage 1 is an essential preparatory step for Stage 2. (2 marks)
- (ii) Explain the importance of adding brine to the mixture in Stage 2. (2 marks)
- (iii) Why is it necessary to use pasteurisation in Stage 3 to sterilise the raw soy sauce? (2 marks)
- (iv) Aseptic techniques are used in food manufacturing processes involving microbes. State the (3 marks)

(a) Soy sauce is made by fermentation of a combination of soy beans, wheat grains, water and salt. The production of soy sauce consists of three stages: incubating boiled soy beans and wheat grains with a fungus to produce the feedstock, fermenting the feedstock in the brine added, and pasteurising the raw soy sauce for bottling. An outline of the manufacturing process is given in the flow chart below:



(ii) Many misinterpreted the role of the brine and thought that its for adding flavour. They failed to pick up the clue in the process outlined.

- (i) Explain why Stage 1 is an essential preparatory step for Stage 2. (2 marks)
- (ii) Explain the importance of adding brine to the mixture in Stage 2. (2 marks)
- (iii) Why is it necessary to use pasteurisation in Stage 3 to sterilise the raw soy sauce? (2 marks)
- (iv) Aseptic techniques are used in food manufacturing processes involving microbes. State the



# Sample 1

the dish, which contaminates the mixture  
3(a) Adding brine to the mixture can kill ~~the organisms~~ ✓  
except salt-tolerant lactic acid bacteria and yeast by  
osmosis. This can ensure the quality of soy sauce

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# Sample 2

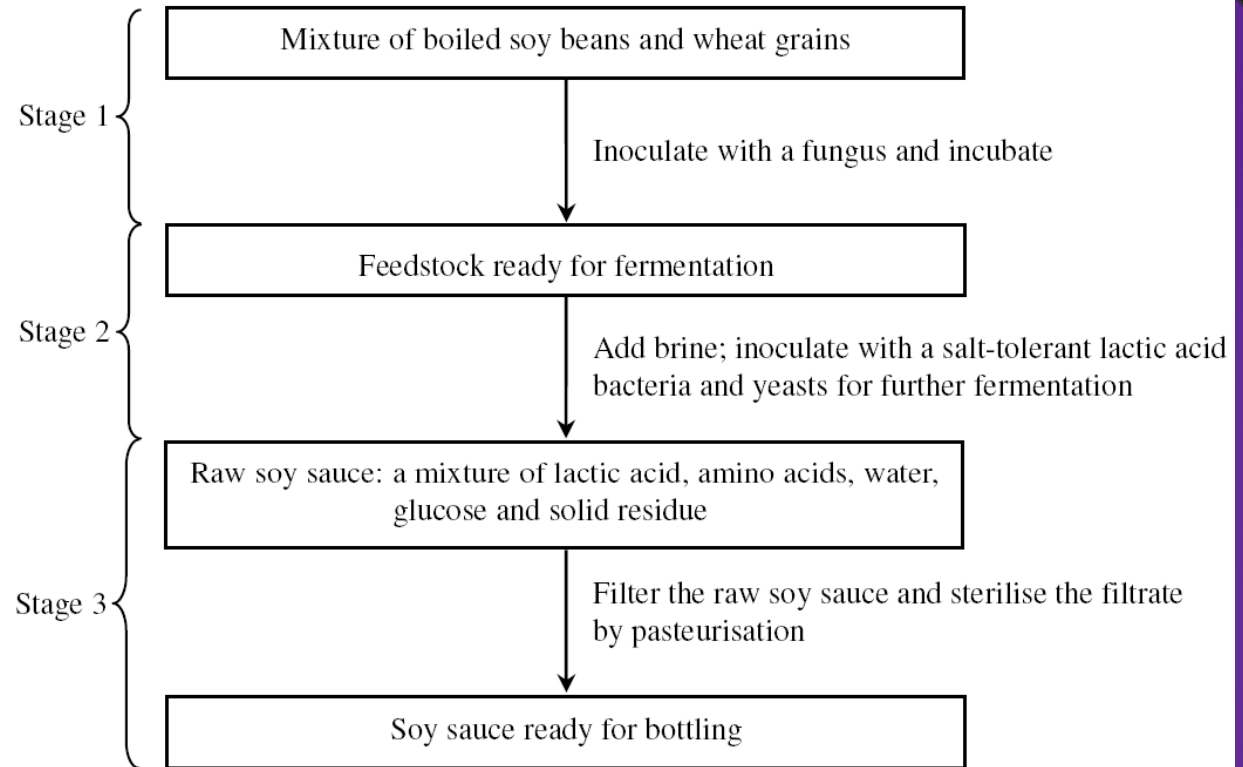
3(a) ii) Brine is concentrated salt (sodium chloride)  
solution. It may provide an alkaline medium  
for the yeast to work best for fermentation.  
Also, Brine gives its salty flavour of the  
soy sauce.

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邊界以外的答案，將不予



(a) Soy sauce is made by fermentation of a combination of soy beans, wheat grains, water and salt. The production of soy sauce consists of three stages: incubating boiled soy beans and wheat grains with a fungus to produce the feedstock, fermenting the feedstock in the brine added, and pasteurising the raw soy sauce for bottling. An outline of the manufacturing process is given in the flow chart below:

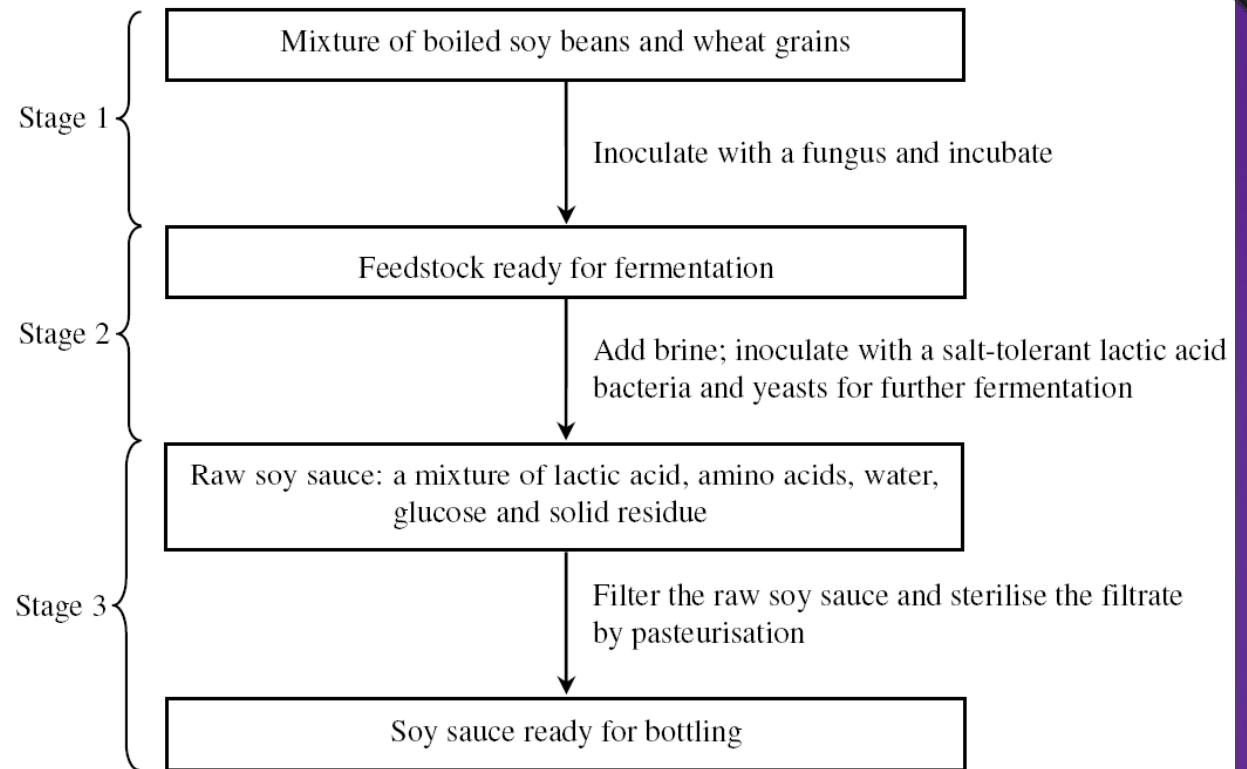


(iii)

- ◆ Most could state that pasteurisation preserves the proteins / flavours in the soy sauce
- ◆ Few could relate the use of pasteurisation to denaturing the enzymes to stop further fermentation

- (i) Explain why Stage 1 is an essential preparatory step for Stage 2. (2 marks)
- (ii) Explain the importance of adding brine to the mixture in Stage 2. (2 marks)
- (iii) Why is it necessary to use pasteurisation in Stage 3 to sterilise the raw soy sauce? (2 marks)
- (iv) Aseptic techniques are used in food manufacturing processes involving microbes. State the principles of aseptic techniques. (3 marks)

- (a) Soy sauce is made by fermentation of a combination of soy beans, wheat grains, water and salt. The production of soy sauce consists of three stages: incubating boiled soy beans and wheat grains with a fungus to produce the feedstock, fermenting the feedstock in the brine added, and pasteurising the raw soy sauce for bottling. An outline of the manufacturing process is given in the flow chart below:

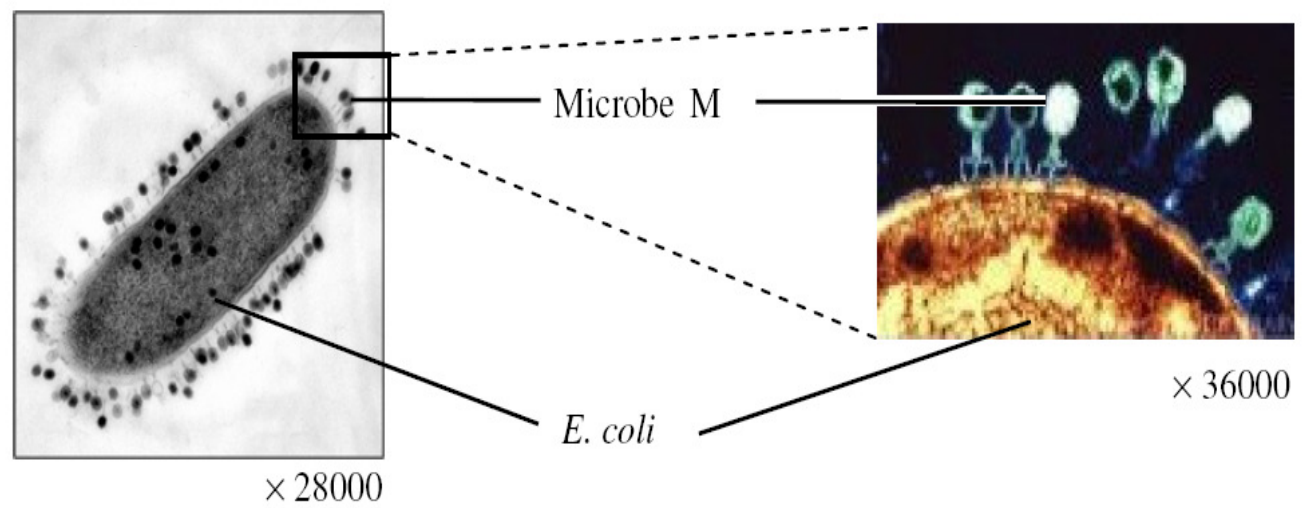


- (i) Explain why Stage 1 is an essential preparatory step for Stage 2. (2 marks)
- (ii) Explain the importance of adding brine to the mixture in Stage 2. (2 marks)
- (iii) Why is it necessary to use pasteurisation in Stage 3 to sterilise the raw soy sauce? (2 marks)
- (iv) Aseptic techniques are used in food manufacturing processes involving microbes. State the principles of aseptic techniques. (3 marks)

(b) The bacterium *E. coli* is a natural inhabitant of the human intestine.

(i) Figure 1 shows an *E. coli* infected by microbe M. Figure 2 is the magnified image of a part of Figure 1.

- ◆ Performance in parts (1) and (2) was good.
- ◆ Most could identify microbe M, stated the difference, and describe the event shown in Figure 2
- ◆ Students could, in general, give one advantage in part (3)



**Figure 1**

**Figure 2**

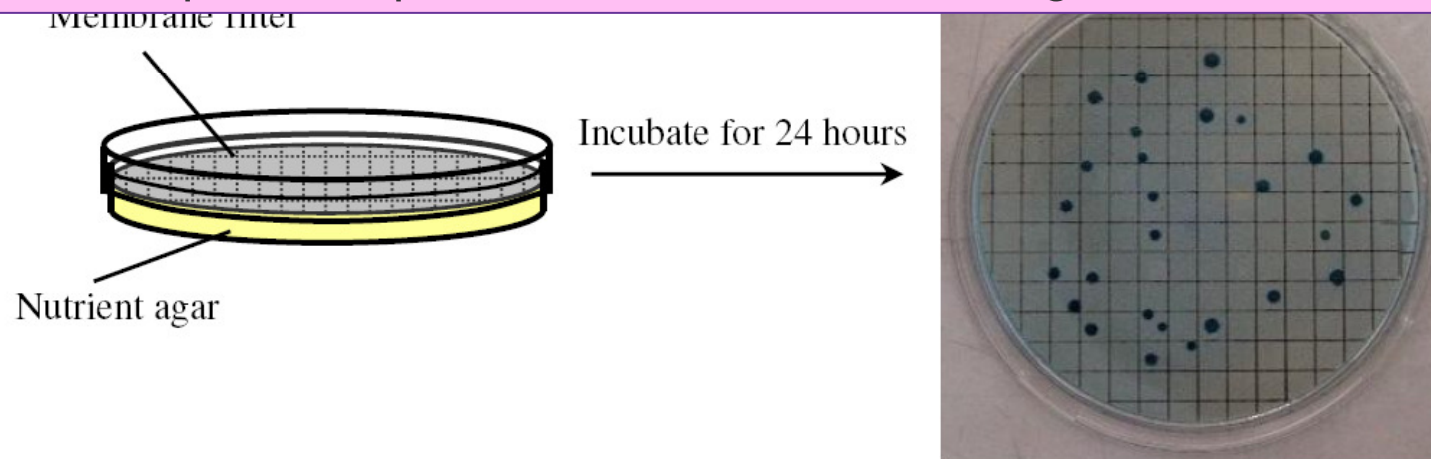
- (1) Identify microbe M. With reference to the above figures, state **one** observable difference between *E. coli* and microbe M. (2 marks)
- (2) Describe briefly the events shown in Figure 2. (2 marks)
- (3) In the mass production of human insulin, *E. coli* is genetically modified to carry the human insulin gene. Explain why bacteria (e.g. *E. coli*) are suitable for use in (2 marks)

(ii) *E. coli* is used as a water pollution indicating organism. A beach with an *E. coli* count exceeding 1600 per 100 cm<sup>3</sup> seawater is graded 'Very Poor' by the Environmental Protection Department. A 'Very Poor' beach is not suitable for swimming.

(1) Suggest why there is a health risk to people swimming in a 'Very Poor' beach. (1 mark)

*E. coli* is a natural inhabitant of the human intestine and a high level of *E. coli* would indicate

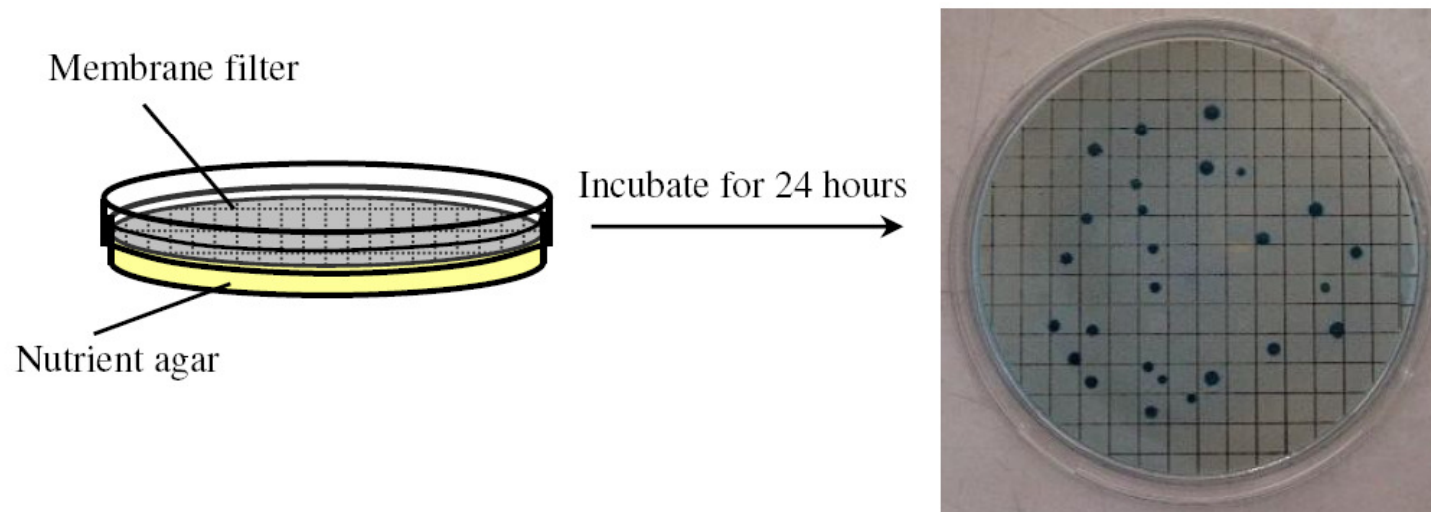
- ◆ a high level of faecal contamination
- ◆ suggest the possible presence of disease-causing microbes.



- (I) Explain how this method can be used to determine the *E. coli* count of the water sample. (2 marks)
- (II) Calculate the *E. coli* count per 100 cm<sup>3</sup> of the water sample. Based on your calculation, determine if this beach is 'Very Poor'. (2 marks)

(2) Students showed an understanding that the number of colonies observed corresponds to the number of bacteria retained on the filter, but they did not explain the reason behind this. However, they were able to use this concept in calculating the *E. coli* count and performed very well in part (II).

- (2) A student collects a water sample from a beach to determine its *E. coli* count. He filters 50 cm<sup>3</sup> of the water sample through a membrane filter, on which bacteria are retained. The membrane filter is then placed on a nutrient agar plate suitable for the growth of *E. coli* and incubated for 24 hours. This step and the result after incubation are shown in the figure below:

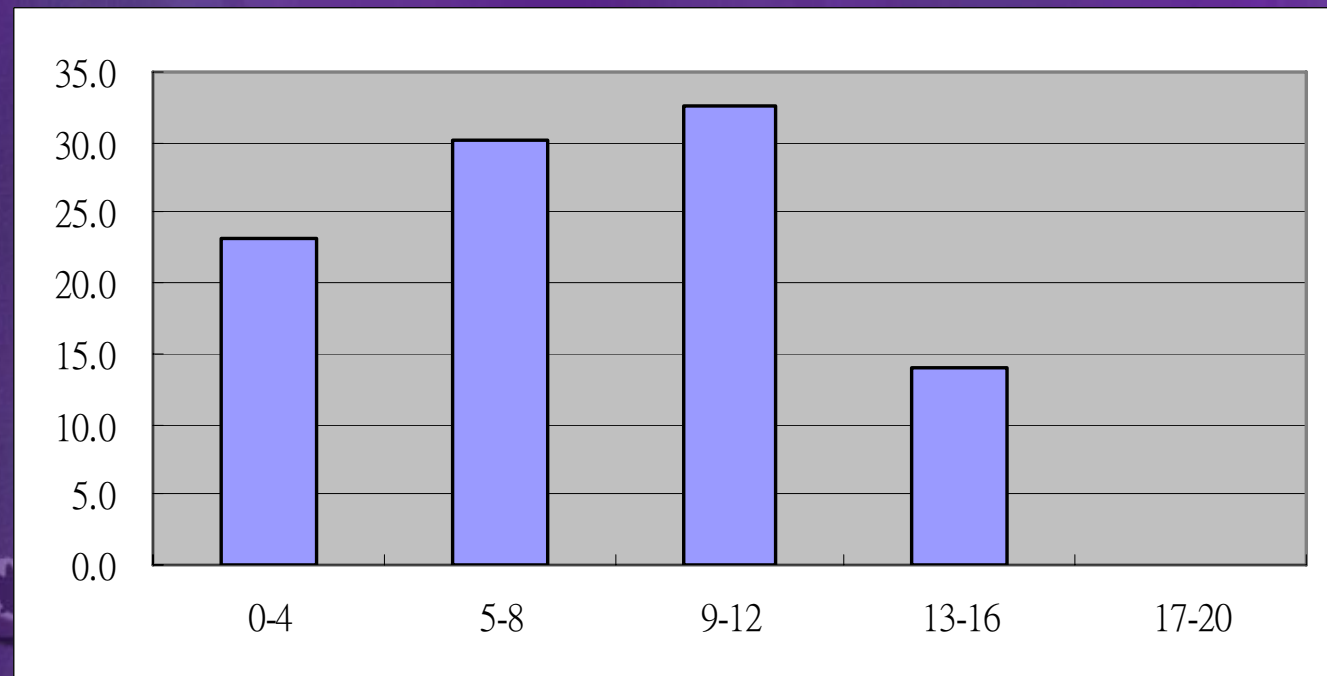


- (I) Explain how this method can be used to determine the *E. coli* count of the water sample. (2 marks)
- (II) Calculate the *E. coli* count per 100 cm<sup>3</sup> of the water sample. Based on your calculation, determine if this beach is 'Very Poor'. (2 marks)

# Q.4 : Biotechnology

- Scripts collected = 43
- Mean = 7.6 marks
- SD = 4.2 marks

% of students



Mark range



- (a) Severe combined immune deficiency (SCID) is an inherited disease. One form of SCID is caused by a gene mutation which renders the person unable to produce lymphocytes. Thus, people with this disease are susceptible to infections and, if untreated, rarely live past the age of two. To cure the disease, patients are transplanted with stem cells from the bone marrow of a healthy person. In 2000, it was first demonstrated that the disease could be cured by somatic gene therapy. In this therapy, a virus is used as a vector to incorporate the normal gene into the bone marrow cells of the patient.
- (i) Why can transplanting bone marrow stem cells to SCID patients be used for treating the disease? (1 mark)
- (ii) What is the basis of using somatic gene therapy for treating SCID? Give **one** advantage of treating SCID patients with somatic gene therapy over transplanting normal bone marrow stem cells to the patients. (2 marks)

(i) Students generally knew that the transplanted stem cells help restore the production of lymphocytes in SCID patients. However, they did not clearly state that stem cells are cells capable of differentiating into the lymphocyte producing cells.

(ii) Students performed very well in stating an advantage of somatic gene therapy over stem cell transplantation. Some thought that the defective gene is 'corrected' after somatic gene therapy. Some could not express clearly that the inserted normal gene compensate for the function of the defective gene.



(iii) There is another type of gene therapy called 'germ line gene therapy'. State **two** differences between the biological consequences of using germ line gene therapy and using somatic gene therapy in treating SCID. (2 marks)

(iv) In 2002, three out of eleven SCID children who received this somatic gene therapy treatment got leukemia (a type of blood cancer). Some scientists believe that the occurrence of the blood cancer is related to the incorporation of the normal gene into the bone marrow cells using a virus as the vector. Suggest an explanation for this belief. (2 marks)

(iii) Most could state that the normal gene could be passed to the offspring with germ-line gene therapy and that the normal gene cannot.

Not many realised that all cells of an individual developed after germ-line gene therapy will contain the normal gene.

Quite a number contrasted the processes involved rather than contrasting the biological consequences of the two processes.

(iv) Some students thought that the virus vector might have elicited an immune response that caused the illness.



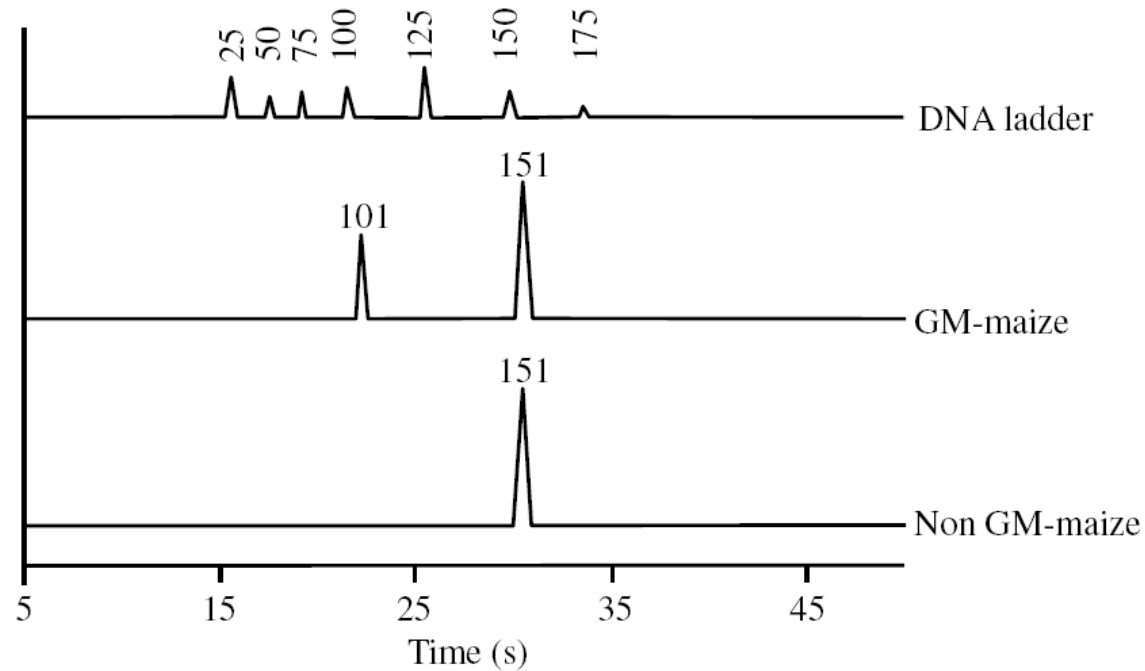
- (b) Polymerase chain reaction (PCR) is a technique in modern biotechnology. A cycle of PCR consists of three principal steps, which operate at 95°C, 55°C and 72°C in sequence.
- (i) Outline what happens in the three principal steps in a cycle of PCR. (3 marks)
  - (ii) One application of PCR is Polymerase Chain Reaction–Short Tandem Repeat Analysis (PCR–STR analysis) which can be used in forensics. In a crime scene, a piece of hair suspected to be the criminal’s is found. A suspect is arrested one week later.
    - (1) With reference to the above case, state the significance of PCR in PCR–STR analysis. (1 mark)
    - (2) Describe how the products of PCR are used in PCR–STR analysis to produce evidence for verifying whether the suspect has committed the crime. (3 marks)

(i) Students performed quite well in this question and showed quite good an understanding of the events taking place in the principal steps in a cycle of PCR.

(ii) Students were generally aware of how the products of PCR could be used for DNA fingerprinting.

(iii) Another application of PCR is for identifying GM organisms. The following shows the analysis of the DNA of a GM maize and a non-GM maize:

[Note: The number above each peak in the figure indicates the number of base pairs (bp).]



(1) A marker (a polynucleotide chain) with 101 bp is introduced to the maize in producing the GM maize. With reference to the above analysis, suggest the purpose of introducing a marker to the maize in the process of producing the GM maize.

(2 marks)

Student generally could suggest the purpose which the marker serves in the process of producing GM maize in part.

- (2) Illustrate with an example how GM plants can help promote people's health. (2 marks)
- (3) What are the possible impacts on the ecosystem of growing GM plants that produce a toxin to kill insects? Describe **two** possible impacts. (2 marks)

(2) Most students could give a correct example.

(3)

- ◆ Students generally could describe one possible impact on the ecosystem.
- ◆ Some students, however, gave an unlikely outcome of 'extinction of the insects' as a possible impact.



# Sample 1

46111. (3) The biodiversity will decrease if the toxin produced by GM plant killed ~~the~~ insects and cause ~~it~~ to extinct. X

(The amount of flowering plant is that also may decrease because some ~~from~~ flowering plant are insect pollinated. If insects killed are responsible for pollinating of flower like bees, then <sup>cause of</sup> pollination ~~the~~ decrease and ~~less~~ <sup>1</sup> decreases the ~~the~~ number of ~~floring~~ flowering plant. ✓ |

# Sample 2

113) The gene of the GM plants may pass to the wildlife of other species. This damage the ecological equilibrium and reduces the biodiversity. X

The GM plants may give rise to "super bugs" as the toxin produced to kill insects may speed up mutation and put selection pressure on pests. ✓

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THANK YOU !  
(Break)

