Theory 1

22 questions | 25 points
60 minutes

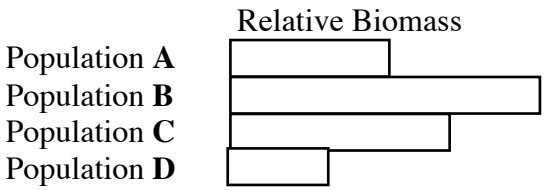
(1) A boy wanted to find the optimum conditions for his chickens to lay eggs. He divided his 20 chickens into 2 groups, X and Y, and recorded their daily care and egg production for 2 weeks.

	Number of chickens	Daily care (conditions tested)		Results after 2 weeks
		Chicken feed for group	Calcium for group	Number of eggs laid by group
Group X	10	1,000 grams	5 grams	82
Group Y	10	1,300 grams	10 grams	104

The boy **DID NOT** do a good job designing this investigation. He should have _____.
[1.5 marks]

A. used more chickens in each group
B. weighed the chickens each day rather than counting eggs
C. recorded how much water he gave the chickens
D. controlled the amount of feed or the amount of calcium

(2) Refer to the following bar graph which shows 4 populations, **A**-**D**, involved in the same food chain.
[1 mark]



Which population is most likely to have the largest amount of energy available to it?

A. Population **A**
B. Population **B**
C. Population **C**
D. Population **D**

(3) A student conducted an experiment using four (4) different set-ups: P, Q, R and S. All set-ups contain water in containers made of the same materials. The table below shows the different conditions when she started each experiment.

	Set-ups			
Conditions	**P**	**Q**	**R**	**S**
Room temperature (^oC)	22	24	22	22
Exposed surface area of water (cm^2)	100	100	50	100
Volume of water (ml)	150	150	150	150
Temperature of water (^oC)	50	50	50	40

Which of the following set-ups are the best for the student to use to ensure a fair test to investigate how the rate of evaporation of water was affected by: [1.5 marks]

	room temperature	exposed surface area of water	temperature of water
A	P and Q	P and R	P and S
B	Q and R	R and S	P and Q
C	Q and S	P and S	Q and R
D	R and S	Q and R	P and R

(4) A child is suffering from a disease caused by a certain nutrient deficiency. The child narrated that he shows the following symptoms: inability to gain weight, edema or swelling of the hand and feet, and stomach bulging. The doctor diagnosed the child of kwashiorkor.

Which groups of nutrient rich foods (P-S) and their corresponding sources will the doctor recommend the child to consume more in order to recover from the said nutrient deficiency? [1 mark]

P	Meat, Fish, Egg
Q	Butter, Lard, Margarine
R	Bread, Biscuit, Potato
S	Lemon, Tomato, Orange

A. Nutrient P
B. Nutrient Q
C. Nutrient R
D. Nutrient S

(5) *Chromobacterium violaceum* is a species of bacteria that is used in different biological tests. *C. violaceum* is able to sense the presence of other cells by releasing and detecting some signaling molecules. When *C. violaceum* multiplies and reaches a certain population called the quorum population, it begins to release a purple-colored compound called violacein. This mechanism is called quorum-sensing.

A scientist is investigating whether a seaweed extract inhibits the quorum sensing of *C. violaceum*. She grows *C. violaceum* together with the seaweed extract in a liquid broth for 24 hours, and then measured the concentration of violacein and the number of cells. In the experiment, methanol is used as negative control, while cinnamaldehyde is used as a positive control. Below is the result that she obtained.

	Methanol	Cinnamaldehyde	Seaweed extract
Concentration of violacein (mg/L)	80	40	20
Number of cells (x1,000)	110	110	110

Based on the results, what is the possible effect of the seaweed extract on *C. violaceum*? [1.5 marks]

A. The seaweed extract is an antibiotic as it does not allow the number of cells to exceed 110,000.
B. The seaweed extract is an antibiotic as it reduces the number of cells producing violacein.
C. The seaweed extract is a quorum-sensing inhibitor as it stops the cells from producing violacein, preventing them to multiply.
D. The seaweed extract is a quorum-sensing inhibitor as it prevents cells to communicate with each other without killing them.

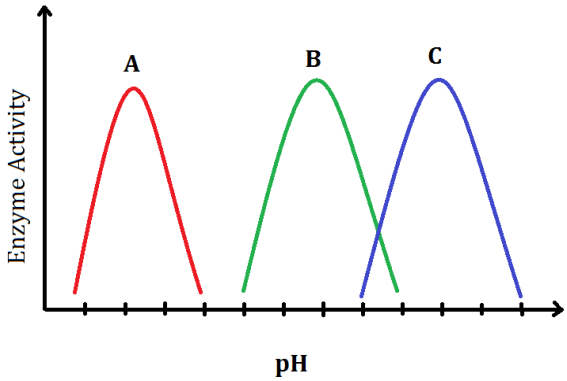
(6) The upper arm has two types of muscles namely triceps and biceps. These muscles work against each other to produce movement. When an athlete lifts weights as illustrated in the picture on the right, what happens to his upper arm muscles? [1 mark]

	Biceps	**Triceps**
A.	Contract	Contract
B.	Relax	Relax
C.	Contract	Relax
D.	Relax	Contract

(7) A block of ice with an iron nail embedded inside is floating on water in a beaker. The initial water level is marked on the side of the beaker. When the ice completely melts, the water level will be _____ the original mark. [1 mark]

A. below
B. at
C. above
D. cannot be determined

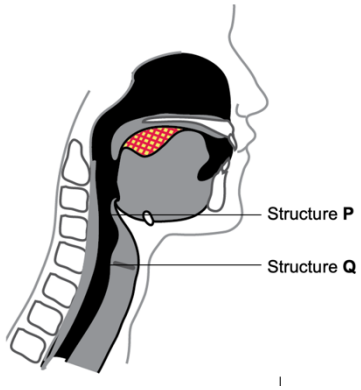
(8) The graph shows the activity of three human enzymes from different regions of the digestive tract with different pH.



Which of the following shows the correct grouping of enzyme and substrate being broken down? [1.5 mark]

	Enzyme A	**Enzyme B**	**Enzyme C**
A.	Protein	Lipid	Starch
B.	Starch	Lipid	Starch
C.	Protein	Starch	Lipid
D.	Starch	Protein	Lipid

(9) The diagram below shows the structures present between the mouth and the oesophagus.



Which of the following options CORRECTLY describes how Structures **P** and **Q** work together to prevent choking during the process of swallowing? [1 mark]

	Structure **P**	Structure **Q**
A.	Moves up	Moves up
B.	Moves down	Moves down
C.	Moves up	Moves down
D.	Moves down	Moves up

(10) Komodo dragon (*Varanus komodoensis*), also known as Komodo monitor, is the national animal of Indonesia. It is a species of lizard found in the Indonesian islands of Komodo East Nusa Tenggara. Komodo dragons, the world's largest lizard, are able to reproduce both sexually and asexually. They are *parthenogenetic*.

Which of the following statements correctly describe *parthenogenetic* animals? [1 mark]

A. They are animals that can produce both sperm cell and egg cell.
B. They are animals that do not produce egg cells and sperm cells.
C. They are animals that reproduce from a single sperm cell without fertilizing an egg.
D. They are animals that reproduce from an egg cell that can develop into an embryo without being fertilized by a sperm.

(11) A student was given four pictures of animals as shown below.

Goose

Whale

Deer

Seahorse

He was told to group the animals correctly into the classification table below.

Animals			
Lay eggs		Give birth to young alive	
Live on land	Live in water	Live on land	Live in water
W	X	Y	Z

Which one of the following rows shows the correct answers for W, X, Y and Z? [1 mark]

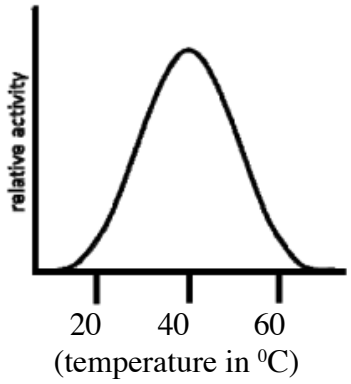
	W	X	Y	Z
A	Goose	seahorse	Whale	Deer
B	Goose	Whale	seahorse	Deer
C	Deer	seahorse	Goose	whale
D	Goose	seahorse	Deer	whale

(12) The table shows features of some blood vessels. Which set of features describes the pulmonary artery? [1 mark]

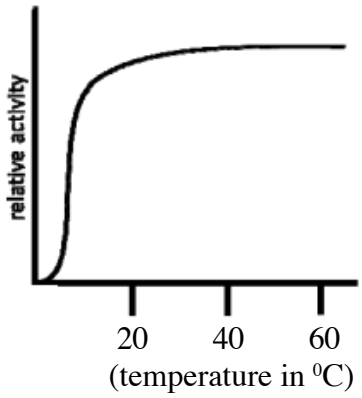
	Feature			
	Muscle layer	Lumen	Direction of blood flow	Blood
A.	thick	narrow	away from the heart	deoxygenated
B.	thick	wide	away from the heart	oxygenated
C.	thin	narrow	towards the heart	oxygenated
D.	thin	wide	towards the heart	deoxygenated

(13) Enzymes are protein substances that digest food completely in the human digestive system. They are produced in various parts of the body such as the salivary glands, gastric glands and pancreas. Enzymes work differently at various temperatures. Which of the following graphs best represents how enzyme activity varies with temperature? [1 mark]

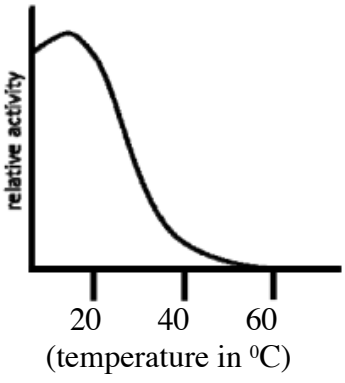
A.



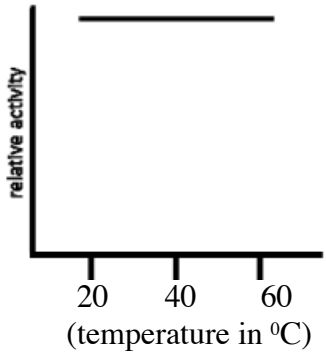
B.



C.



D.



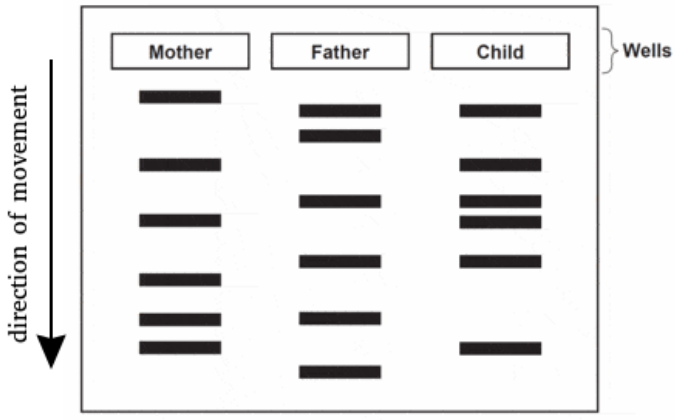
(14) When cyan and yellow paints are mixed together, the result is green. The reason for this is that _____. [1 mark]

A. cyan light and yellow light make green light.
B. yellow pigments absorb green light and reflect all the others.
C. between cyan and yellow pigments, all colors are absorbed except green.
D. cyan absorbs yellow light and yellow absorbs cyan light.

(15) Agarose gel electrophoresis is a laboratory method used to separate DNA by size. In a gel electrophoresis, DNA molecules migrate from one end of the gel to the other end, where lighter molecules migrate faster than the heavier ones.

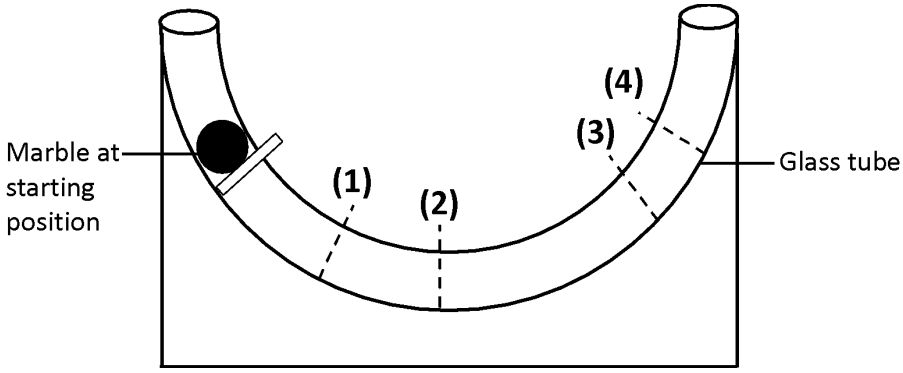
The parents of a new baby believe they brought the wrong child home from the hospital. Gel electrophoresis was performed using DNA samples from the parents and the child. A section of the gel electrophoresis results is shown below.

Which conclusion is valid based on the results? [1 mark]



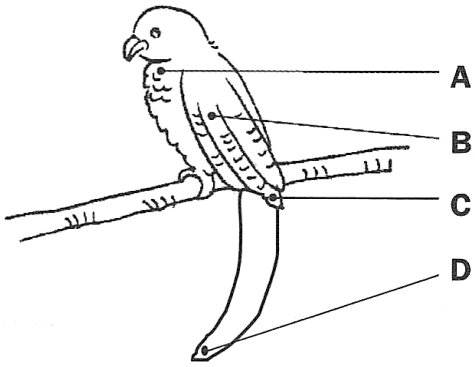
A. They have the correct child, because her genetic information is identical to that of the father.
B. They have the wrong child, because her genetic information does not match that of either parent.
C. They have the correct child, because her genetic information came from both parents.
D. They have the wrong child, because her genetic information matches only that of the mother.

(16) A student placed a marble in a glass tube. She observed that when she released the marble it rolled to the other end of the tube before rolling back downwards.

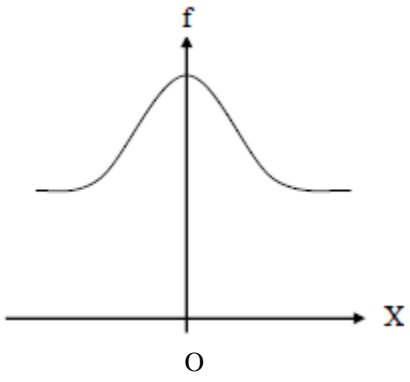


At which position will the marble reach before it rolls back downwards? [1 mark]
A. (1) B. (2) C. (3) D. (4)

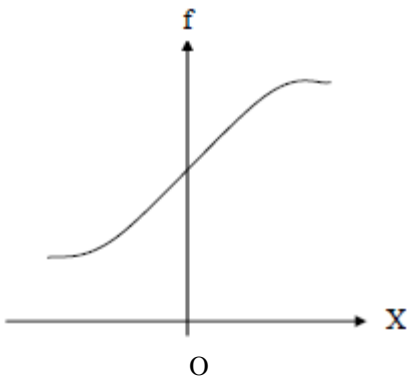
(17) The diagram shows a toy bird pivoted on a support and in stable equilibrium. When designing the toy bird, the manufacturer needs to plan the position of its center of gravity. Which position, **A**, **B**, **C** or **D**, should the center of gravity be? [1 mark]



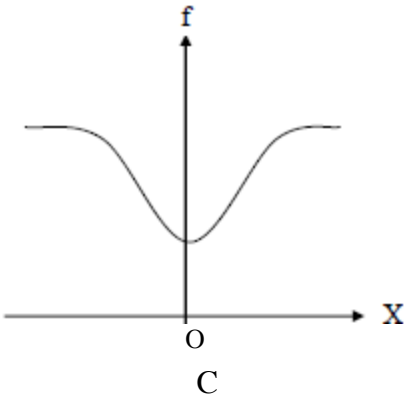
(18) An ambulance moves through a street along the positive X direction and a person who stands beside the street hears the sound of the ambulance siren. Which option represents the frequency (f) received by the person? X is the position of the ambulance; the person stands at the origin. [1 mark]



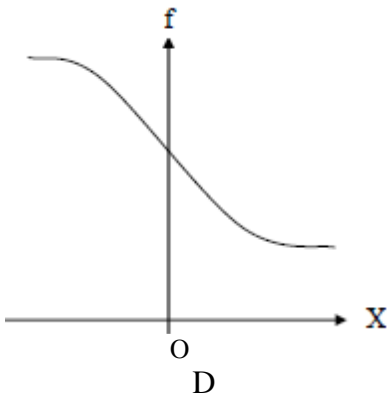
A



B



C



D

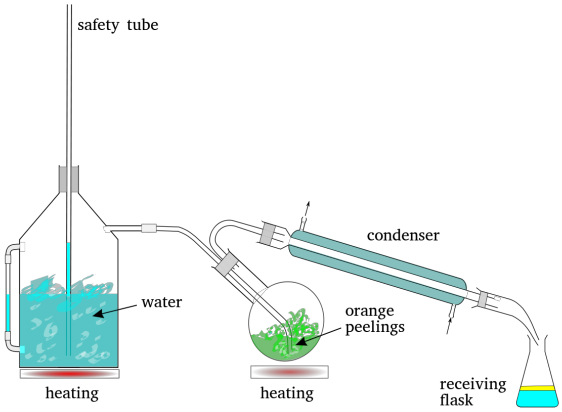
(19) The table below shows what happens in the chemical equation, $A + B \rightarrow C + D$, and the time it takes for the reaction to take place.

Reaction	Reactant (gram)		Product (gram)		**X** (gram)	Time (minute)
	A	B	C	D		
1	10	15	18	7	-	20
2	10	15	18	7	1	12

What is substance X? [1 mark]

A. catalyst
B. inhibitor
C. enzyme
D. conductor

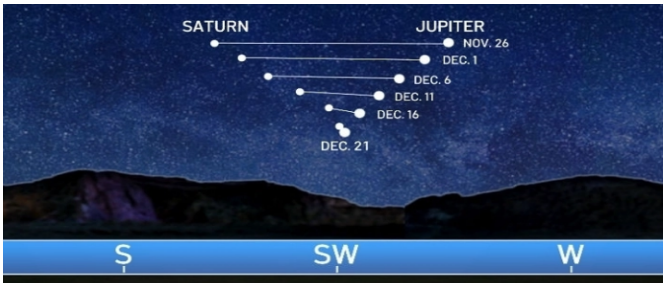
(20) Steam distillation is used to extract limonene, a volatile essential oil, from oranges. In steam distillation, a flask containing water is heated to form steam. The steam then enters another flask with the orange peelings. Finally, limonene and water are collected at the receiving flask. Steam allows the limonene to boil at a lower temperature and carries its vapor with it.



Which of the following statements is the main reason why steam distillation is used to extract limonene? [1.5 marks]

A. Because steam has greater kinetic energy than water, steam distillation can extract limonene faster than in simple distillation.
B. Because the initial amount of water is greater in the first flask, steam distillation can extract more limonene than in simple distillation.
C. Because limonene and water is immiscible, the distillate can be separated easily.
D. Because the peelings contain both volatile and non-volatile compounds, steam distillation only extracts limonene without extracting the rest of the non-volatile materials.

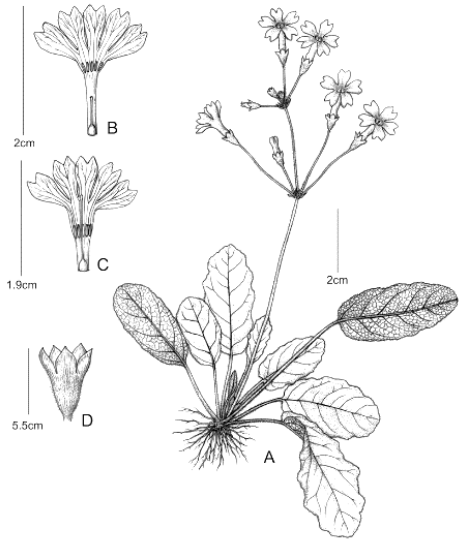
(21) Last December 21, 2020, a very rare phenomenon was observed in the sky just above the southwestern or western horizon after sunset. It was the moment when planets Jupiter and Saturn appear at their closest. It was also the first time the planets became so close since 1623. The event has been dubbed the "Christmas star," because some astronomers have theorized the “Star of Bethlehem” could have been a product of a close approach of Saturn and Jupiter.



https://www.nbcchicago.com/news/local/christmas-star-to-be-visible-for-first-time-in-nearly-800-years-this-month/2388427/

What is this rare phenomenon called? [1 mark]

(22) A scientist takes a sample of plant from the forest. Use the dichotomous key below to identify species of the plant. [1.5 marks]



Drawn by Yunxiao LIU, from the holotype.

1. a. narrow leaf …….. go to 2
   b. broad leaf …… go to 3
2. a. bell-like flower …….. bluebell
   b. trumpet-like flower……. wild daffodil
3. a. top petal overhangs lower petal …… dead nettle
   b. top petal does not overhang lower petal …….. go to 4
4. a. heart-shaped leaf …… lesser celandine
   b. ovate leaf ……... primrose

- END OF THEORY 1 -

IMSO SCIENCE TEST THEORY 1

ANSWER SHEET

25

Printed name: ..... *ID:* .....

Instructions:

1. Do NOT start answering this paper until you are told to do so.
2. Be sure that your name and ID are written on spaces provided.
3. Write only your answers in this ANSWER SHEET.
4. Write only the letter of the correct answer in UPPERCASE/CAPITAL LETTER.
5. Use BLACK ink to write on the Answer Sheet.
6. Diagrams are not drawn to scale. They are intended as aids only.
7. There are 20 multiple-choice questions and 2 short answer questions printed in 10 pages. There is only one correct answer for each question.
8. Submit a clear scanned copy of this paper to your team leader within 30 minutes after the end of the session.

1		**12**	
2		**13**	
3		**14**	
4		**15**	
5		**16**	
6		**17**	
7		**18**	
8		**19**	
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10		**21**	
11		**22**	