



香港資優教育學苑
The Hong Kong Academy for Gifted Education

International Junior Science Olympiad 2018 - Hong Kong Screening

Question Book

Contestant No. : _____

Name of Contestant : _____

Rules and Regulations:

1. The contest is a 1 hour written test.
2. The paper consists of 45 multiple-choice questions.
3. Only calculators approved by The Hong Kong Examinations and Assessment Authority with “HKEAA APPROVED” logo may be used for the contest. Measuring instruments like rulers, compasses, etc. can also be used. No stationeries will be provided.

Co-organised by The Hong Kong Academy for Gifted Education,
the Gifted Education Section of the Education Bureau,
Faculty of Science, The Chinese University of Hong Kong, and
the Hong Kong Association for Science and Mathematics Education

Multiple Choice Questions (45 marks)

Please put your answers on the MC Answer Sheet. Each question carries 1 mark. Choose the BEST answer for each question. No marks will be deducted for incorrect answers.

1. Two unbiased coins are tossed. What is the probability of getting at most one head?

- A. $1/2$
- B. $1/3$
- C. $2/3$
- D. $3/4$

(Ans: D)

2. Which one of the following shapes with the same perimeter has the largest area?

- A. a circle
- B. a square
- C. a triangle
- D. a parallelogram

(Ans: A)

3. The area of a right-angled triangle is 36 m^2 . One of its angles is 45° . Find the length of the hypotenuse of the triangle.

- A. 6 m
- B. 15 m
- C. 9 m
- D. 12 m

(Ans: D)

4. When we ride an elevator, we feel slightly lighter if the elevator

- A. accelerates up.
- B. accelerates down.
- C. moves upward steadily.
- D. moves downward steadily.

(Ans: B)

5. A boat and a ferry both start from rest and accelerate at the same rate. However, the boat accelerates for twice the amount of time as the ferry. What is the travelled distance of the boat compared to the ferry?

- A. half as much
- B. the same
- C. twice as much
- D. four times as much

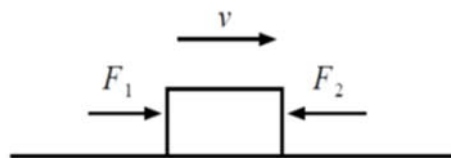
(Ans: D)

6. A ball is thrown vertically upwards under the influence of gravity. At the highest point in the ball's motion,

- A. its velocity is zero and its acceleration is zero.
- B. its velocity is zero and its acceleration is nonzero.
- C. its velocity reaches a maximum value and its acceleration is nonzero.
- D. it experiences no force.

(Ans: B)

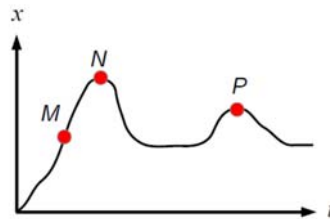
7. A box is sliding on a smooth horizontal surface at a constant velocity v as shown in the figure. It is acted upon by two forces F_1 and F_2 . Compare the magnitudes of F_1 and F_2 .



- A. $F_1 > F_2$
- B. $F_1 = F_2$
- C. $F_1 < F_2$
- D. Not enough information to decide

(Ans: B)

8. The graph shows the position x of a particle (moving along a straight line) as a function of time t . Which of the following descriptions is correct?



- A. The velocity at N is larger than the velocity at M .
- B. The force acting on the particle is constant.
- C. The force acting on the particle at N is zero.
- D. The acceleration at P is nonzero.

(Ans: D)

9. A boy sits at rest on a chair. The gravitational force on the boy is one half of an action-reaction pair according to Newton's third law of motion. Which force is the other half?

- A. The upward force that the chair exerts on the boy.
- B. The downward force that the boy exerts on the chair.
- C. The upward force that the ground exerts on the chair.
- D. The upward force that the boy exerts on the earth.

(Ans: D)

10. Which of the following planets has the smallest mass?

- A. Jupiter
- B. Venus
- C. Mars
- D. Saturn

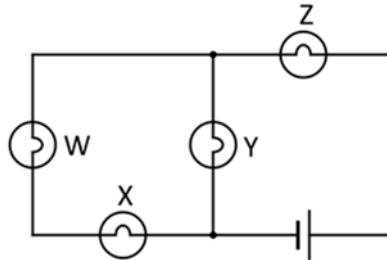
(Ans: C)

11. A bullet of mass m is shot upwards at 45 degrees to the horizontal. The initial speed of the bullet is u , and the gravitation acceleration is g . What is the net force acting on the bullet right after it has left the gun barrel? Ignore air resistance in your estimation.

- A. mv
- B. mg
- C. $1.4 m$
- D. There is no net force acting on the bullet.

(Ans: B)

12. There are one battery and four identical light bulbs in the following circuit.



Which of the following statements is/are correct?

- I. Bulbs W and X have the same brightness.
- II. Bulbs Y and Z have the same brightness.
- III. Bulb X is dimmer than bulb Y.

- A. I only
- B. II only
- C. I and III
- D. II and III

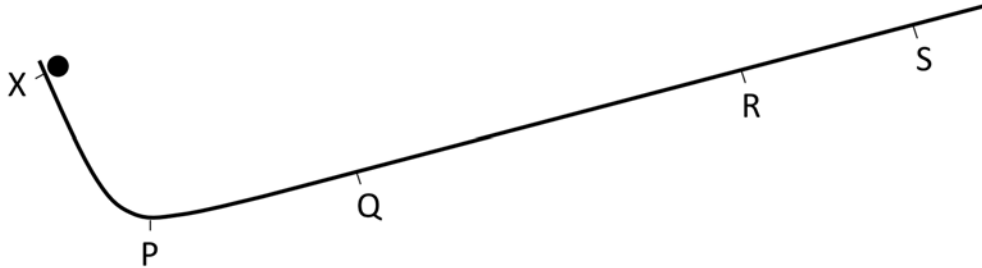
(Ans: C)

13. When a metal ring is heated, how do the inner radius and the outer radius change?

- A. inner radius increases, outer radius increases
- B. inner radius increases, outer radius decreases
- C. inner radius decreases, outer radius increases
- D. inner radius decreases, outer radius decreases

(Ans: A)

14. A small ball is released at rest from point X on the following smooth track. It slides down the left side (which has an angle of inclination of 75 degrees), passes the bottom of the track at point P, and slides up the right side (which has an angle of inclination of 15 degrees). Where would the ball stop momentarily?



- A. at point Q, which has the same distance as point X from point P.
- B. at point R, which is at the same height as point X.
- C. at point S, which is at 3.7 times the distance from point P compared to the distance XP.
- D. The answer depends on the mass of the ball.

(Ans: B)

15. After being thrown vertically upward with an initial speed u , a sphere reaches a height h . How high would it reach if the initial speed were $2u$?

- A. $1.4h$
- B. $2h$
- C. $2.8h$
- D. $4h$

(Ans: D)

16. Which of the following elements is the THIRD most abundant in the earth crust?

- A. Oxygen
- B. Nitrogen
- C. Aluminum
- D. Iron

(Ans: C)

17. What is the number of protons in an atom of ${}_{31}^{69}\text{Ga}$?

- A. 100
- B. 69
- C. 38
- D. 31

(Ans: D)

18. Which of the following statements best describes milk?

- A. It is an element.
- B. It is a compound.
- C. It is a homogenous mixture.
- D. It is a heterogeneous mixture.

(Ans: C)

19. Which of the following substances has a chemical formula different from the other three substances?

- A. Silicate glass
- B. Fullerene
- C. Sand
- D. Quartz

(Ans: B)

20. Which of the following is a chemical change?

- A. Blue ink and red ink are mixed to give purple ink
- B. When yeast is placed in warm water, bubbles are produced
- C. When water is heated, it turns to steam
- D. A piece of paper is cut into smaller pieces

(Ans: B)

21. Acidity is related to the concentration of hydrogen ions in the solution. Mathematically, the acidity of a solution can be calculated by $pH = -\log[H^+]$. If a solution of pH 2 is diluted by 100 times, what will be the effect on the pH?

- A. The pH will be increased by 1.5
- B. The pH will be increased by 2.0
- C. The pH will be decreased by 1.5
- D. The pH will be decreased by 2.0

(Ans: B)

22. What are the values for a, b, c, d and e in the following chemical equation?



- A. a = 2; b = 16; c = 2; d = 11; e = 4
- B. a = 1; b = 8; c = 2; d = 6; e = 2
- C. a = 1; b = 16; c = 1; d = 11; e = 2
- D. a = 2; b = 8; c = 1; d = 7; e = 4

(Ans: A)

23. Which of the following is NOT a correct match between metal ions in water and color?

	<u>Metal Ions</u>	<u>Color</u>
A.	Na ⁺	Colorless
B.	Cu ²⁺	Blue
C.	Cr ³⁺	Purple
D.	Fe ²⁺	Green

(Ans: C)

24. Which of the following compounds is the heaviest per unit?

- A. C₆H₁₂O₆
- B. CoCl₂
- C. C₂B₁₀H₁₂
- D. LiAlH₄

(Ans: A)

25. The following table shows the results of the reactions of four different metals with cold water, steam and hydrochloric acid.

Metal	Reaction with		
	Cold water	Hydrochloric acid	Steam
W	✓	✓	✓
X	×	×	×
Y	×	✓	✓
Z	×	✓	×

✓: Reaction occurs

× : Reaction does not occur

Arrange the reactivity of the metals in ascending order.

- A. W, Z, Y, X
- B. X, Z, Y, W
- C. Z, X, Y, W
- D. W, Y, Z, X

(Ans: B)

26. When 7.23 g of magnesium are heated in air, 11.99 g of magnesium oxide are formed. What is the percentage by mass of oxygen in the compound?

- A. 39.7%
- B. 18.7%
- C. 4.38%
- D. 0.603%

(Ans: A)

27. In an experiment, 32 g of element X reacts with 48 g of element Y to produce 80 g of compound Z. If 16 g of element X and 100 g of element Y are placed into a closed container and allowed to react, what is the total mass of the substance(s) in the container after the reaction is completed?

- A. 16 g
- B. 40 g
- C. 100 g
- D. 116 g

(Ans: D)

28. Which of the following gases is used in water purification process?

- A. Oxygen
- B. Hydrogen
- C. Fluorine
- D. Chlorine

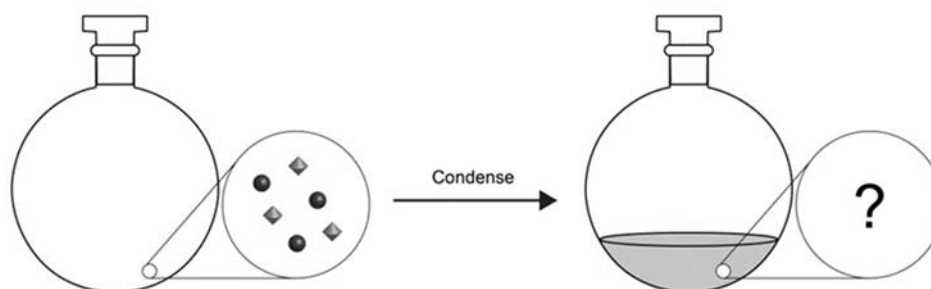
(Ans: D)

29. Which of the following reaction does NOT involve oxidation-reduction?

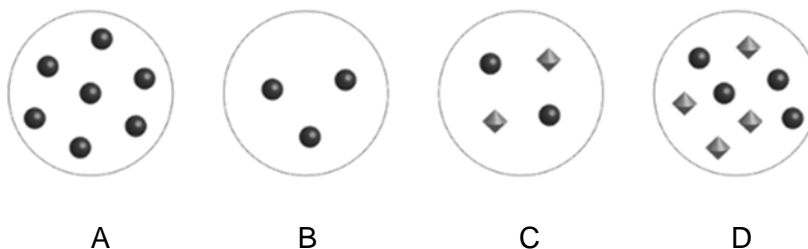
- A. Burning sodium in chlorine
- B. Combustion of wood
- C. Decomposition of KClO_3
- D. Neutralization of NaOH with H_2SO_4

(Ans: D)

30. The following closed container contains two gases. When the container is cooled down to 5°C , one of the gases condenses.



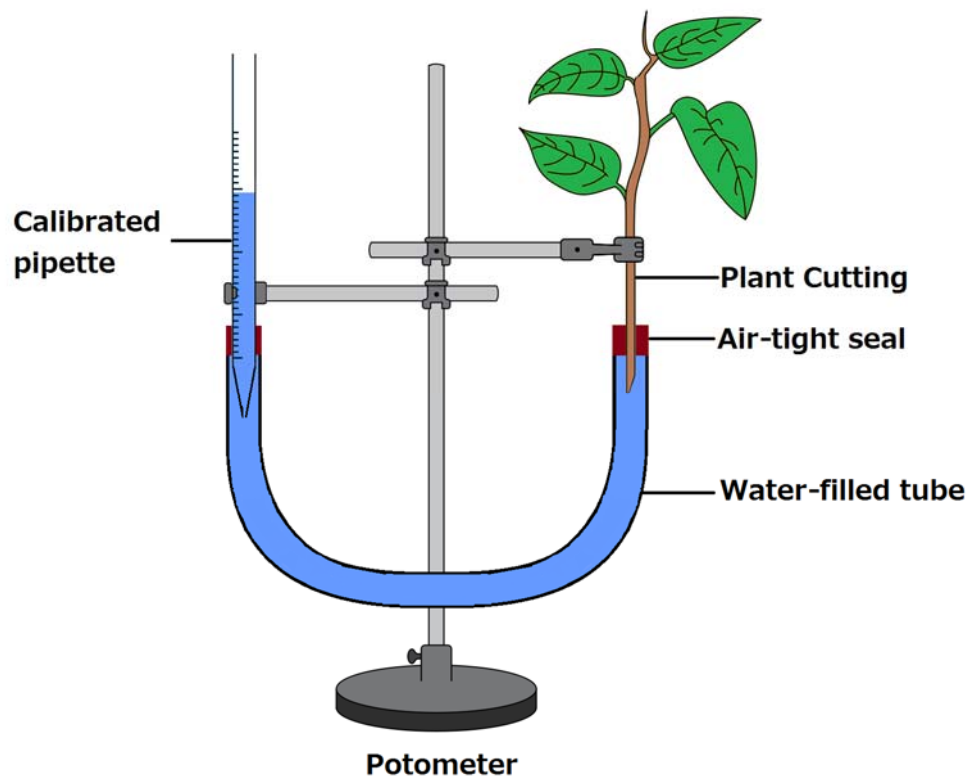
Which of the following diagram best represents the same area of the magnified view of the liquid in the right figure with a circle?



(Ans: A)

Answer **Q31** and **Q32** based on the following information.

Transpiration refers to evaporation of water from plant leaves. Below is an experimental setup for measuring transpiration rate.



31. Compared to the intact plant, predict the change of the water level at the calibrated pipette if two of the leaves have been removed.

- A. Going up in a faster way
- B. Going up in a slower way
- C. Going down in a faster way
- D. Going down in a slower way

(Ans: D)

32. Which of the following factors will affect the measured rate of transpiration?

- A. Length of the water-filled tube
- B. Length of the calibrated pipette
- C. Temperature
- D. More than one of the factors above

(Ans: C)

Answer **Q33** and **Q34** based on the following information.

Below shows an identification key of invertebrates in woodland X.

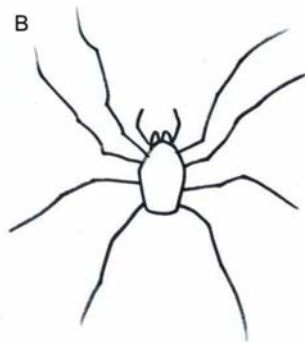
- | | | |
|----|----------------------------------|------------|
| 1a | No legs..... | Go to 2 |
| 1b | Legs..... | Go to 4 |
| 2a | Shell..... | Snail |
| 2b | No shell..... | Go to 3 |
| 3a | Segments..... | Worm |
| 3b | No segment..... | Slug |
| 4a | 6 legs..... | Insect |
| 4b | More than 6 legs..... | Go to 5 |
| 5a | 8 legs..... | Go to 6 |
| 5b | More than 8 legs..... | Go to 7 |
| 6a | Body in 1 part..... | Harvestman |
| 6b | Body in 2 parts..... | Spider |
| 7a | 1 pair of legs per segment..... | Centipede |
| 7b | 2 pairs of legs per segment..... | Millipede |

33. Which of the following is harvestman?

A



B



C

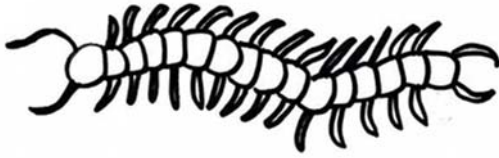


D



(Ans: B)

34. Identify the following invertebrate.

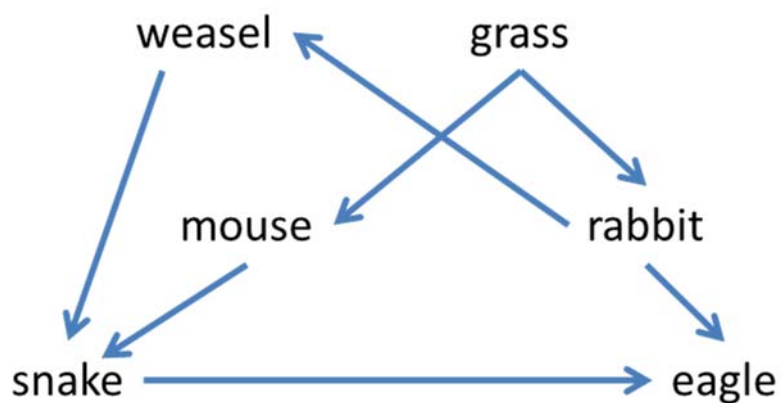


- A. Worm
- B. Insect
- C. Centipede
- D. Millipede

(Ans: C)

Answer **Q35** and **Q36** based on the following information.

Food chain is a series of organisms that are linked because each group of organisms eats the next one in the chain and is in turn eaten while food web is a network of food chains. Below shows a typical food web in a grassland.



35. How many groups of organisms that can be found in the longest food chain in this food web?

- A. 2
- B. 3
- C. 4
- D. 5

(This question is cancelled.)

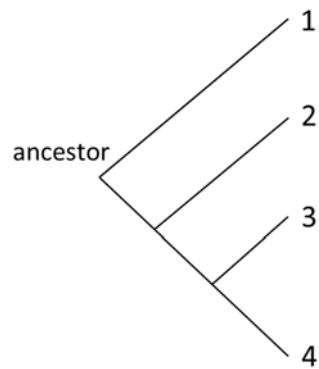
36. Which of the following is NOT a possible short-term consequence if mouse is removed from the food web?

- A. Number of weasel increases
- B. Number of rabbit increases
- C. Number of snake decreases
- D. Biomass of grass increases

(Ans: A)

Answer **Q37** and **Q38** based on the following information.

Phylogenetic tree **w** depicts the evolutionary relationship of four groups of organisms (1, 2, 3 and 4).



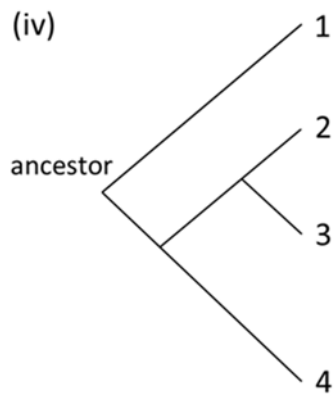
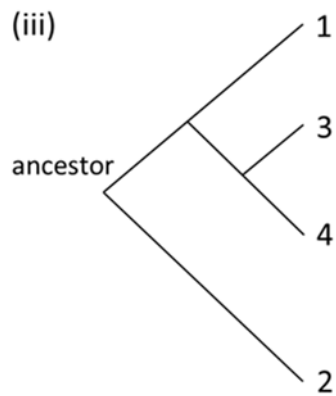
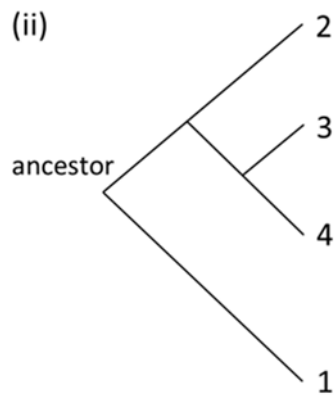
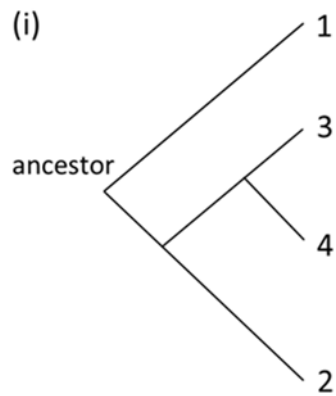
Phylogenetic tree **w**

37. Which group(s) of organisms has/have the closest relationship with group 2?

- A. 1
- B. 3
- C. 4
- D. 3 & 4

(Ans: D)

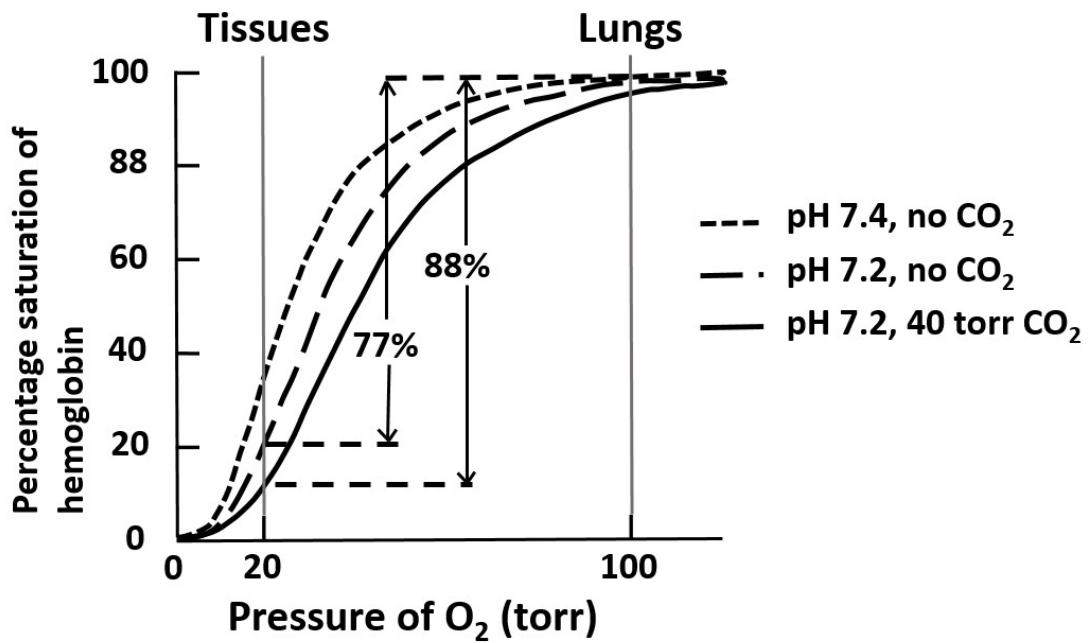
38. Which tree(s) below is/are equivalent to tree **w**?



- A. (i) only
- B. (iv) only
- C. (i) & (ii) only
- D. (iii) & (iv) only

(Ans: C)

39. Shown below is the experimental results on the binding of oxygen to hemoglobin molecules under different pH values and CO₂ partial pressure.



According to the figure, the effect of increasing acidity and increasing CO₂ partial pressure on the percentage saturation of hemoglobin molecule is:

- Increase in percentage saturation of hemoglobin in both cases.
- Decrease in percentage saturation of hemoglobin in both cases.
- Increase in percentage saturation of hemoglobin with increasing acidity but decrease in percentage saturation of hemoglobin with increasing CO₂ partial pressure.
- Increase in percentage saturation of hemoglobin with increasing CO₂ partial pressure but decrease in percentage saturation of hemoglobin with increasing acidity.

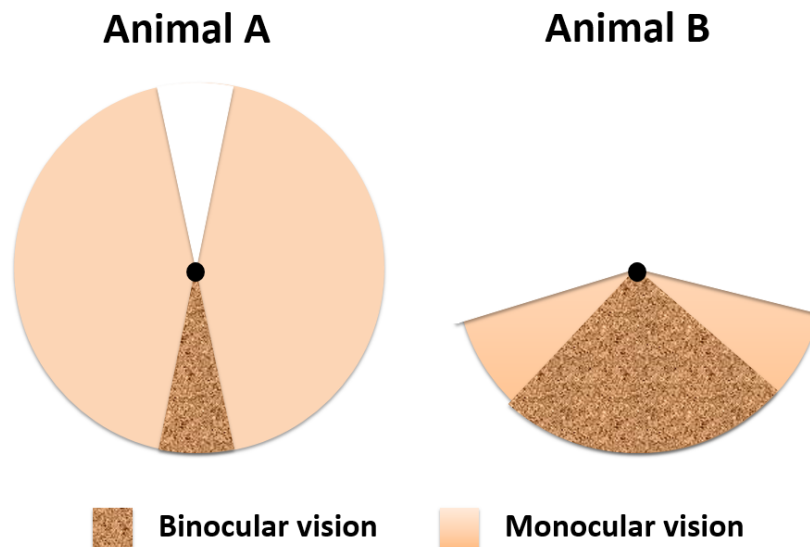
(Ans: B)

40. In newly formed ecosystems such as islands formed by volcanic eruption, living organisms from the mainland will invade the islands with decreasing number of new species arriving over time. On the other hand, the rate of extinction will rise with increasing in total number of species as a result of competition. In the long run the rate of migration and extinction will be much reduced and the number of species on the island will reach an equilibrium. Which of the following island ecosystems will have the highest number of species at equilibrium?

- A. Large island close to mainland.
- B. Small island far from mainland.
- C. Large island far from mainland.
- D. Small island close to mainland.

(Ans: A)

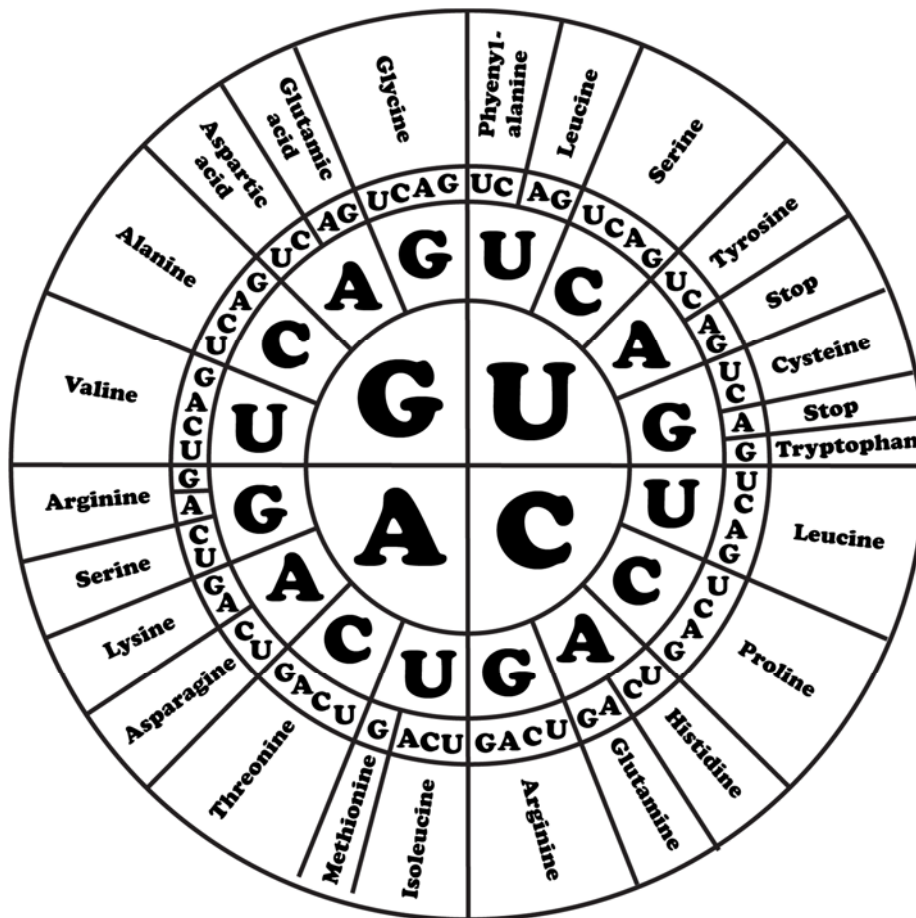
41. The figure below shows the field of vision of two animals, A and B. Assuming that the ability of vision in animals correlates with their mode of life and survival, which of the following statements regarding the vision in the two animals is FALSE?



- A. The eyes of animal A should be located at the sides of the head.
- B. The eyes of animal B should be located at the front of the head.
- C. Animal A should be a predatory species because the wide field of vision will facilitate searching of prey.
- D. Animal B should be a predatory species because binocular vision is needed in locating the exact position of prey.

(Ans: C)

Answer questions Q42 and Q43 with reference to the figure below:



RNA Codon Chart

42. Nucleotides are building blocks of genetic materials such as DNA and RNA. The figure on universal genetic code shows how the nucleotide sequences in RNA molecules code for amino acids. According to the codon chart, which of the following statements is FALSE?

- A. The amino acid methionine is coded for only by the nucleotide sequence AUG.
- B. The amino acid leucine is coded for only by the sequences CUU, CUC, CUA, and CUG.
- C. The amino acid tryptophan is coded for only by the nucleotide sequence UGG.
- D. There are 3 possible combinations in nucleotide sequences that can stop the process of translating RNA codes to amino acids.

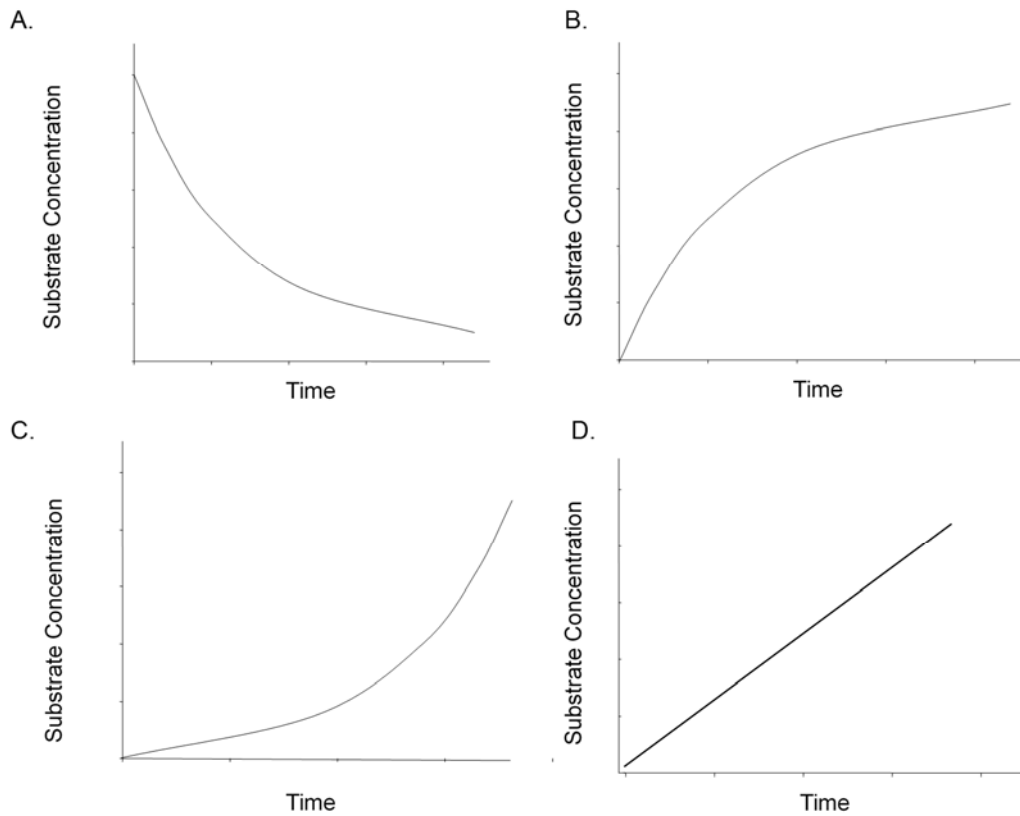
(Ans: B)

43. Which of the following statements regarding the genetic codes is FALSE?

- A. The genetic code is made up of 3 consecutive nucleotides.
- B. The sequences in the RNA molecules will govern the sequence of amino acids in protein molecules constructed by living organisms.
- C. The maximum possible combinations of genetic codes is 78.
- D. There are only four types of nucleotides in making up the RNA molecules.

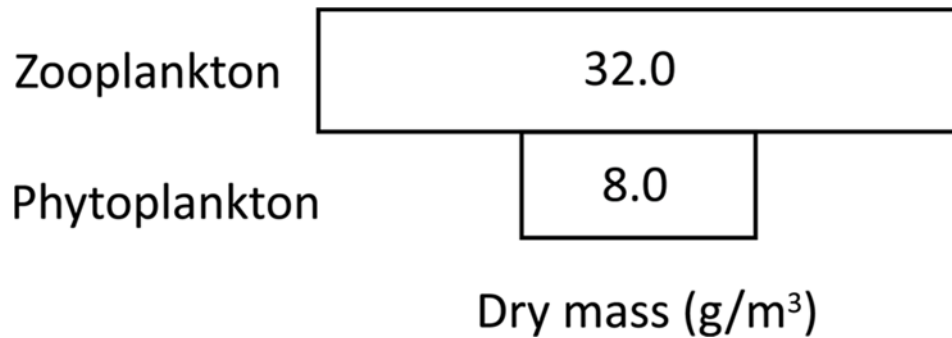
(Ans: C)

44. Which of the following figures best represents the changes in substrate concentration for an enzyme reaction in vitro?



(Ans: A)

45. The pyramid of biomass diagram was constructed based on data collected in a recent sampling of plankton at the Tolo Harbour.



Which of the following statements best explains the inverted pyramid?

- A. The sampling procedures must have been wrong.
- B. The phytoplankton is not consumed by the zooplankton.
- C. The reproductive rate of zooplankton must be higher than that of phytoplankton.
- D. The reproductive rate of phytoplankton must be higher than that of zooplankton.

(Ans: D)

PERIODIC TABLE 周期表

GROUP 族

atomic number 原子序		relative atomic mass 相對原子質量																					
I	3 Li 6.9	II	4 Be 9.0																	VII	9 F 19.0	0	2 He 4.0
	11 Na 23.0		12 Mg 24.3																	VI	8 O 16.0		10 Ne 20.2
	19 K 39.1		20 Ca 40.1																	V	7 N 14.0		18 Ar 40.0
	37 Rb 85.5		38 Sr 87.6																	IV	6 C 12.0		36 Kr 83.8
	55 Cs 132.9		56 Ba 137.3																	III	5 B 10.8		54 Xe 131.3
	87 Fr (223)		88 Ra (226)																	II			86 Rn (222)
	21 Sc 45.0		22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8						
	39 Y 88.9		40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3						
	57 * La 138.9		72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)						
	89 ** Ac (227)		104 Rf (261)	105 Db (262)																			
	58 Ce 140.1		59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0								
	90 Th 232.0		91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)								

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