



VANDA

SCIENCE GLOBAL FINALS

Secondary 4 / Grade 10

Full Name: _____ Country: _____

School: _____ Index Number: _____

Instructions to Students:

1. Only scientific calculators are allowed during the contest for secondary school/Grade 7 and above students.
2. The duration of this contest is **1 hour**. You may not leave the contest venue within the first half an hour of the paper.
3. This examination paper contains **20** questions and comprises of **14** printed pages, inclusive of the cover page.
4. Each question has only 4 possible answers: **A, B, C** and **D**. You must shade your correct option on the Answer Entry Sheet provided.
5. The total marks for this paper is 70 points:

Section A:

Question 1 to 5: +2 points for correct answer, 0 points for no answer and –1 point for wrong answer.

Section B:

Question 6 to 10: +3 points for correct answer, 0 points for no answer or wrong answer.

Section C:

Question 11 to 20: +4 points for correct answer, 0 points for no answer or wrong answer.

6. You are not allowed to bring the question paper and answer script out of the contest venue.

Note:

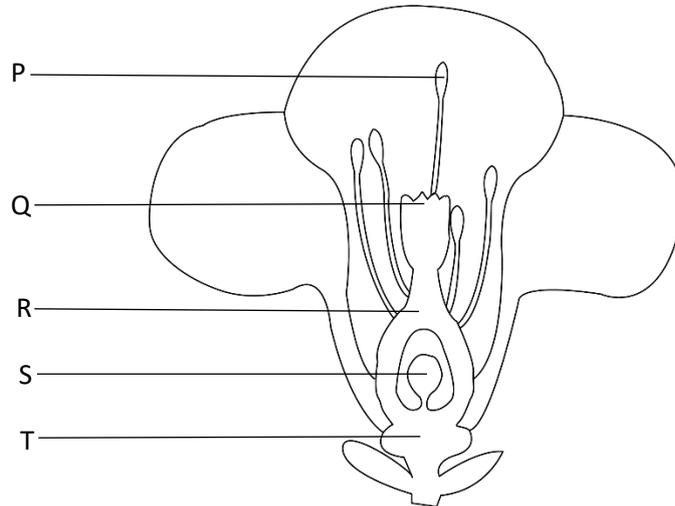
- 1) You may assume that there is no air resistance throughout the contest, unless otherwise stated.
- 2) All temperatures are in degree Celsius, unless otherwise stated.
- 3) Room temperature is 25°C at 1 atmospheric pressure.
- 4) Gravitational Acceleration is taken to be 9.8 m/s².

Rough Working

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Section A (Question 1 to 5: +2 points for correct answer, 0 points for no answer and –1 point for wrong answer.)

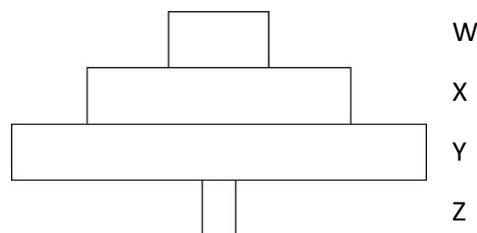
1. The diagram below shows a bisexual flower from a flowering plant. Bisexual flowers that have both male and female parts.



Which of the following pairs of labels corresponds correctly to the parts where the male gamete is produced and where the zygote develops in the flower after fertilisation?

	part that produces the male gamete	part where the zygote develops after fertilisation
A.	S	Q
B.	S	P
C.	P	S
D.	P	T

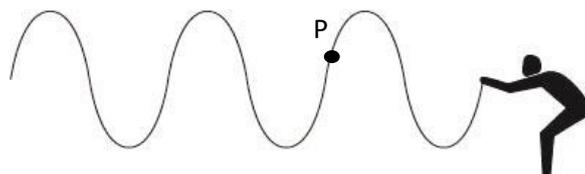
2. The diagram below shows the biomass pyramid for four organisms, W, X, Y and Z.



Which of the four organisms in the diagram has the highest trophic level?

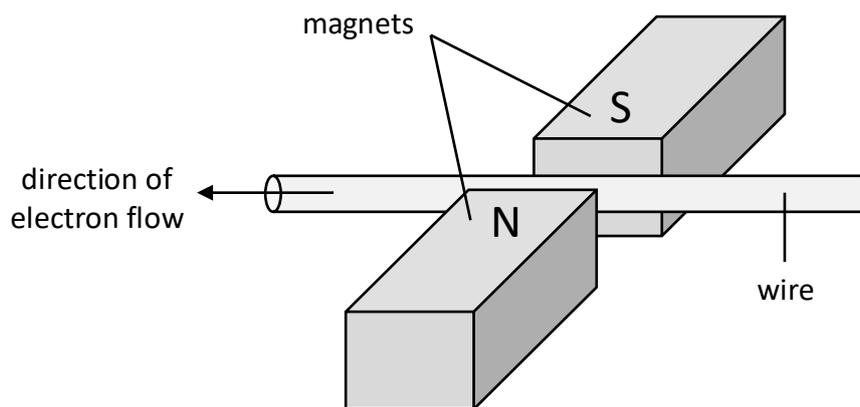
- A.** W
- B.** X
- C.** Y
- D.** Z

3. An exercise an athlete can do at a gym is the battling ropes. The athlete transfers his energy via waves as consistently as possible down to the other end of the rope.



One way to increase the difficulty of the exercise is to use more energy to generate bigger amplitudes. How will this affect the position of point P on the rope?

- A. P will not change with the wave motion.
 - B. P will move further upwards and further downwards.
 - C. P will move towards the other end of the rope.
 - D. P will move towards the direction of the athlete.
4. A current-carrying wire is placed in between two magnets. The direction of electron flow is shown.



What is the direction of the force on the wire?

- A. downwards
 - B. upwards
 - C. closer to the magnet with the N-pole
 - D. closer to the magnet with the S-pole
5. Which of the following reactions is possible using the titration method?
- A. $K_2CO_3 + HNO_3 \rightarrow 2KNO_3 + CO_2 + H_2O$
 - B. $H_2SO_4 + Mg \rightarrow MgSO_4 + H_2$
 - C. $AgNO_3 + NaCl \rightarrow Na + NO_3 + AgCl$
 - D. $Fe_2O_3 + 6HCl \rightarrow 2FeCl_3 + 3H_2O$

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Section B (Question 6 to 10: +3 points for correct answer, 0 points for no answer or wrong answer.)

Each question has 4 numbered options. Response is based on the following table:

A	B	C	D
1 is correct only	1 and 3 correct only	2 and 4 correct only	1,2,3,4 are correct

6. The following is a response of the skin when the body encounters a slight change of temperature.

“The hair erector muscle relaxes, lowering the hair.”

Which of the following responses by the skin would also correspond to the slight change of temperature as above?

1. The arterioles under the skin get dilated.
 2. The blood flow in the capillaries under the skin decreases.
 3. The amount of heat loss through the skin increases.
 4. Involuntary contractions of the muscle cause the whole body to shiver.
7. Thalassaemia is a blood related genetic disorder which affects the production of haemoglobin, a protein present in the red blood cells. Thalassaemia manifests when two recessive alleles are combined. People who are aware of this disease recommend they undergo testing to check if they themselves are compatible to his/her partner.

Which of the following statements is true about such beliefs?

1. If one parent is a carrier of the recessive gene and the other parent does not carry the gene at all, there is a chance the offspring may also carry the gene.
2. Adults who do not show any exhibit symptoms of thalassaemia are guaranteed not to have children with thalassaemia.
3. If both parents are carriers of the recessive gene but do not show any signs of thalassaemia, there is a 50% chance the offspring may suffer from thalassaemia.
4. Offspring will always suffer from thalassaemia if just one of the parents suffers from the disease.

8. Overexposure to ultraviolet radiation in the past century has become a concern to human health. As such, one of the recommendations is to wear hats and sunglasses on sunny days to protect the eyes.

Which of the following statements is true about how ultraviolet radiation affects the body?

1. The human skin responds to ultraviolet radiation exposure by turning lighter over time.
2. Darker skins absorb more ultraviolet light so less ultraviolet radiation reaches the deeper tissues.
3. The presence of clouds blocking the sun will reduce the amount of exposure to ultraviolet radiation significantly.
4. It is good to wear sunscreen with high sun protection factor on sunny days to avoid skin cancer.

9. Jackson replaced the names of several metals and listed them in order of the reactivity series. The list was as follows:

ayru, eyru, carbon*, iyru, oyru, hydrogen*, uyru

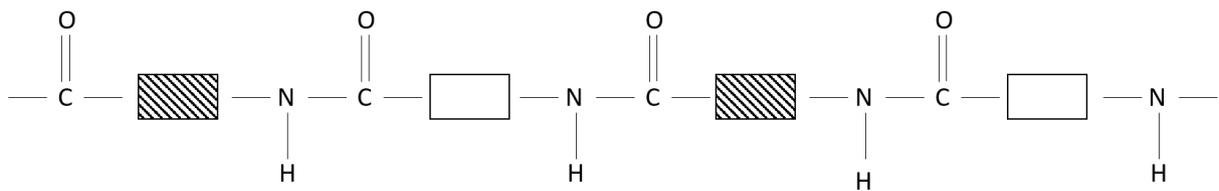
← increasing order of chemical reactivity

*added for comparison

Which of the following statements is true about the list?

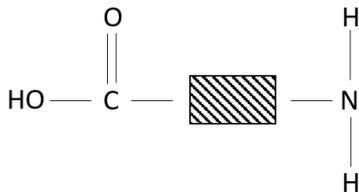
1. The metal which reacts the most slowly with nitric acid, forming hydrogen is oyru.
2. Ayru metal can be used a sacrificial element when coated on to eyru metal.
3. Heating carbon and iyru oxide strongly will yield iyru metal.
4. The metal that is least resistant to corrosion is uyru.

10. Study the structure of the polymer below.

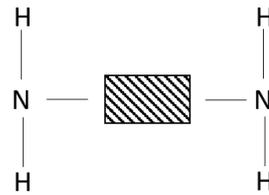


Which of the following are the monomers that make up this polymer?

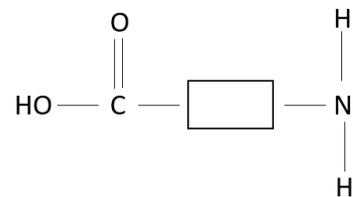
1.



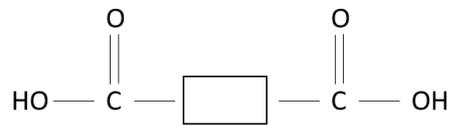
2.



3.



4.



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Section C: (Question 11 to 20: +4 points for correct answer, 0 points for no answer or wrong answer.)

11. The table shows the arbitrary amounts of substances J, K, L and M before and after leaving the nephron in a kidney found in healthy human being.

	amount of substance in arbitrary units			
	J	K	L	M
before passing through nephron	27	25	10000	9
after passing through nephron	27	24	9949	5

Which of the following substances could be urea?

- A. J
- B. K
- C. L
- D. M

12. A student wrote the following description about adrenaline and how it affects the human body.

“In times of fear or stress, adrenaline is produced by the adrenal glands. Adrenaline targets the vital organs and increases the heart rate. Adrenaline boosts the delivery of oxygen to the brain and muscles. Glucose is converted into glycogen in the liver cells when there is an energy demand. Energy is released by respiration in the muscles.”

Which sentence in the above description is wrong?

- A. Glucose is converted into glycogen in the liver cells when there is an energy demand.
- B. Adrenaline targets the vital organs and increases the heart rate.
- C. Energy is released by respiration in the muscles.
- D. Adrenaline boosts the delivery of oxygen to the brain and muscles.

13. High frequency sound waves can be used to detect objects in deep water and to measure water depth. This technique is applied in sonar systems is used by fishing boats to find shoals of fish.

A fishing boat sent out a sonar wave to a school of fish below it and received the signal back 6.6 seconds later.

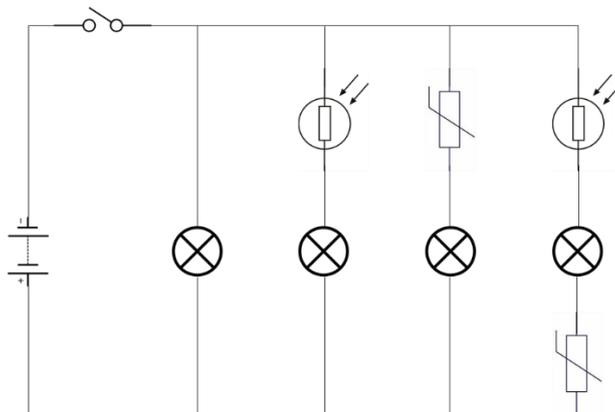
Given that the speed of sound underwater is about 1500 m s^{-1} , what is the distance of the school of fish from the boat?

- A. 49.5 metres
 - B. 99 metres
 - C. 4950 metres
 - D. 9900 metres
14. Xerography uses electrostatics in order to work. The first two stages involve leaving a positive charge in the shape of the image on a drum that is to be copied while the rest of the drum remains electrostatically neutral. The third stage is the attraction of charged dry black powder on to the drum. The fourth stage is a charging a blank piece of paper so that it will pull the dry black powder from the drum. Finally, the whole paper pass through heated pressure rollers.

What is the charge of the dry black powder and the blank piece of paper respectively during the process?

	dry black powder	blank piece of paper
A.	positive	positive
B.	positive	negative
C.	negative	positive
D.	negative	negative

15. The circuit diagram below consists of a power source, four light bulbs, a switch, two light-dependant resistors, two thermistors and wires connecting all of them.



The circuit was initially placed in an open area without any shade and beside a heater. The switch was closed and all four light bulbs were brightly lit.

Jason brought the circuit into a dark room and placed the circuit beside another strong heat source.

How many bulbs will still be brightly lit after Jason moved the circuit to the new location?

- A. one
 - B. two
 - C. three
 - D. four
16. An experiment was setup in which two similar bars, P and Q made from different materials were magnetised. Both bars were placed near some paper clips and the number of paper clips that were attracted to each bar was recorded. Afterwards, both bars were hammered several times in an east-west direction. Both bars were again placed near some paper clips and the number of paper clips that were attracted to each bar was recorded.

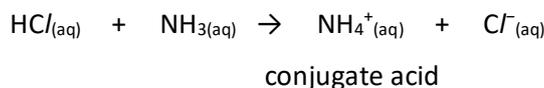
The table below shows the result of both experiments.

	number of paper clips attracted	
	after being magnetised	after hammering
P	6	0
Q	6	5

Which bar would be most suitable to be used to make the electromagnet in a fire alarm and the reason for the choice?

- A. P because it is a temporary magnet
- B. P because it is a permanent magnet
- C. Q because it is a temporary magnet
- D. Q because it is a permanent magnet

17. In Brønsted-Lowry Theory of acids and bases, a Brønsted-Lowry acid is a proton donor, while a Brønsted-Lowry base is a proton acceptor. In the acid-base reaction example below, HCl is the Brønsted-Lowry acid while NH₃ is the Brønsted-Lowry base.



Brønsted-Lowry acid-base reactions results in the formation of conjugate acids. From the example above, the conjugate acid is NH₄⁺.

Which of the following reactions below has the conjugate acid correctly labelled?

- A. $\text{C}_2\text{H}_4(g) + \text{H}_2(g) \rightarrow \text{C}_2\text{H}_6(g)$ conjugate acid: C₂H₆
 B. $\text{NO}_3^-(aq) + \text{H}_2\text{O}(l) \rightarrow \text{HNO}_3(aq) + \text{OH}^-(aq)$ conjugate acid: HNO₃
 C. $\text{Cu}(\text{OH})_2(s) + 4\text{NH}_3(aq) \rightarrow [\text{Cu}(\text{NH}_3)_4]^{2+}(aq) + 2\text{OH}^-(aq)$ conjugate acid: [Cu(NH₃)₄]²⁺
 D. $\text{Al}(\text{OH})_3(s) + 3\text{H}^+(aq) \rightarrow \text{Al}^{3+}(aq) + 3\text{H}_2\text{O}(l)$ conjugate acid: H₂O

18. The amount of energy used to break the bonds of some diatomic molecules are listed below.

Bond	Energy / kJ mol ⁻¹
H-F	562
H-Cl	431
H-Br	366
H-I	299

Which of the following statements is true about the elements in Group VII?

- A. The longer the bond length, the less energy it takes to break the bond.
 B. All the values listed in the table are positive because bond breaking is an exothermic process.
 C. The bigger the element down the group, the shorter the bond length between the hydrogen atom and the halide.
 D. The amount of energy required to break the intra-molecular bond and the amount of energy to break the inter-molecular bond is the same.
19. The table below lists the relative concentrations of polluting gases in the air produced by four areas, A, B, C and D.

Which city limestone statues will suffer the most amount of corrosion by acid rain?

	sulfur dioxide	carbon monoxide	nitrogen dioxide	methane
A.	27	30	21	22
B.	22	27	30	21
C.	21	22	27	30
D.	31	21	22	26

20. When it comes to the manufacturing of margarine, generally the more solid the margarine, the more trans-fat it contains. Trans-fat, like saturated fat, lowers high-density lipoprotein (HDL), or "good" cholesterol levels.

Which of the following statements is true about margarine?

- A. Consuming more trans-fat will decrease the risk of heart disease.
- B. Some margarines involve the process of hydrogenation of vegetable oil.
- C. The higher degree of unsaturation the vegetable oil, the more solid the margarine will be.
- D. Saturated fat contains more C=C bonds within its molecules compared to unsaturated fat.

Rough Working

Rough Working