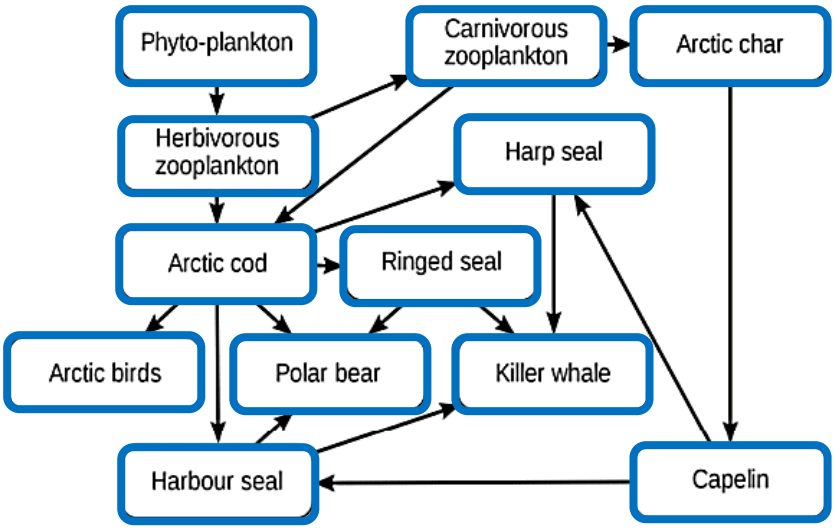
1. Single-celled organisms are able to maintain homeostasis, even though they lack higher levels of organization such as organs and organ systems, because

1. single-celled organisms do not carry out the same life processes as multicellular organisms
2. multicellular organisms do not rely on tissues or organs to carry out life processes
3. cell structures work together to maintain homeostasis in single-celled organisms
4. single-celled organisms are able to coordinate organ functions to maintain homeostasis

2. Use the following diagram of a marine food web.



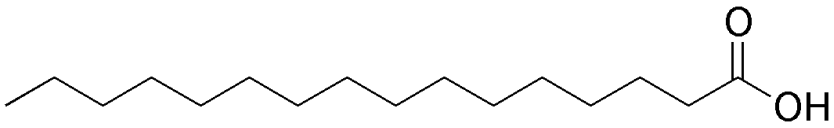
Which of the following statements is correct?

1. Herbivorous zooplankton are primary producers.
2. Polar bears are under threat of extinction because harbour seals are tertiary consumers in the food chain.
3. Harp seals eat arctic cod and capelin and killer whales eat harp seals.
4. The primary production is increased when the number of zooplankton increase.

3. *Euglena* are unique single-celled organisms. Depending on the physical conditions present in their aquatic environment, Euglena can act as either producers or consumers. *Euglena* will most likely act as consumers when placed in an environment that has

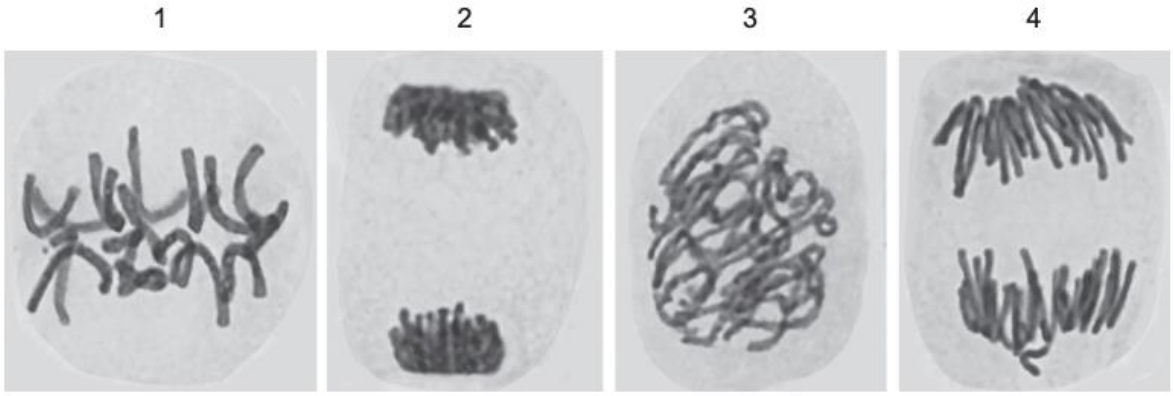
1. an acidic pH
2. a low oxygen level
3. little or no light present
4. many predators

4. The chemical structure below is the basic chemical component of which substance?



1. Carbohydrate
2. Protein
3. Nucleic acid
4. Fatty acid

5. The photomicrographs show cells in various stages of the cell cycle.



Which cells contain twice as many DNA molecules as a cell from the same organism that has just finished a complete mitotic cell cycle ending with cytokinesis?

1. 1, 2, 3 and 4
2. 1, 2 and 4 only
3. 1 and 3 only
4. 2 and 4 only

6. Bacteria reproduce asexually by a process known as binary fission. In binary fission, the bacterium's single chromosome is copied and the cell splits in half, with each new cell receiving a copy of the chromosome. The biggest advantage that binary fission often has over sexual reproduction is that ....

1. the offspring inherit only favorable genes
2. the genetic material comes from two parents
3. there is more genetic variety in the resulting cells
4. a large number of identical offspring are produced

7. The single-celled organism *Thiomargarita namibiensis* measures 700 μm in diameter and is enclosed in a cell wall. The genetic material of *T. namibiensis* is located free in the cytoplasm where it occurs as thousands of copies of circular DNA. Most of the cell is taken up by a large vacuole, which stores essential chemicals for metabolism.

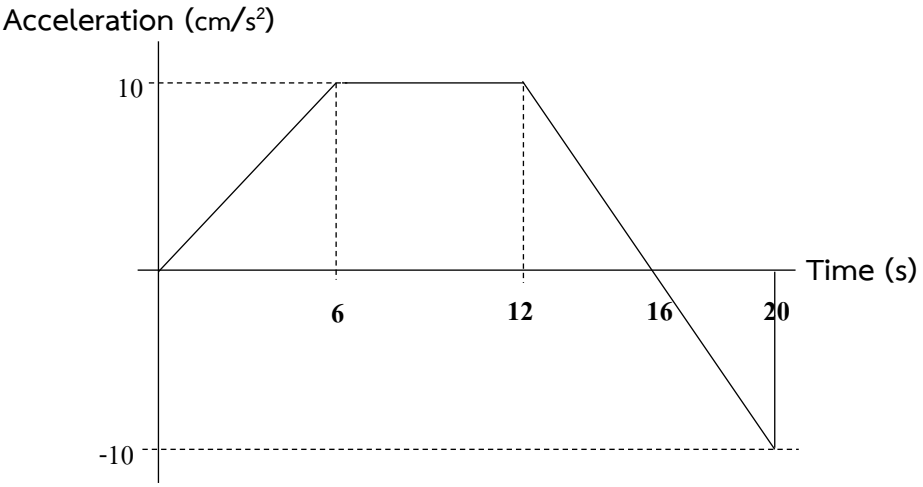
Which statement is correct?

1. It must be a plant because it contains a vacuole.
2. It must be a plant because it is enclosed in a cell wall.
3. It must be a prokaryote because its DNA is circular and located in the cytoplasm.
4. It must be a eukaryote because a diameter of 700 μm is too large for a prokaryote.

8. A contractile vacuole is an organelle that pumps excess water out of many freshwater protozoan cells. A freshwater protozoan was placed in solution A and observed to form contractile vacuoles at a rate of 11 per minute. The same protozoan was then placed in solution B and observed to form contractile vacuoles at a rate of 4 per minute. Based on this information, which of the following statements is correct?

1. Solutions A and B are isosmotic
2. Solution B is hyperosmotic to solution A
3. Solution A is hyperosmotic to solution B
4. Solutions A and B are isosmotic to the protozoan cell

9. The relationship between acceleration and time for a certain test car over a period of 20 seconds is shown in the graph below.



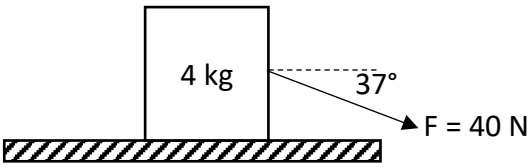
Should this test car start moving at a speed of 10 cm/s northwards, what its speed will be in the 20th second?

1. 90 cm/s
2. 100 cm/s
3. 130 cm/s
4. 140 cm/s

10. A student measures the outer diameter of a certain PVC pipe as 20.50 mm and needs to find its radius squared, which of the following recorded results is incorrect?

1. 105.1 mm^2
2. 0.0001051 cm^2
3. 1.051×10^{-4} cm^2
4. 105.0625 mm^2

11. When a force of 40 N pulls a 4 kg object on a frictionless horizontal surface with coefficients of static and kinetic friction of 0.375 and 0.125 respectively, making a 37 degree angle with the horizontal as shown in the diagram,



what is the acceleration of the object? Given that sin 37° = 0.6, cos 37° = 0.8, and the acceleration due to gravity is 10 m/s^2.

1. 2 m/s^2
2. 4.25 m/s^2
3. 6 m/s^2
4. 6.75 m/s^2

12. Which of the following should not be done in a chemistry laboratory?

A. Mixing chemicals in unlabeled bottles together before disposing them in the chemical waste bin.

B. Storing concentrated alkaline solutions, such as sodium hydroxide, in an amber glass bottle.

C. Taking an unused measuring cup to measure chemicals in the laboratory.

D. Pouring distilled water into a beaker containing a highly concentrated acidic solution to prepare a solution.

1. A and B
2. A, B, and D
3. B, C, and D
4. All are correct

13. What is the total number of valence electrons in H_2PO^{4-} ?

1. 28
2. 30
3. 32
4. 50

14. If element M has an atomic number of 17 and element N has an atomic number of 56, what would be the chemical formula of compound MN, and what type of bond would it be?

	Chemical formula for the compound	Type of bond
1.	M_2N	Ionic bond
2.	MN_2	Covalent bond
3.	NM_2	Ionic bond
4.	N_2M	Covalent bond

15. An experiment was carried out to determine whether drinking caffeinated soda increases pulse rate. The pulse rates of two groups of people at rest were measured. Group A was then given caffeinated soda and group B was given caffeine-free soda. One hour after drinking the soda, the pulse rates were measured. The participants in the experiment were all the same age, and they were all given the same amount of soda. The dependent variable in this experiment is the

1. type of soda given to each group
2. amount of soda given to each group
3. pulse rate of each group
4. age of participants in each group

16. Scientists have sequenced the DNA of the extinct woolly mammoth. The data suggested that the woolly mammoth was more closely related to present-day elephants than previously believed.

Which statement could account for the similarities between the woolly mammoth and present-day elephants?

1. Common gene mutations were caused by agents such as industrial chemicals and radiation.
2. Present-day species developed from earlier, different species.
3. Selective breeding results in offspring better able to survive.
4. Both animals have identical genetic information.

17. Ecological pyramids are used in biology to represent relationships between and within populations quantitatively. Producers are shown on the bottom and subsequent layers represent higher-level consumers. The following diagram shows three different pyramids of population numbers.



I II III

Which pyramid represents a population in the process of decreasing?

1. I only
2. II only
3. III only
4. I and III

18. Over the last 50 million years, icefish evolved many adaptations that contributed to their success in surviving the decreasing water temperatures of the ocean surrounding Antarctica. For example, they have the ability to produce an antifreeze protein that prevents their blood from freezing in waters that are now below the normal freezing point of fresh water.

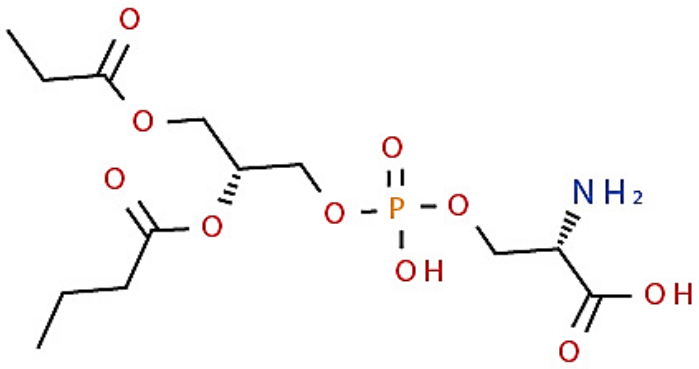
Scientists have analyzed the icefish DNA and documented genetic changes that gave rise to the antifreeze gene. Their findings are represented in the diagram below.



Process X is referred to as

1. mitosis
2. mutation
3. differentiation
4. meiosis

19. Neurons carry neuronal information critical for thought, movement, and sensation. Phosphatidylserine is a type of lipid that is the main component of nerve cell membranes which play a role in preventing or slowing down the deterioration of nerve cells in the brain and help treat impaired memory or Alzheimer's disease. Its chemical structure is as shown in the figure.



Source: https://www.chemspider.com/Chemical-Structure.13628254.html

From the figure above, how many phosphate and amino groups does a molecule of phosphatidylserine have?

	Phosphate group	Amino group
1.	2	2
2.	2	1
3.	1	1
4.	1	2

20. On Science Day, a group of students was assigned to organize an exhibition on the structure, components, and functions of a plant cell. They presented the model of a plant cell that they had created along with labels and explanations of the functions of these cellular structures. However, labels and descriptions are printed ambiguously and may be misidentified.

Functions:

A. Site of cellular respiration and ATP (energy) synthesis for the cell.

B. Flattened membranous sacs responsible for photosynthesis (capturing light energy).

C. Network of membranous tubes that transport materials throughout the cell.

D. Large sac that stores water, nutrients, and sometimes waste products.

Descriptions:

1. Folded double membrane with cristae.
2. Single membrane surrounding a large fluid-filled cavity.
3. Stacks of membranous sacs containing green pigments.
4. Extensive network of interconnected tubes.

Match the correct function with the description of the relevant organelle:

1. A - 1 , B - 2 , D - 3 , B - 4
2. D - 1 , B - 2 , A - 3 , D - 4
3. A - 1 , D - 2 , B - 3 , C - 4
4. B – 1 , C - 2 , A - 3 , D - 4

21. A scientist designed a model membrane using dialysis tubing, which simulates a semi-permeable property of the cell membrane. He prepared three different types of solutions for each dialysis tubing and placed them into a separate beaker. The movement of each type of the solute across a dialysis tubing into the surrounding water was monitored. After a set time, they measured the concentration of each solute in the beaker. The results are shown in the table below.

Solution	Initial concentration in a dialysis tubing(%)	Final concentration in a dialysis tubing (%)
Sucrose	10 %	7 %
Glucose	10 %	2 %
Starch	10 %	9 %

Based on the results, consider the following statements:

A. All solutions and solvents are completely permeable.

B. All solutes can pass freely regardless of size or charge.

C. The membrane is semi-permeable, allowing some solvents to pass through more than others.

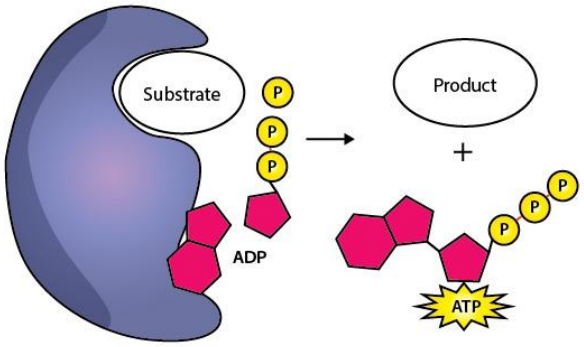
D. Energy is required to transport solutes across the membrane.

E. The size of the solute affects its movement across the membrane.

Which statements are correct?

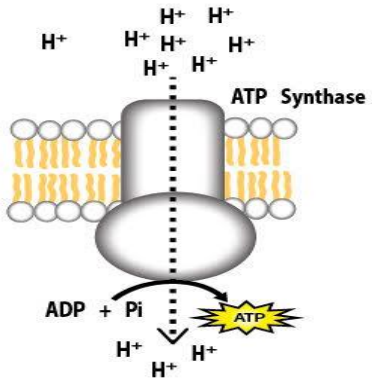
1. A and B are correct.
2. C and E are correct.
3. A, B, and C are correct.
4. C, D, and E are correct.

22. Cells can produce ATP by adding a phosphate group to ADP during an oxidation of glucose.The 2 methods of ATP synthesis are shown in Figures 1 and 2.



Figures 1 : ATP synthesis are shown in method 1

Source :https://commons.wikimedia.org/wiki/File:Substrate_Level_Phosphorylation.svg#/media/File:Substrate_Level_Phosphorylation.svg



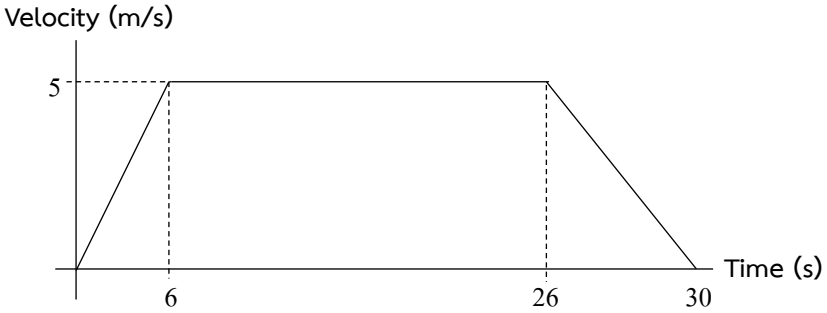
Figures 2 : ATP synthesis are shown in method 2

Source : https://commons.wikimedia.org/wiki/File:Oxidative_phosphorylation.png

Which of the choices correctly identifies the difference between the two methods of ATP synthesis?

	Method 1	Method 2
1.	It gives a higher yield of ATP when glucose is completely oxidized.	It gives a lower yield of ATP when glucose is completely oxidized.
2.	It involves the Krebs cycle.	It involves glycolysis.
3.	ATP synthesis occurs in the cytoplasm.	ATP synthesis occurs in the mitochondria.
4.	Oxygen is required as the final electron acceptor.	Oxygen is not required as the final electron acceptor.

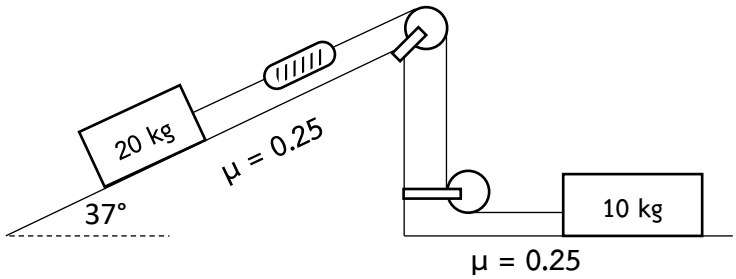
23. A student enters a building and takes the elevator to the top floor, with the graph showing the relationship between velocity and time of the elevator as shown in diagram.



Upon reaching the top of the building, the student throws a rock vertically upwards. It is observed that the rock reaches its highest point after 2 seconds. How long from the moment of throwing will the rock take to be 20 meters above the ground? Given that the acceleration due to gravity is 10 m/s².

1. 3.0 seconds
2. 3.4 seconds
3. 7.0 seconds
4. 7.4 seconds

24. A system consists of a box weighing 20 kg placed on an inclined plane, and connected by a light string to other box weighing 10 kg on a horizontal surface, via a pulley as shown in the diagram.



Both boxes are on surfaces with coefficients of kinetic friction of 0.25. What weight the spring balance will read in Newtons? Given that sin 37° = 0.6, cos 37° = 0.8 and the acceleration due to gravity is equal to 10 m/s^2

1. 37.67 N
2. 40.00 N
3. 43.33 N
4. 45.00 N

25. According to the NFPA labels for substances X and Y, how should these substances be stored?



สาร X



สาร Y

A. Store substance X in a tightly sealed container in a dry place with good ventilation.

B. Store substances X and Y together because both have the same blue label.

C. The storage area for substance Y should have an emergency ventilation system to release vapors and prevent explosions.

1. A, B, and C
2. A and B
3. B and C
4. A and C

26. Which of the following pairs of covalent compounds have different molecular shapes?

1. $BeCl_2$ and SCl_2
2. CH_4 and SO_4^{2-}
3. PCl_5 and SbI_5
4. BF_3 and CO_3^{2-}

27. If a person weighs 120 kg and the average glomerular filtration rate is 125 cm^3/minute, what is the volume of glomerular filtrate produced per day by this person?

1. 144,000 cm^3
2. 150,000 cm^3
3. 180,000 cm^3
4. 200,000 cm^3

28. A researcher studied the effects of cyanide on cellular respiration by using mammalian liver cells. The organelles from the liver cells, including ribosomes, mitochondria, and cytosol, were extracted. After that, a researcher incubated liver cells, ribosomes, mitochondria, and cytosol with the following substances.

1. Glucose
2. Pyruvate
3. Glucose + cyanide
4. Pyruvate + cyanide

After incubation, the presence of carbon dioxide and lactate were determined in each sample. The results are shown in the table below.

Substances.	**Sample**							
	Liver cell		**Ribosome**		**Mitochondria**		**Cytosol**	
	CO_2	**lactate**	**CO_2**	**lactate**	**CO_2**	**lactate**	**CO_2**	**lactate**
Glucose	√	√	×	×	×	×	×	√
Pyruvate	√	√	×	×	√	×	×	√
Glucose + cyanide	×	√	×	×	×	×	×	√
Pyruvate + Cyanide	×	√	×	×	×	×	×	√

Note: **√** mean present **×** mean not present

Consider the following information.

A. Ribosomes are involved in cellular respiration.

B. Pyruvate is a precursor of the Krebs cycle. It can occur in the mitochondria but not the cytosol.

C. Cyanide is likely to render mitochondria in the liver cells non-functional by possibly suppressing the Krebs cycle.

D. The liver cells in the experiment were able to produce more ATP when cyanide was added.

From the above information, which of the following statements are correct regarding the experiment?

1. A and B are correct
2. B and C are correct
3. C and D are correct
4. A and D are correct

29. The skydiver with a mass of 60 kg jumps off the aircraft at an altitude of 2,882 m above the ground and opens the parachute after descending to a height of 1,200 m above the ground. During freefall, the skydiver aligns the body parallel to the ground and extends arms and legs to reduce falling speed, resulting in an acceleration of 1 m/s² during this phase. If the skydiver would like to land with a speed of 2 m/s, what is parachute area requires to meet his objective? Given that the drag force of 228 N/m² generated by the parachute is only effect on itself, the acceleration due to gravity is 10 m/s² and the weight of the parachute is neglected.

1. 3.00 m^2
2. 3.76 m^2
3. 4.62 m^2
4. 5.58 m^2

30. A student needs to move a load box weighing 120 kg by placing it at the rear of a truck bed, which is lined with a rubber mat, resulting in coefficients of static and kinetic friction between the load box and the rubber mat of 0.50 and 0.45 respectively. What is the maximum acceleration the truck achieving to prevent the load box from sliding off the truck bed, disregarding the possibility of the box tipping over? Given that the acceleration due to gravity is 10 m/s².

1. 3.00 m/s^2
2. 10.12 m/s^2
3. 4.00 m/s^2
4. 5.00 m/s^2

31. Consider the information from the following table.

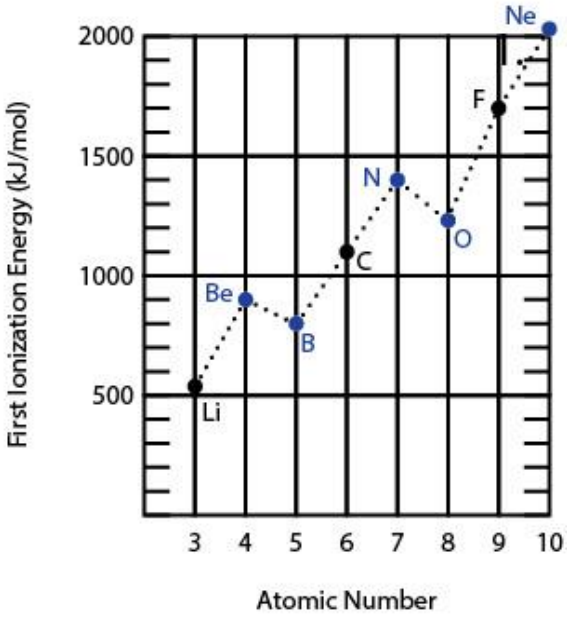
Table : Growth of eight plants in a three week period

	Amount of Light per day (hours)	Amount of Water per day	Height Week 1 (cm)	Height Week 2 (cm)	Height Week 3 (cm)
Plant 1	0	$^1/_4$ cup	0	0	0
Plant 2	0	1 cup	0	0	0
Plant 3	4	$^1/_4$ cup	1	3	6
Plant 4	4	1 cup	0.5	1	1.5
Plant 5	8	$^1/_4$ cup	1.5	4	8
Plant 6	8	1 cup	1	3	6
Plant 7	16	$^1/_4$ cup	1	2	3
Plant 8	16	1 cup	1.5	5	10

Which protocol provided the best growth conditions?

1. 8 hours of light per day and 1 cup of water
2. 4 hours of light per day and $^1/_4$ cup of water
3. 8 hours of light per day and $^1/_4$ cup of water
4. 16 hours of light per day and 1 cup of water

32. The figure shows the first ionization energy (IE1) of atoms of elements in the same period. Typically, the value of IE1 increases from left to right for elements in the same period.



https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcR0iWGTLMi7O0pDZKx08Fbqj1OQK-4tE_7DUA&s

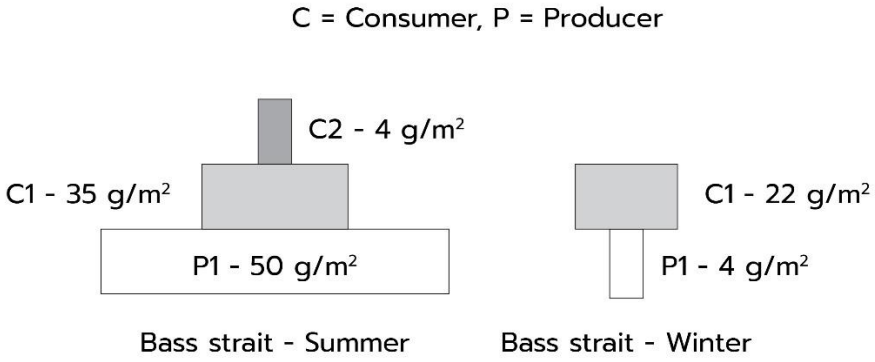
Despite the typical trend for the value of IE1, why is the value of IE1 of atoms in Group 2 higher than those in Group 3, and the value of IE1 of atoms in Group 5 higher than those in Group 6?

A. Removing an electron from an atom in Group 2 requires more energy because the full filled configuration is more stable.

B. Atoms in Group 5 have three electrons in their p-orbital ($ns^2\ np^3$), which is a half-filled configuration and thus more stable.

1. A only
2. B only
3. A and B
4. not all above

33. The diagram below shows the seasonal changes in the pyramid of biomass in the Bass Strait.



1. the primary production decreases dramatically and results in a die-off of zooplankton

2. the primary production decreases and, as the producers are rapidly consumed by the zooplankton, they never develop a large population size

3. the primary production remains the same all year but the cold means that the zooplankton and secondary consumers migrate elsewhere

4. the primary production is increased but the phytoplankton have a shorter turn overtime in winter

34. Body cells include nerve cells and muscle cells. Each makes a number of different proteins. For example, nerve cells make cholinesterase and muscle cells make myosin. Which statement best compares the DNA normally found in these two types of cells in an individual?

1. The two cells have identical DNA sequences and use the same section of the DNA to make these two proteins.
2. The two cells have identical DNA sequences, but use different sections of the DNA to make these two proteins.
3. The two cells have different DNA sequences, but use the same section of the DNA to make these two proteins.
4. The two cells have different DNA sequences and use different sections of the DNA to make these two proteins.

35. A team of botanists is investigating the impact of prolonged drought conditions on the function of chloroplasts in *Spinacia oleracea* (spinach). They discover that drought stress causes the thylakoid membranes within the chloroplasts to lose their integrity, leading to impaired function.
Which of the following is a likely immediate consequence of this impairment?

1. The synthesis of amino acids in the cell will increase.
2. The production of NADPH and ATP in the chloroplasts will decrease.
3. Chloroplasts cannot import nuclear-encoded proteins.
4. Chloroplasts cannot export photosynthetic products to the cytosol.

36. Protozoa are small, single-celled organisms found in natural bodies of water. Protozoa have an organ called a contractile vacuole that acts like a water pump to remove excess water. If a student conducts an experiment by placing the protozoa in two different concentrations of solutions, and solution A has a lower concentration of solute than solution B, what is the possible rate of contractile vacuole formation?

1. The rate of contractile vacuole formation is greater in solution A than in B because solution A is hypoosmotic and solution B is hyperosmotic.

2. The rate of contractile vacuole formation is greater in solution B than in A because solution B is hyperosmotic and solution A is hypoosmotic.

3. The rate of contractile vacuole formation in solution A is greater than B because solution A is hyperosmotic and solution B is hypoosmotic.

4. The rate of contractile vacuole formation is greater in solution B than in A because solution B is hypoosmotic and solution A is hyperosmotic.

37. Gross primary production (GPP) is the total amount of energy fixed by primary producers in an ecosystem. A fraction of this energy is used in the process of cellular respiration, and the remaining fixed energy is known as the net primary production (NPP) of the ecosystem.

This relationship can be described as: Respiration = GPP – NPP

The table below compares the energy flow in a temperate forest and a tropical rain forest.

Process	Energy (KJ m^{-2} $year^{-1}$)	
	Temperate forest	Tropical forest
GPP	48 800	180 000
NPP	30 000	52 000

State two factors that may contribute to the greater amount of gross primary production in the tropical forest than in the temperate forest.

An experiment is set up to test the effectiveness of a newly developed antibiotic, ‘Nobact’. Bacteria are plated out onto agar and the plates are incubated at 37°. The composition of the 5 plates are shown below:

Plate 1	*E. coli*
Plate 2	*E. coli* + doxycycline (a Known antibiotic at a concentration Known to be bactericidal)
Plate 3	*E. coli* + Nobact (0.25 relative concentration)
Plate 4	*E. coli* + Nobact (0.50 relative concentration)
Plate 5	*E. coli* + Nobact (1.00 relative concentration)

Which of the plates can be described as a positive control?

1. Plate 1
2. Plate 2
3. Plate 3
4. Plate 4 and Plate 5

38. Over the last 50 million years, icefish evolved many adaptations that contributed to their success in surviving the decreasing water temperatures of the ocean surrounding Antarctica. For example, they have the ability to produce an antifreeze protein that prevents their blood from freezing in waters that are now below the normal freezing point of fresh water.

In addition to the appearance of the antifreeze gene, icefish have also been found to have DNA sequences similar to the DNA sequences in hemoglobin genes of other fish species. However, these DNA sequences are not complete and therefore not functional in icefish. This evidence makes it likely that

1. icefish ancestors had hemoglobin
2. icefish will soon produce offspring with hemoglobin
3. hemoglobin is a molecule made by some fish that do not have genes for it
4. soon all fish will stop producing hemoglobin

39. Heat-moisture treatment (HMT) is defined as a process involving the treatment of starch at a temperature above the glass transition temperature but below the gelatinization temperature for a certain time period at a restricted moisture content (MC) (below 35%). Changes occur in the granule swelling, the pasting properties, the acid and enzymatic hydrolysis, and the characteristic of gel. Starches from different botanical sources show different responses to treatment conditions.

Moisture content of starch samples during the treatment have been reported to be an important factor that affects the physicochemical properties of the modified products. Water in the starch samples acts as a plasticizer that renders starch polymeric chains more flexible; thus, facilitating the rearrangement

of amylose/amylopectin unit chains. In most reports, however, the moisture was limited to a certain extent, generally at 30% MC. Higher than this level, gelatinization could occur, as indicated by an alteration of the granule morphology. For some starch, no changes on granule surface morphology were found even at the MC of 30%, indicating that it had high tolerance for gelatinization. As a consequence, it is worth investigating the HMT of starch at higher MC (>30%) since high moisture is supposed to accelerate the modification process.

Based on the information provided, is it possible to conduct an experiment using a moisture content of greater than 35%?

1. No, because starch granules will deteriorate.
2. Yes, but the experimental temperature must be lower than that of the glass transition temperature.
3. No, because previous reports have found that MC used should be less than 35%.
4. Yes, the modified starch could be achieved within a shorter treatment time when starch contains high MC.

40. The experiment studied the effect of using an alkaline solution, water, and hydrogen peroxide (H_2O_2) to digest cassava pulp in oligosaccharide production. A solution containing H_2O_2 and 1M sodium hydroxide (NaOH) was used to digest cassava pulp, resulting in the formation of oligosaccharides. The oligosaccharide yield from cassava pulp is shown on the table.

Time of digestion of cassava pulp (h)	**Yield of oligosaccharide (%)**	
	Solutions used with H_2O_2	
	NaOH	**H_2O**
12	50.11	24.87
24	61.02	27.32
48	53.28	20.81

The results show that when using NaOH solution instead of water, the oligosaccharide yield increased by more than 20% compared to when using water. Because sodium hydroxide is able to dissolve more polysaccharide components in cassava pulp, it is easier for H_2O_2 to break down the polymers in cassava pulp, resulting in a higher yield.

From the above information, what would you do if you want to develop the methods of oligosaccharide production from cassava pulp?

1. Increase the digestion time of cassava pulp for solutions with H_2O_2 and NaOH solutions.
2. Adjust the concentration of NaOH solution for digestion.
3. Increase the amount of NaOH solution used when mixing with H_2O_2.
4. Adjust the concentration of cassava pulp in solutions of H_2O_2 and NaOH.

คำตอบวิชาวิทยาศาสตร์ ชั้นมัธยมศึกษาปีที่ 4

ข้อ	คำตอบ	ข้อ	คำตอบ
1	3	21	2
2	3	22	3
3	3	23	3
4	4	24	3
5	1	25	4
6	4	26	1
7	3	27	3
8	2	28	2
9	2	29	1
10	4	30	4
11	3	31	4
12	2	32	3
13	3	33	1
14	3	34	2
15	3	35	2
16	2	36	1
17	2	37	2
18	2	38	1
19	3	39	4
20	3	40	2