AUSTRALIAN SCIENCE INNOVATIONS

Australian Science Olympiads

2022 AUSTRALIAN SCIENCE OLYMPIAD EXAM

BIOLOGY

TO BE COMPLETED BY THE STUDENT. USE CAPITAL LETTERS.

First Name: ……..…..…… Last Name…….

Date of Birth: ……/……/...……

□ Male □ Female □ Unspecified Year 10 □ Year 11 □ Other: …….

Name of School: ……..……..**State:** ……...

Examiners Use Only:

AUSTRALIAN SCIENCE INNOVATIONS

Australian Science Olympiads

2022 AUSTRALIAN SCIENCE OLYMPIAD EXAM

BIOLOGY

Time Allowed

Reading Time: 10 minutes

INSTRUCTIONS

- ***Attempt all questions in ALL sections of this paper.***
- **Permitted materials: non-programmable, non-graphical calculator, pens, pencils, erasers and a ruler.**
- **Answer all questions on the MULTIPLE CHOICE ANSWER SHEET PROVIDED. Use a pencil.**
- **Marks will not be deducted for incorrect answers.**

Examination Time: 120 minutes

MARKS

- **1 mark for each question**
- **Total marks for the paper 60 marks**

Integrity of Competition

If there is evidence of collusion or other academic dishonesty, students will be disqualified. Markers' decisions are final.

1. The cell membrane of red blood cells allow water, oxygen and carbon dioxide to pass through. Because other substances are unable to pass through, this membrane is called:

    a. perforated

    b. semi-permeable **

    c. permeable

    d. non-selective

2. Most of the mass of organic material of a plant comes from:

    a. water

    b. carbon dioxide **

    c. soil minerals

    d. nitrogen

3. Which of the following is a polysaccharide?

    a. Glucose

    b. Glycogen **

    c. Lactose

    d. Fructose

4. The six (6) most common atoms in organic molecules are:

    a. C, H, O, He, Ca and S

    b. C, H, O, N, P and S **

    c. C, H, O, Mg, Mn and S

    d. C, H, O, N, P and K

5. Sharks are unique amongst the classification of living fish. What trait differentiates the sharks from other major classes of fish?

    a. Bony skeleton

    b. Cartilaginous skeleton **

    c. Big teeth

    d. Only live in marine water

6. Cleaning stations are where sharks go to be cleaned. Small fish congregate at these cleaning stations to facilitate the cleaning of the larger fish.

    This kind of association is called:

    a. predation

    b. commensalism

    c. parasitism

    d. mutualism **

7. Some animals are territorial. Territoriality occurs as a result of:

    a. predation

    b. symbiosis

    c. parasitism

    d. competition **

8. Which of the following animals would lose heat to the environment most quickly?

    a. Bat **

    b. Camel

    c. Kangaroo

    d. Wombat

9. A plant deficient in which of the following nutrients will not be able to make DNA?

    a. Phosphorus **

    b. Zinc

    c. Iron

    d. Sulphur

10. Which of the following have a cell wall?

    a. Bacteria, plants and animals

    b. Bacteria, fungi and plants **

    c. Bacteria, fungi, plants and animals

    d. Bacteria and plants only

11. Erwin Chargaff was responsible for the discovery that, in DNA from any species, the amount of adenine equals the amount of thymine, and the amount of guanine equals the amount of cytosine. Cytosine makes up 42% of the nucleotides in a sample of DNA from an organism.

    Approximately what percentage of the nucleotides in this sample will be thymine?

    a. 8% **

    b. 16%

    c. 42%

    d. 84%

12. A length of DNA comprises 8000 nucleotides. What is the predicted number of cytosine bases if 32% of the nucleotide bases in the DNA are adenine?

    a. 36

    b. 180

    c. 1440 **

    d. 2880

13. What is the primary function of chloroplasts?

    a. Transfer of potassium ions

    b. Production of oxygen **

    c. Storage of water and starch

    d. Production of carbon dioxide

14. Which of the following structures are present in both animal and plant cells?

    a. Nucleus, cytoplasm and cell wall

    b. Cell membrane, cell wall and vacuole

    c. Cytoplasm, ribosome and nucleus **

    d. Cell membrane, ribosome and vacuole

15. Maltose can be broken down into glucose molecules by the enzyme maltase. Which of the following would slow the reaction rate?

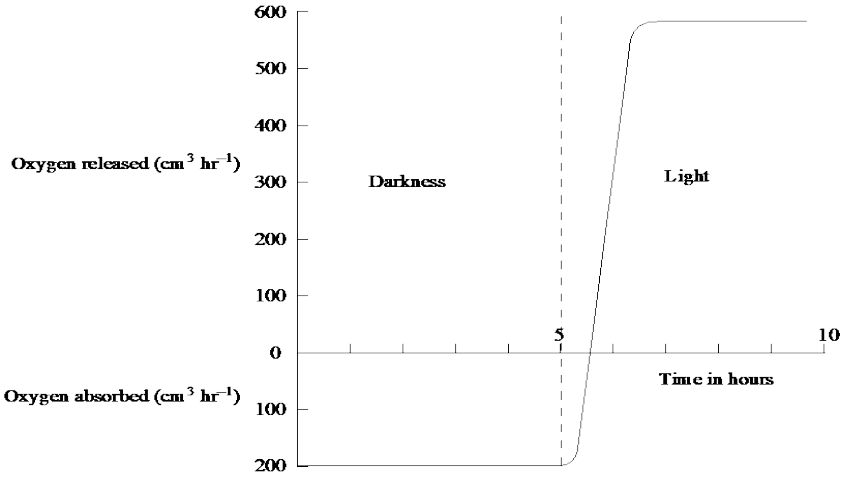
    a. Adding maltase

    b. Adding maltose

    c. Diluting with water **

    d. Adding both maltase and maltose

16. A student was asked to conduct an experiment on gas exchange in a water plant and collected data about the rate of oxygen uptake and release. The plant was in darkness for 5 hours and then illuminated for 5 hours, while the temperature was kept constant. The results are shown in the graph below.



If it is assumed that changes in light intensity have no effect on the rate of respiration, the best estimate of total oxygen produced by photosynthesis in the last two hours of the experiment is:

a. 600 m^3

b. 1200 m^3

c. 1600 m^3 **

d. 1800 m^3

17. When genes are on separate chromosomes, or very far apart on the same chromosome, they assort independently and are said to be unlinked. Since each gamete gets one of two possible versions of a chromosome by random chance, two unlinked genes will be inherited together 50% of the time. If two genes are inherited together more than 50% of the time, this is evidence that they are linked on the same chromosome. The closer together the genes are, the more frequently they will be inherited together. The further away they are, the more likely there is to be crossing over between them with the other chromosome, resulting in offspring with a recombinant genotype.

Crossing over happens at the very beginning of meiosis when homologous chromosomes randomly exchange matching fragments. Crossing over can put new alleles together in combination on the same chromosome, causing them to occur together in the same gamete. The percentage of offspring with this recombination therefore gives an indication of their relative locations when compared to that of other gene pairs. The lower the recombination frequency, the closer they are together.

Use the recombination frequencies between four hypothetical genes (m, n, o and p) to deduce their relative order on their chromosome. Their frequencies are: 6% between m and p, 41% between m and o, 13% between n and m, 35% between p and o, and 19% between p and n.

Which of the answers represents their relative locations?

a. m n p o

b. p m n o

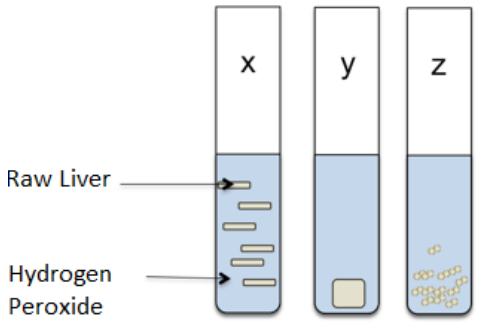
c. n o p m

d. o p m n **

e. o n p m

Questions 18 and 19 relate to the following information.

Three test tubes, X, Y and Z, contain the same volume of dilute hydrogen peroxide (H_2O_2) solution. Equal volumes of raw liver are added to each tube, but the liver is cut into different sized pieces, or ground as in test tube Z.



18. When the liver was added the solutions started to bubble, but at different rates.

Which of the following options ranks the rate of bubbling in the tubes from lowest rate to highest rate: C**

	Lowest rate	Medium	Highest rate
a.	X	Y	Z
b.	X	Z	Y
c.	Y	X	Z
d.	Y	Z	X
e.	Z	X	Y

19. The bubbles of gas that were observed in each test tube would be which gas?

    a. H_2

    b. CO_2

    c. O_2 **

    d. H_2O vapor

20. Equal lengths of three (3) different blood vessels were threaded on to the horizontal arm of a retort stand. Weights were then hooked on the vessels until they broke.

    Which letter, a – e shows the most likely results? C**

	Mass needed (in grams) to cause breakage		
	800	**3500**	**5000**
a.	aorta	pulmonary artery	vena cava
b.	vena cava	aorta	pulmonary artery
c.	vena cava	pulmonary artery	aorta
d.	pulmonary artery	vena cava	aorta
e.	pulmonary artery	aorta	vena cava

21. There are seven (7) processes which are said to be possessed by all living things. This venus fly trap has just caught a fly. The fly is trying to escape from the trap.

Which characteristic of living things, shared by both plants and insects, is illustrated by the action in this image?

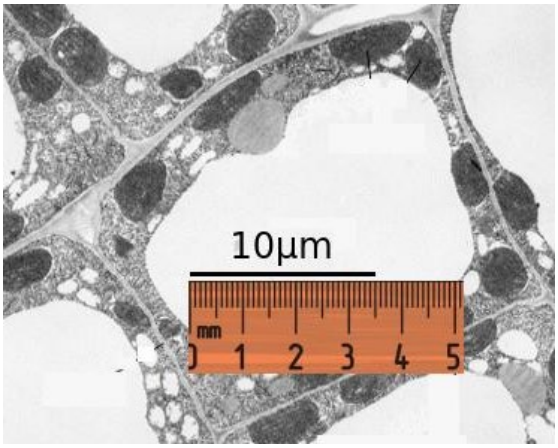
a. Growth

b. Excretion

c. Reproduction

d. Response to the environment **

22. The electron microscope image below shows a scale bar marked with 10 µm. It has been measured to be 3.5 cm long by a student using a ruler.



What is the magnification of the image?

a. x35

b. x350

c. x3500 **

d. x35000

Questions 23 and 24 relate to the following information.

In an experiment about transpiration (the movement of water through a plant driven by evaporation from the leaf), 40 leaves of the same species and of similar age were divided into four groups of 10, and treated as follows:

Group 1: leaves were smeared with grease on the entire upper surface
Group 2: leaves were smeared with grease on the entire lower surface
Group 3: leaves were smeared with grease on the entire upper and lower surfaces
Group 4: leaves were left untouched

All the leaves were then weighed and suspended by cotton for 6 hours. In each group, half were kept in darkness and the other half were kept in the light. All other conditions were the same for all the leaves. The leaves were then re-weighed and the percentage loss in mass determined. The results, with percentages to the nearest whole number, are shown in the table below.

	Average percentage loss in mass			
	Group 1 Upper surface	Group 2 Lower surface	Group 3 Upper + lower	Group 4 Neither
Light	20	3	0	23
Dark	5	2	0	7

23. What conclusion can be drawn from the data above?

a. Transpiration does not occur from the upper surface of leaves

b. There is no transpiration occurring at night when it is dark

c. Transpiration is greatest from the lower surface of the leaf **

d. Transpiration is greatest from the upper surface of the leaf

24. The ratio of total upper epidermis transpiration to lower epidermis transpiration was:

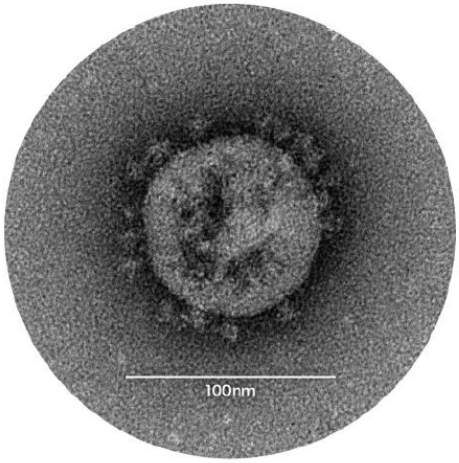
a. 1 : 2

b. 1 : 2.5

c. 1.5 : 1

d. 1 : 5 **

25. The picture below shows an image of the coronavirus responsible for the COVID-19 pandemic.



Source: Jason Roberts, VIDRL – Doherty Institute

It is spherical with an average diameter of 100 nm.

Note the formula for volume of a sphere is: $V = \frac{4}{3}\pi r^3$

Note there are 1000 nanometres in a micrometre.

Given that an average sized alveolus in an adult human is 200 micrometres in diameter, approximately how many virus particles could possibly fit in a single alveolus, given the packing ratio for equal spheres is approximately 74% of the volume?

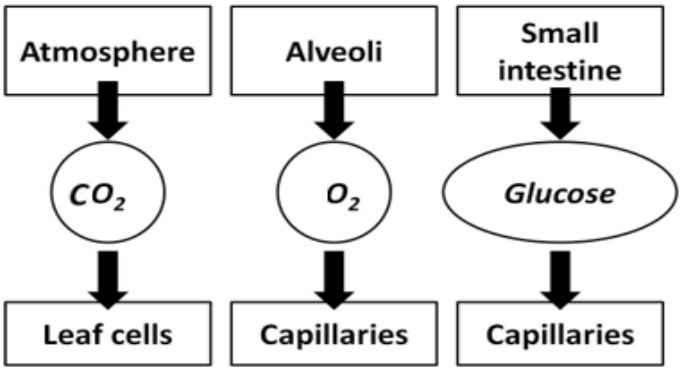
a. 8×10^9

b. 5.92×10^9 **

c. 3.35×10^9

d. 4.18×10^6

26. The diagram below shows examples of directional movement of substances.



Which process is taking place in all three (3) examples?

a. Absorption

b. Assimilation

c. Diffusion **

d. Osmosis

Questions 27 and 28 relate to the following information.

Numbers of Representative Species

Era	Period	Dinosaurs	Turtles	Crocodilians	Snakes	Lizards
Cenozoic	Quaternary					
	Tertiary					
Mesozoic	Cretaceous					
	Jurassic					
	Triassic					
Paleozoic	Permian					
	Pennsylvanian					
	Mississippian					
	Devonian					
	Silurian					
	Ordovician					
	Cambrian					

27. According to this information, which group demonstrated the greatest biodiversity during the Cretaceous period?

    a. Dinosaurs

    b. Crocodilians

    c. Snakes

    d. Lizards **

    e. Turtles

28. According to this information, which group has persisted for the longest period?

    a. Dinosaurs

    b. Crocodilians

    c. Snakes

    d. Lizards

    e. Turtles **

29. A number of mosquito populations today are resistant to insecticides that were once quite effective. Biologists think that insecticide resistance evolved in mosquitoes because:

    a. individual mosquitoes built up an immunity to an insecticide after being exposed to it.

    b. mosquitoes needed to develop insecticide resistance to survive after the insecticide was used.

    c. a few mosquitoes were probably resistant to the insecticide before it was ever used, and these individuals were more likely to survive and reproduce. **

    d. a new allele developed in response to the insecticide that provided future generations the benefit of resistance.

Questions 30 and 31 relate to the following information.

On 4 March 2022, Australia's Acting Chief Medical Officer, declared the Japanese Encephalitis Virus (JEV) situation a communicable disease incident of national significance. A national working group of communicable disease, vaccine and arbovirus experts was quickly established.

The working group implemented mosquito surveillance and control measures quickly.

30. What is a communicable disease?

    a. Diseases that are past from cell to cell

    b. Diseases that are spread from one person or organism to another **

    c. Diseases that lie dormant in the community

    d. Diseases that are seasonal

31. Why did the working group target mosquitoes?

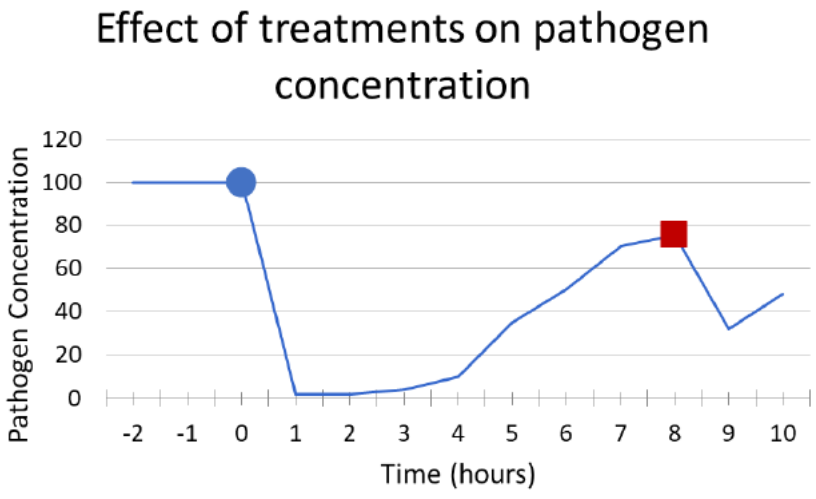
    a. Mosquitoes are vehicles for the JEV virus

    b. Mosquitoes are vectors for the JEV virus **

    c. Mosquitoes carry airborne particles containing the JEV virus

    d. Mosquitoes rely on the JEV virus to reproduce

32. Antimicrobials are given to control infections with pathogens like the bacterium, *Salmonella typhi*, which cases typhoid fever. The effects of two treatments are shown below: treatment 1 was administered at 0 hours (blue circle) and treatment 2 at 8 hours (red square).



Which of the following responses is correct?

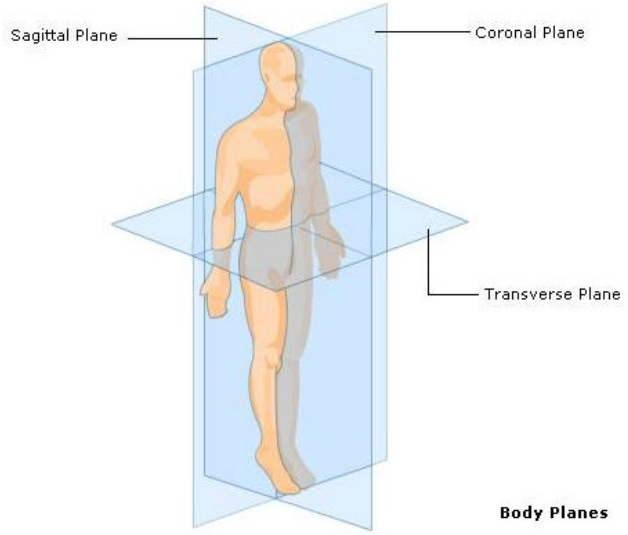
a. Treatment 2 is less effective than treatment 1

b. The population of typhoid bacteria contained antimicrobial-resistant individuals

c. The rapid decline in population numbers between T=0 and T=1 hours show treatment 1 is very effective

d. All responses are correct **

33. The diagram on the left illustrates the different body planes anatomists and radiologists use when talking about structures within the human body.



Which plane is depicted on the radiographic image on the right?

a. Sagittal plane

b. Coronal plane **

c. Transverse plane

d. Oblique plane

34. Evie had a bowl of strawberries. After eating one, she gave half the remainder to her mum. After eating another strawberry, she gave half of what was left to her dad. Evie now had only five strawberries left. How many strawberries did Evie start with?

    a. 11

    b. 22

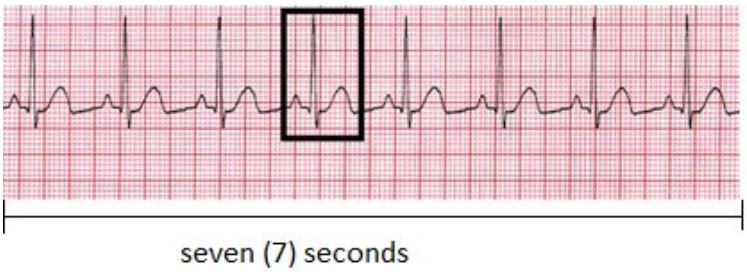
    c. 23 **

    d. 45

    e. 46

Questions 35, 36, 37, 38 and 39 relate to the following information.

The following diagram is what an exercise physiologist saw on his client Sean's electrocardiogram (ECG). An ECG measures the electrical impulse passed by the heart in one heartbeat. One complete heartbeat is depicted in the black box. Heart rate (HR) is most commonly defined as the number of times the heart beats in one minute.



35. What heart rate did the exercise physiologist record for Sean (rounded to the nearest number)?

    a. 8

    b. 42

    c. 56

    d. 69 **

    e. 80

36. Cardiac output (CO) is the product of the heart rate (HR) per minute multiplied by the volume of blood (stroke volume - SV) ejected from the left ventricle during a cardiac cycle.

    The correct formula for calculating cardiac output is:

    a. CO = HR ± SV

    b. CO = HR - SV

    c. CO = HR x SV **

    d. CO = HR ÷ SV

37. Calculate the stroke volume (SV) in mL if CO = 6.2 L/min and HR = 70 beats/min?

    a. 0.88 mL/min

    b. 11.29 mL/min

    c. 88.57 mL/min **

    d. 434 mL/min

38. Sean decided to go for a run. What change, if any, would you expect to see in cardiac output?

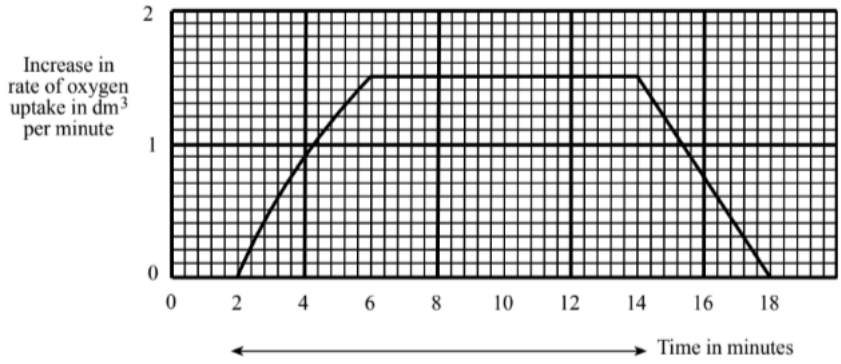
    a. Increase **

    b. Decrease

    c. Increase initially and then decrease

    d. Stay the same

39. The graph shows the effect of exercise on the rate of oxygen uptake.



The total additional volume of oxygen used by Sean due to the exercise is approximately:

a. 12 dm^3

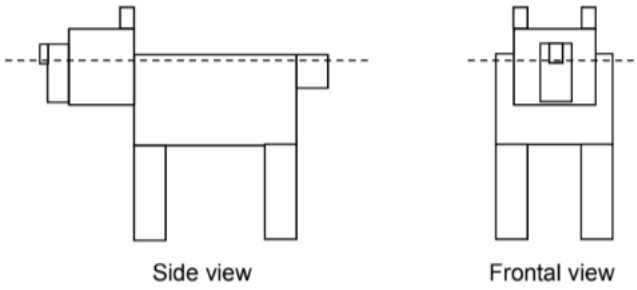
b. 15 dm^3

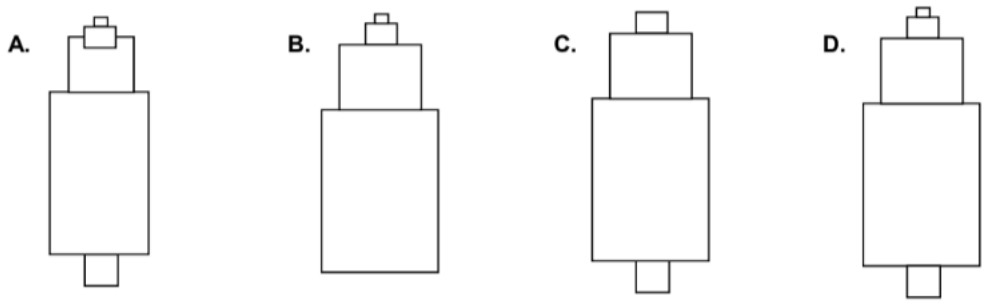
c. 18 dm^3 **

d. 21 dm^3

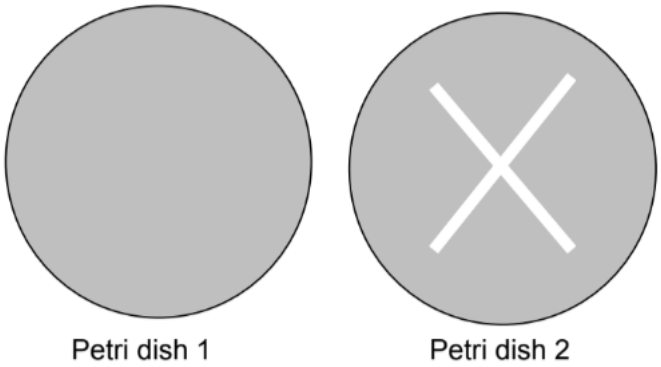
e. 24 dm^3

40. Which of the following images best depicts the cross section indicated by the dashed line?
**D





41. A student filled two Petri dishes with a clear corn-starch gel, then marked the letter “X” invisibly onto the gel in Petri dish 1 with a damp cotton swab. He then placed saliva from his mouth onto a second cotton swab and used that swab to mark the letter “X” invisibly onto the gel in Petri dish 2.



Fifteen minutes later, the student rinsed both Petri dishes with a dilute solution of iodine to indicate the presence of starch. The entire surface of Petri dish 1 turned blue-black, indicating starch. Most of the surface of Petri dish 2 was blue-black, except that the letter “X” was clear, as shown above.

The most probable explanation of the clear “X” is that?

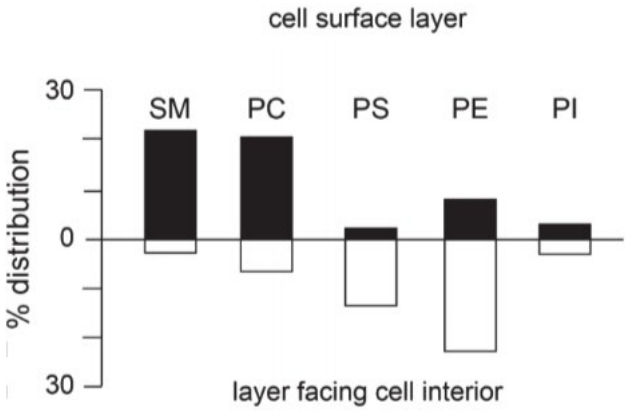
a. The starch in the gel was absorbed by the damp cotton swab

b. A chemical in the saliva broke down the starch in the gel **

c. The saliva prevented the iodine from contacting the starch in the gel

d. The cotton swab removed the iodine from the areas it touched

42. Mammalian plasma membranes are characterised by the presence of different types of phospholipids (SM, PC, PE, PS and PI). The graph below shows the percentage distribution of each phospholipid across the plasma membrane of human erythrocytes (red blood cells).



Which of the following statements is incorrect?

a. Membranes, in general, can be concluded to be asymmetric

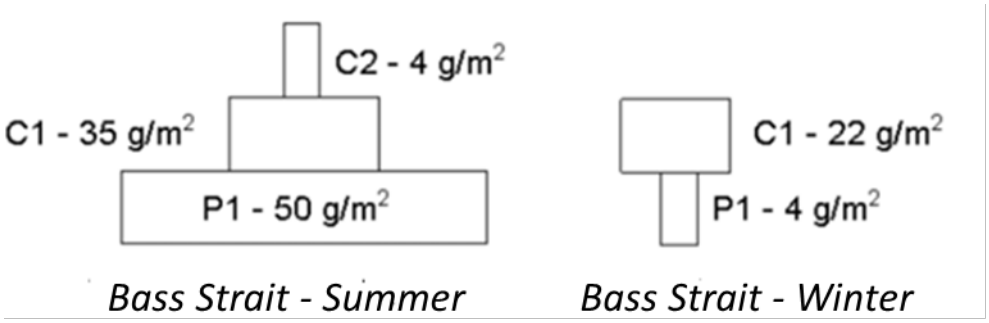
b. 24% of the total membrane phospholipids contain SM and 4% contain PI

c. 80% of the inner total membrane phospholipids contain PE and 16% contain PC *

d. Most PC is confined to the outer surface of the erythrocytes while most of the PE and PS are confined to the inner surface of the erythrocytes

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

C = Consumer, P = Producer



In winter the pyramid of biomass is inverted because:

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

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

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

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

44. Running ‘out of breath’ on completion of a field athletics event is common. This is also true for non-athletes after a short bout of exercise like cycling up a hill for example. At the end of a normal inhalation, the breath can usually be held for between 30 to 50 seconds. The breath-holding time immediately after exercise is shorter. The least likely cause of this would be:

    a. an increase in the CO_2 concentration in the blood

    b. a decrease in pH of the blood

    c. an increase in the lactic acid concentration of the blood

    d. fatigue of the respiratory muscles **

45. Many flowers have adapted to have specialised patterns of pigments on their petals which are only visible in the ultraviolet (UV) range of light, thus being invisible to the human eye. Itis found that these flowers are pollinated by insects such as the European honey bee (*Apismellifera*) whose vision includes this ultraviolet range.

    What is a reasonable inference to draw from this relationship?

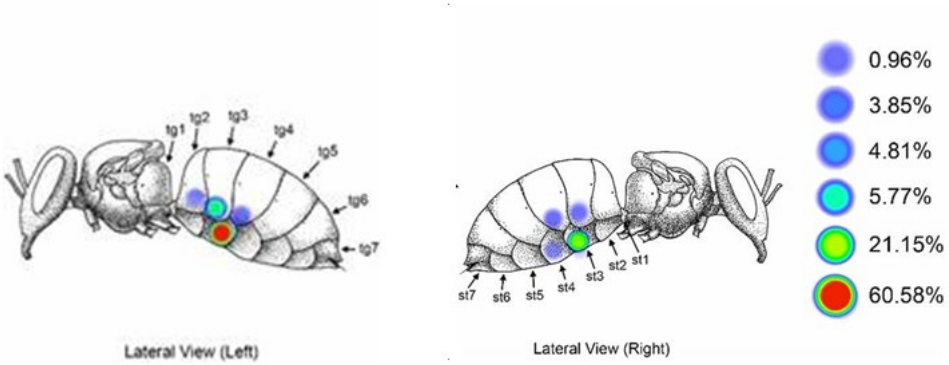
    a. The ultraviolet pigments assist the plant in the light capture phase of photosynthesis.

    b. Insect pollinators evolved ultraviolet vision after several generations of trying to locate their food sources.

    c. These flowers were genetically modified for commercial purposes and have established themselves in natural ecosystems.

    d. The plants which developed ultraviolet pigmentation attracted more pollinators and thus were more reproductively successful. **

46. In 2022, the Varroa destructor mite, a honey bee parasite was discovered in Newcastle. The mite is very dangerous to agriculture because it not only sucks fat from the host bee's body rendering them weak, but it can also transmit fatal bee viruses to other bees and larvae in the hive. Hence, a huge effort has been made to eradicate the mite from Australia. The figure below depicts the favoured feeding areas in percentages that the mites populated on a sample of 104 worker bee bodies.



What is the most likely explanation for why mites would preferentially feed in these areas?

a. Easy access to the bee's circulatory fluid called haemolymph

b. They are more likely to be deposited onto flowers

c. Most of the bee's fat is stored in those segments **

d. The top of the body is exposed to the elements during bee flight, endangering the mites

47. Mistletoes are hemiparasitic, obtaining their water and nutrients through haustorial connections to the host plants xylem but producing their own energy from photosynthesis.

Hemiparasitic plants can:

i. photosynthesise to make their own glucose
ii. extract nutrients from the host plant
iii. utilise the height gained from living high in the host tree
iv. reduce the lifespan of the host plant by 50%
v. access water from the host

a. i, ii and iii

b. i, ii, and v **

c. ii, iii and iv

d. iii, iv, and v

e. v is the only correct answer

48. Mistletoe plants are found high in their host trees and are an important source of nectar and fruit for birds.

This position will be favoured so that mistletoe can:

i. be pollinated by native birds
ii. grow on the branches of trees and avoid trunks where predators can access them as food
iii. access maximum sunlight for photosynthesis
iv. avoid fungal infection from ground dwelling pathogens
v. ensure fruit is prominent to maximise seed dispersal by native birds

a. i, ii and iii

b. i, iii, iv and v **

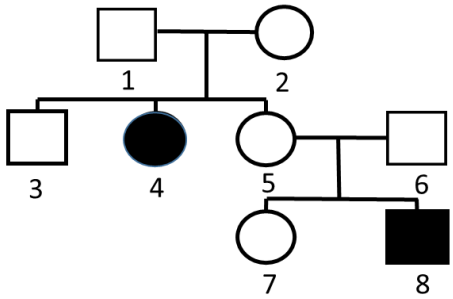
c. iii, iv and v

d. ii, iii and iv

e. v is the only correct answer

Questions 49, 50 and 51 relate to the following information.

The pedigree depicted shows the inheritance of a genotypic characteristic in a family. Circles depict XX genotypes and squares depict XY genotypes. Coloured symbols denote individuals who are afflicted by a genetically inherited disease.



49. What is the most likely type of inheritance of the disease demonstrated by this family tree?

    a. Autosomal recessive **

    b. X-linked dominant

    c. X-linked recessive

    d. Autosomal dominant

50. Which of the following individuals in the pedigree are definitely homozygous for this characteristic?

    a. 3

    b. 5

    c. 6

    d. 7

    e. None of these options **

51. Hereditary afflictions that are X-linked recessive mainly affect:

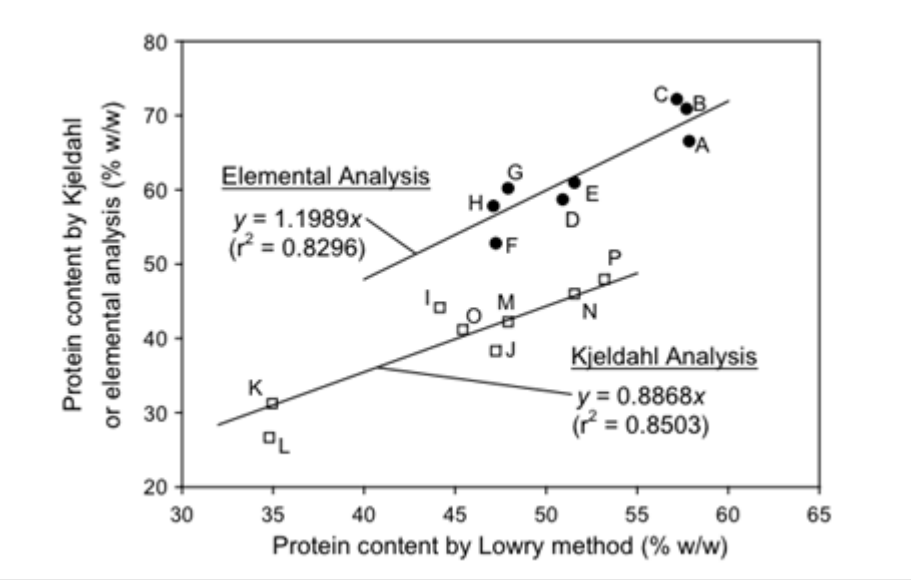
a. daughters

b. sons **

c. granddaughters

d. grandsons

52. The graph below is from a study of the protein content in algae.



Protein content was measured using elemental analysis and the Kjeldahl method (a titrometric analysis). The results were then compared against a 'gold standard' technique, the Lowry method. Using the graph and assuming the Lowry method gives the most accurate results, which of the following statements is true?

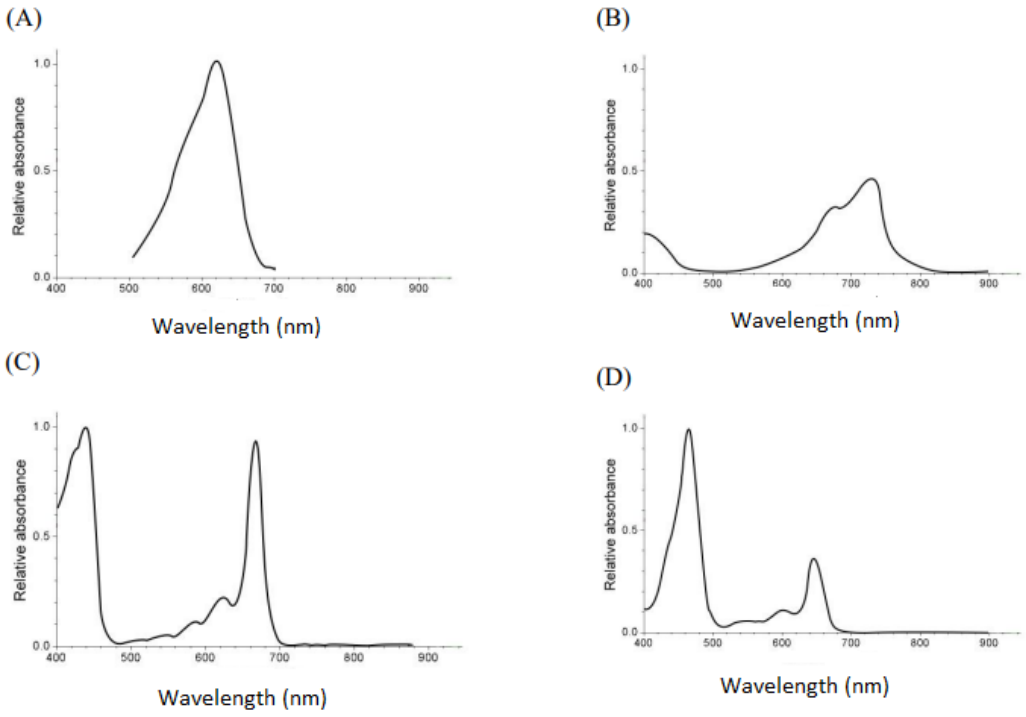
a. The r^2 value is a measure of how well a trend line represents data. **

b. Elemental analysis is the more accurate method of the two because it has the lowest r^2.

c. Samples A-H were grown under different conditions to samples I-P.

d. The y-axis should give the independent variable, while the x-axis should give the dependent variable.

53. Phytochromes exist in two isoforms, Pr and Pfr. In darkness, they are synthesised as the Pr form, then turned into the Pfr form after absorbing red light (most effective at 666 nm). When irradiated with far red light, Pfr transforms back to Pr.
According to the description above, which of the following is likely to be the absorption spectra of phytochrome? B**



54. There are two types of bird hatchlings: precocial and altricial. In general, precocial birds are covered with feathers when they hatch, and can find their own food with help from their mothers. In contrast, altricial hatchlings require feeding and caring for from the parents. Based on this, which of the following statements are correct?

a. Precocial hatchlings usually take longer to hatch than altricial hatchlings. **

b. Altricial hatchlings usually develop imprinting earlier than precocial hatchlings.

c. Parents invest more in precocial hatchlings than in altricial hatchlings during nesting periods.

d. For a group of young birds that hatch at the same time, altricial hatchlings tend to develop the ability to move earlier than precocial hatchlings.

55. Humans have what are referred to as homologous autosomal chromosomes, labelled 1 to 22. Under typical circumstances we have two of each of the autosomal chromosomes; homologous chromosomes are those that pair because they are similar.

    For instance, homologous chromosomes:

    a. have the same genetic code

    b. pair next to each other during meiosis but not during mitosis **

    c. pair next to each other during cell division

    d. are only found in reproductive cells

    e. enhance the activity of each other

56. DNA replication produces a mirror image of the original strand. DNA replication works from the 5' end to the 3' end of the DNA strand. Transcription of DNA to produce an mRNA strand requires a substitution of Thymine nucleobases for Uracil before they are then translated into a protein.

    If a segment of DNA has the sequence, **5'-GATTAGACAT-3'**, which of the following would be the mRNA strand produced using this DNA sequence as a template?

    a. **5'-CUAAUCUGUA-3' ****

    b. **5'-CTAATCTGTA-3'**

    c. **3'-CUAAUCUGUA-5'**

    d. **5'-GATTAGACAT-3'**

    e. **3'-GATTAGACAT-5'**

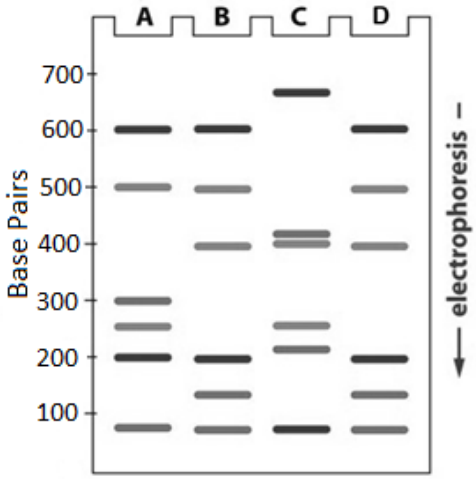
Questions 57, 58, 59 and 60 relate to the following information.

Someone is leaving their dirty dishes in the kitchenette sink of your student common room for others to wash. As a budding biologist you decide to use biotechnology to find out who it is. You collect a number of samples from the dishes and process them to see if you can identify the messy individual(s). This type of DNA analysis takes a number of steps, as follows.

Once you obtain and isolate DNA samples from the dishes in the sink (sample D) plus from a cheek swab of three fellow students who you suspect may be the culprit(s), labelled A, B and C, your Biology teacher helps you conduct a DNA restriction enzyme digest on each sample.

The final step in this type of genetic fingerprinting (or genetic profiling) is to run the samples through an agarose gel using electrophoresis. Gel electrophoresis requires an electric current be applied to the gel tank such that the samples will start to move from the negatively charged end towards the positively charged end. The position of the sample identification from A-D indicates the position of the wells into which the samples were deposited before applying the current. The whole gel was running for 40 mins.

This is the result:



57. What function does the restriction enzyme digest perform in preparation for running the agarose gel?

    a. Initiates replication of DNA

    b. Separates the chromosomes from each other

    c. Cuts the DNA at specific recognition sites **

    d. Cuts the DNA strands at uniform intervals

    e. Divides each chromosome into single strands

58. What do the bands depicted represent?

    a. DNA **
    b. Proteins
    c. Nucleotide types
    d. Agarose polypeptides
    e. Restriction enzymes

59. Which of the following (A-D) are most likely to be leaving dirty dishes in the communal sink for someone else to wash?

    a. A
    b. B **
    c. C
    d. D
    e. A and C
    f. B and D

60. On examination of the resulting gel some of the bands moved further through the gel than other bands. Which of the following statements is true with regards to this observation?

    a. The longer the molecular strands the faster they move
    b. The longer the molecular strands the slower they move **
    c. All samples contained identical positively charged samples that moved the furthest
    d. Negatively charged samples that differ in size usually move the same distance
    d. The distance travelled is an indication of how highly charged they are

END OF EXAM

SOURCES

Question 14 - 15: Questions & Images sourced:
https://www.thinkib.net/biology/page/26434/intro-to-cells-quiz-11

Question 46: Ramsey, S.D., Ochoa, R., Bauchan, G., Gulbronson, C., Mowery, J.D., Cohen, A., Lim, D., Joklik, J., Cicero, J.M., Ellis, J.D. and Hawthorne, D., 2019. Varroa destructor feeds primarily on honey bee fat body tissue and not hemolymph. Proceedings of the National Academy of Sciences, 116(5), pp.1792-1801.

Question 52: Lopez et al, Bioresource Tech. 2010 vol. 101

Questions 57 – 60: Figure is redrawn from Molecular Biology of the Cell 5th edition, Garland Science 2008 Fig. 8-47b

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