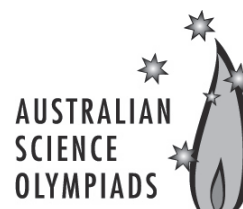




BIOLOGY
2013 Australian Science Olympiad Examination



Time Allowed

Reading Time: 10 minutes

Examination Time: 120 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 SECTIONS A and B on the MULTIPLE CHOICE and TRUE/FALSE ANSWER SHEETS PROVIDED. Use a pencil.

Answer SECTION C in the answer booklet provided. Write in pen and use pencil only for graphs.

Ensure that your diagrams are clear and labelled.

All numerical answers must have correct units.

Marks will not be deducted for incorrect answers.

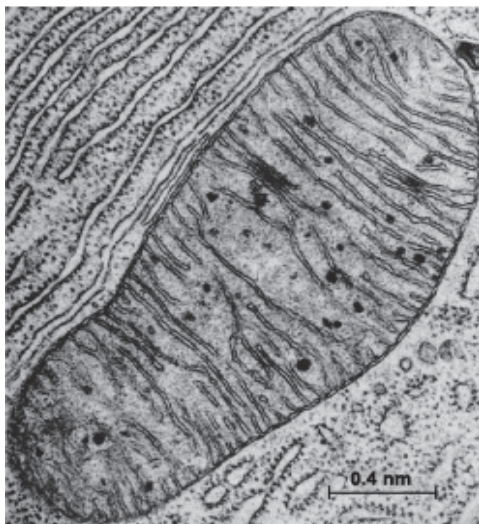
Do not write on this question paper. It will not be marked.

MARKS

SECTION A	47 multiple choice questions	47 marks
SECTION B	6 sets of true/false questions	9 marks
SECTION C	24 written answer questions	47 marks
Total marks for the paper		103 marks

SECTION A: MULTIPLE CHOICE USE THE ANSWER SHEET PROVIDED

Use the following photograph of an organelle to answer questions 1 – 3.



Wikipedia, 2012. *Answers.com* 01 Jan. 2013. <http://www.answers.com/topic/>

1. What is the name of this organelle?
 - A. Chloroplast.
 - B. Ribosome.
 - C. Endoplasmic reticulum.
 - D. Mitochondrion.

2. What is its function?
 - A. Aerobic respiration.
 - B. Photosynthesis.
 - C. Lipid synthesis.
 - D. Anaerobic respiration.

3. What does it produce when functional in a cell?
 - A. Fats.
 - B. Starch.
 - C. Oxygen.
 - D. Carbon dioxide.

4. National DNA day was held in the US on the 19th of April 2013 to celebrate 60 years since Watson and Crick's letter to Nature was published and 10 years since the publication of the human genome. Which element is found in both nucleic acids and polypeptides?
- A. Iron.
 - B. Nitrogen.
 - C. Phosphorous.
 - D. Sulfur.
5. 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.
6. Which type of chemical bonds hold the two strands together in double stranded DNA?
- A. Ionic.
 - B. Weak ionic.
 - C. Hydrogen.
 - D. Covalent.
7. Which of the following is found in RNA but not in DNA?
- A. Cytosine.
 - B. Adenine.
 - C. Phosphate group.
 - D. Ribose.
8. Which of the following do host cells provide for viruses to replicate?
- A. Nucleotides and proteins.
 - B. Amino acids and DNA.
 - C. Proteins and DNA.
 - D. Amino acids and nucleotides.

9. What is one of the primary functions of chloroplasts?

- A. Transfer of potassium ions.
- B. Storage of water and starch.
- C. Production of transport proteins.
- D. Production of oxygen.

Use the following information to answer question 10.

Ribulose-1,5-bisphosphate carboxylase oxygenase (or RuBisCO for short) is known as the most abundant protein on planet earth. It is an enzyme that catalyses a carbon fixation reaction in the Calvin Cycle of photosynthesis in most plants (C_3 plants). O_2 is an inhibitor of the reaction, competing with CO_2 for the active site of RuBisCO. O_2 fixation leads to photorespiration, reducing the efficiency of photosynthesis by up to an estimated 25%. RuBisCO evolved hundreds of millions of years ago when atmospheric CO_2 levels were much greater than O_2 levels. These days plants have to contend with an atmosphere where the O_2 availability is far greater than CO_2 . C_4 and CAM plants are believed to have evolved under more oxygenated conditions.

10. Given their evolutionary history, which of the following is most likely. C_4 plants differ from C_3 plants in that they:

- A. have a greater number of stomata to allow more CO_2 into their leaves.
- B. use more water.
- C. fix atmospheric carbon via a different sugar to C_3 plants at the end of photosynthesis
- D. have more chlorophyll per unit area.
- E. fix atmospheric carbon via a different chemical pathway to C_3 plants.

11. In the carbon cycle, a carbon atom which is released into the atmosphere by a human being will, after a period of time, leave the atmosphere by:

- A. going into the soil during carbon fixation.
- B. going into a plant during photosynthesis.
- C. diffusion into the fungi associated with plant roots.
- D. depletion of the ozone layer.

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

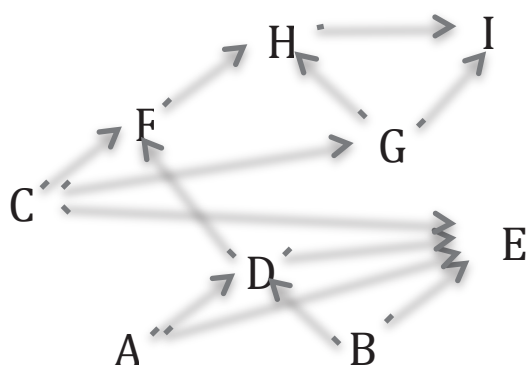
- A. Nucleus, cytoplasm and cell wall.
- B. Cell membrane, cell wall and vacuole.
- C. Cytoplasm, ribosome and nucleus.
- D. Cell membrane, ribosome and vacuole.

13. Analysis of one cell component revealed that it was composed of proteins and lipids.

Which of the following could it be?

- A. Cell wall.
- B. Tracheid.
- C. Chitin.
- D. Cell membrane.

Use the following diagram of a terrestrial food web to answer questions 14 – 15.



From <http://www.cramster.com/multiple-choice--questions-and-answers-exam-r30-19980.aspx>

14. Based on the diagram above, the combined biomasses of C and D are likely to be:

- A. Less than the biomass of E.
- B. Less than the biomass of A and B.
- C. Greater than the biomass of A and B.
- D. The same as H.

15. Which of the species is most likely to be a tertiary consumer?

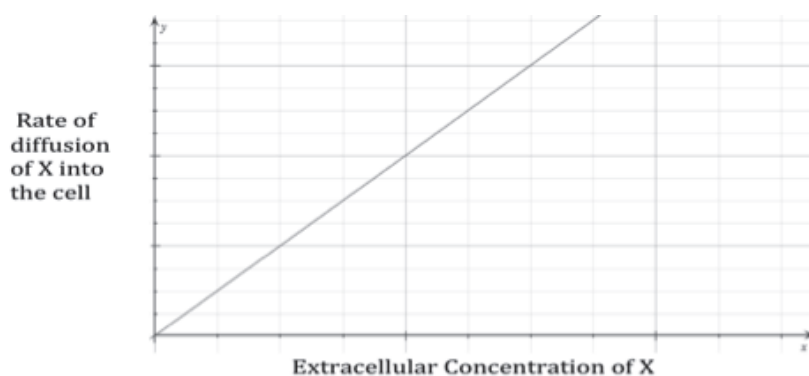
- A. C.
- B. D.
- C. F.
- D. H.

Use the following information to answer question 16.

The pineal gland in the human brain produces a hormone called melatonin, which induces sleep. Some air travellers take supplements of melatonin to avoid sleeplessness when they cross time zones. For most people, melatonin is produced at dusk or during darkness, which is why we sleep mainly at night. This is also why it is difficult for night shift workers in factories to stay awake. Experiments have shown that if people are exposed to artificial light of certain wavelengths and intensities, their production of melatonin is suppressed.

- 16.** Which one of the following can be drawn as a conclusion from the above passage?
- A. Factories where people work at night should use lighting of the highest intensity.
 - B. Lighting conditions could be used to help night workers to stay awake.
 - C. The pineal gland of night workers produces melatonin during the daytime.
 - D. People who suffer from insomnia should take supplements of melatonin.

Use the following graph to answer questions 17 – 18.



- 17.** Which of the following processes is represented by the above graph?
- A. Simple diffusion.
 - B. Facilitated diffusion.
 - C. Active transport.
- 18.** Molecule X is most likely:
- A. Lipid soluble and hydrophobic.
 - B. Lipid soluble and hydrophilic.
 - C. Lipid insoluble and hydrophobic.
 - D. Lipid insoluble and hydrophilic.

Use the following information to answer question 19.

An enzyme-catalysed reaction can be followed by measuring either the appearance of a product or the disappearance of a substrate. An enzyme and its substrate were incubated together with different concentrations of copper and magnesium salts and the data are shown in the table below.

Concentration of metal ions (mol^{-1})	Time taken to break down the substrate (seconds)	
	Copper	Magnesium
0	39	39
1×10^{-8}	42	21
1×10^{-6}	380	49
1×10^{-4}	1480	286

19. Which line on the table below best describes the observed effects of high concentrations of the metal ions on the activity of this enzyme?

	Copper	Magnesium
A.	Promoted	Promoted
B.	Promoted	Inhibited
C.	Inhibited	Inhibited
D.	Inhibited	Promoted

20. Endorphin is a natural analgesic released by the pituitary gland and other brain cells.

Upon binding to its receptor in brain cells, endorphin relieves pain and creates a sense of euphoria. Morphine can achieve a similar pain relief effect by binding to the endorphin receptor. Why do both endorphin and morphine bind to the endorphin receptors of brain cells?

- A. The shapes of both molecules are similar.
- B. Both molecules are isomers.
- C. Molecular weights of both molecules are similar.
- D. Sizes of both molecules are similar.

Use the following information and table to answer question 21.

The following table shows various inhalational anaesthetic agents comparing their pungency, potency, onset and blood-gas solubility. Potency is measured by minimal alveolar concentration (MAC), which is the concentration of vapour required to produce immobility on surgical stimulus in 50% of patients. A high MAC indicates a low potency. Onset is the time it takes for the effects of a drug to be observed after administration.

Anaesthetic Agent	Pungency	Potency (MAC)	Onset	Blood-gas Solubility
Nitrous oxide	Non-pungent	101%	Rapid	Low
Halothane	Non-pungent	0.86%	Slow	Intermediate
Isoflurane	Pungent	1.1%	Medium	Intermediate
Sevoflurane	Non-pungent	1.7%	Rapid	Low
Desflurane	Pungent	6.0%	Rapid	Low

21. Which of the following statements is true?

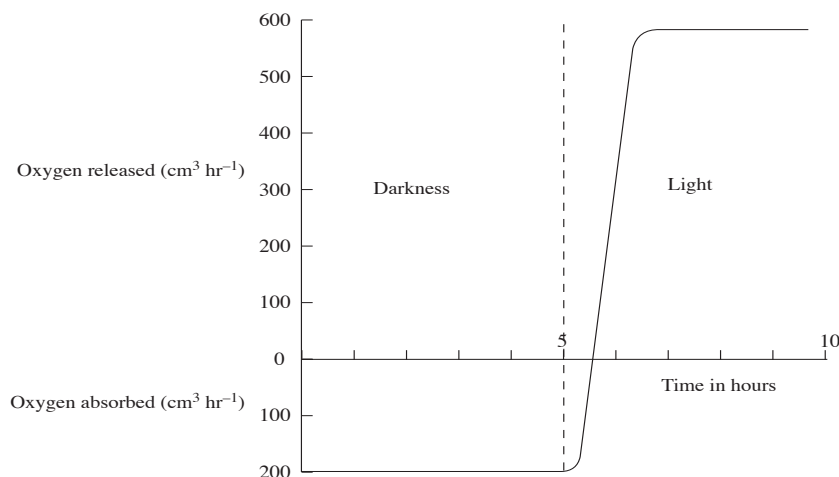
- A. Nitrous oxide has a high potency and rapid onset.
- B. Sevoflurane and Desflurane are both pungent agents with rapid onsets.
- C. Halothane has a high potency and low blood-gas solubility.
- D. Halothane and Isoflurane are both highly potent with intermediate blood-gas solubility.
- E. Desflurane has a very low potency and rapid onset.

22. In some cells, synthesis of isoleucine from threonine is catalysed by the sequential action of five enzymes **a**, **b**, **c**, **d** and **e**, which produce four intermediates A, B, C, and D, and the end product isoleucine, respectively. What is most likely to happen when isoleucine is overproduced and there is an ample supply of threonine in cells?

- A. Isoleucine binds to enzyme **a** and inhibits its activity.
- B. Isoleucine associates with threonine to inhibit the activity of enzyme **a**.
- C. Isoleucine associates with intermediate D to inhibit the activity of enzyme **e**.
- D. Isoleucine binds to enzyme **e** and inhibits its activity.

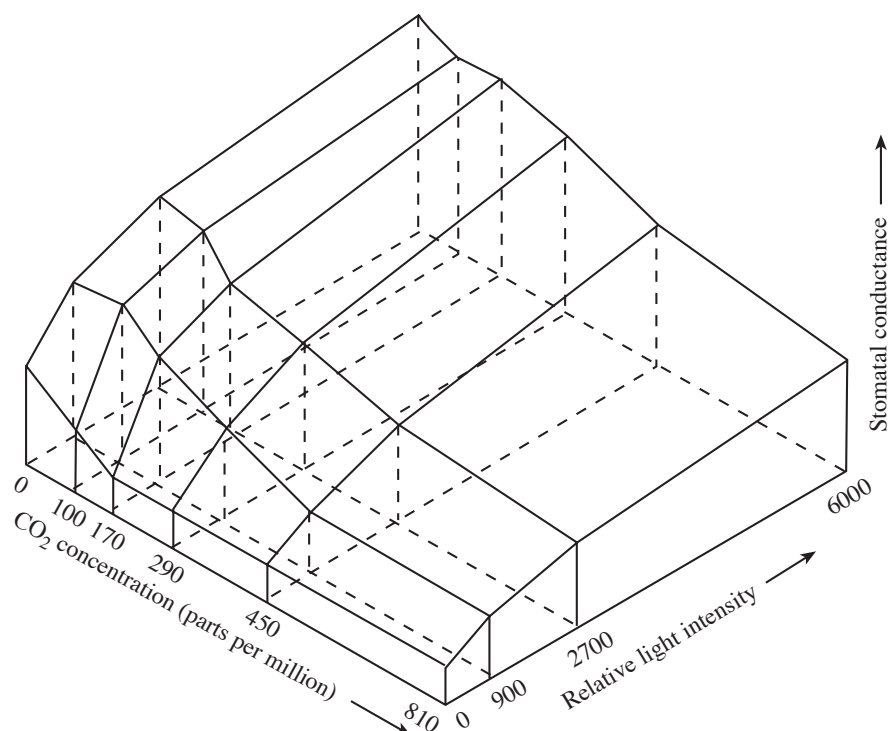
Use the following information and graph to answer question 23.

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 constant. The results are shown in the graph below.



23. 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 cm³
 - B. 800 cm³
 - C. 1200 cm³
 - D. 1600 cm³
 - E. 1800 cm³
24. The species of coral *Acropora digitifera* is unable to produce cysteine as it lacks a gene which encodes an enzyme essential in the cysteine synthesis pathway. Instead the coral gains cysteine from dinoflagellates, algae that reside within its cells, which also give the coral its colour. This is an example of what kind of relationship?
- A. Commensalism.
 - B. Parasitism.
 - C. Competition.
 - D. Predator-prey.
 - E. Mutualism.

25. Measurements of the rate of diffusion through stomata ('stomatal conductance') were made under various CO₂ concentrations, and the following stereograph was drawn.



Which one of the following is a valid deduction from the stereograph?

- A. Stomatal conductance is maximal when conditions for photosynthesis are optimal.
- B. Increasing light intensity increases stomatal conductance at all CO₂ levels shown.
- C. Stomatal conductance is unaffected by an increase in CO₂ concentration from 170 to 810 parts per million.
- D. Changes in CO₂ concentration have a greater influence on stomatal conductance than changes in light intensity.
- E. Changes in light intensity have a greater influence on stomatal conductance than changes in CO₂ concentration.

Use the following information to answer question 26.

With only skeletons to work from, we rely on artists' impressions of how dinosaurs looked 'in the flesh'. Lawrence Witmer (Ohio University) is one of the world's foremost experts in the soft anatomy of dinosaur heads and caused a stir when he said that artists have generally put the nostrils of dinosaurs too high on the head. This conclusion was the result of months spent studying the relative positions of noses and nostrils in modern animals. He found that there is a correlation between the shape of the bone of the nose and the location of the fleshy nostril. On examination of dinosaur fossils he concluded that in modern reconstructions of dinosaur heads the nostrils have always been misplaced. They should be shown low on the nose, near the mouth. Nostrils in that position would heighten the animal's ability to nuzzle potential food and decide whether it was edible.

- 26.** According to the passage above, Witmer based his hypothesis on which one of the following pieces of evidence?
- A. The correlation between the bones of the nose and the position of the nostrils in modern animals.
 - B. The correlation between the positions of the noses in modern animals and in dinosaurs.
 - C. The similarity between the skeletons of modern animals and those of dinosaurs.
 - D. The fact that modern animals use their nostrils to decide whether or not potential food is edible.
- 27.** In mammals, a large quantity of fluid is filtered every day by the nephrons in the kidneys. Only about 1% of it is excreted as urine. The remaining 99% of the filtrate:
- A. is lost as sweat.
 - B. is stored in the urinary bladder.
 - C. is reabsorbed into the blood.
 - D. gets collected in the renal pelvis.
- 28.** Which statement is true of arteries?
- A. All arteries carry oxygenated blood away from the heart.
 - B. All arteries carry blood high in carbon dioxide to the heart.
 - C. All arteries carry blood low in carbon dioxide away from the heart.
 - D. All arteries lack valves.
 - E. All arteries have valves.

Use the following information to answer questions 29 – 30.

Supporters of ‘intelligent design’ argue that complex organisms cannot have evolved by random events. This is because the chances of such complexity occurring naturally are so small. However, we do not need intentional design to explain the outcome of nature’s processes. Nature does not have fixed intentions but makes billions of combinations of genes or characteristics. Any particular outcome is possible, however unlikely. Some individuals will have combinations of genes, which make them more likely to survive. These will successfully raise young and pass on the beneficial characteristics.

29. Which one of the following best expresses the main conclusion of the argument presented above?

- A. Natural evolution can lead to any combination of genes, however unlikely.
- B. The notion of a designer is not required to explain the development of complex organisms.
- C. Individuals with unlikely characteristics have a better chance of reproducing successfully.
- D. Complex organisms are so unlikely they must be the product of design not chance.

30. Which one of the following is a further conclusion that can be drawn from the reasoning in the passage?

- A. People have a natural tendency to explain evolution in terms of design.
- B. Life must necessarily have been created.
- C. A designed product cannot be better than one that occurs by chance.
- D. There may be desirable characteristics for a species that have yet to evolve.

31. Angiotensin II is a chemical that causes blood pressure to rise. Peyton is a normal individual and he has X amount of angiotensin II in his blood stream. Eli has low blood pressure because his heart does not beat with the proper force. Eli has Z amount of angiotensin II in his blood stream. Which of the following is TRUE?

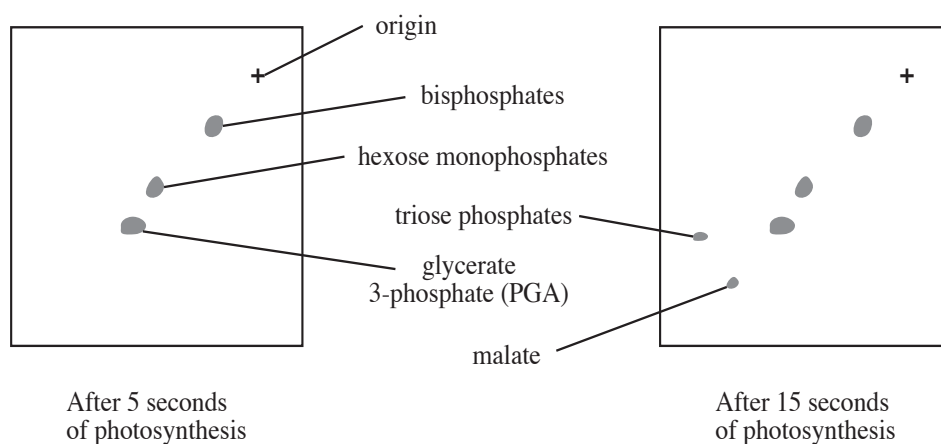
- A. $X=Z$.
- B. $X>Z$.
- C. $X<Z$.

32. A population of endangered parrots was relocated to a protected area just prior to the logging of their original habitat. In the new habitat, they were hunted by fewer predators, so the death rates dropped by 50%, from 0.1 per individual per year to 0.05 per individual per year. In their new habitat, however, recorded birth rates also fell by 50%, from 0.2 per individual per year to 0.1 per individual per year. From these observations, the conservationists:

- A. worried that the population would overshoot as a result of the decreased death rate.
- B. decided there would be no change in population growth rate in the new habitat .
- C. expected an increase in the carrying capacity of the new habitat.
- D. expected to observe a lower rate of population growth compared to the original habitat, because the intrinsic rate of increase had decreased.

Use the following information to answer question 33.

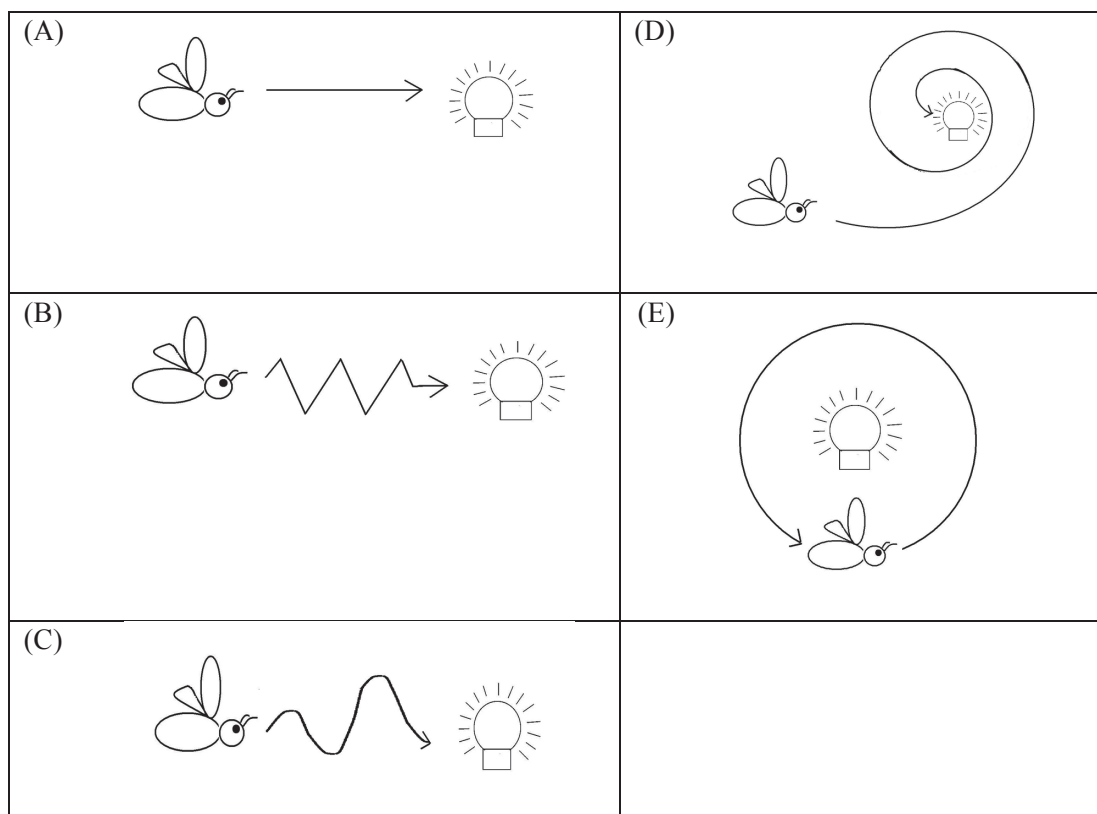
Two cultures of algae were exposed to $^{14}\text{CO}_2$ for 5 seconds and 15 seconds respectively. They were then killed and the soluble products of photosynthesis extracted, separated by chromatography. The locations of molecules containing ^{14}C on each chromatogram are shown below.



33. Which one of the following statements can be inferred from the above data?

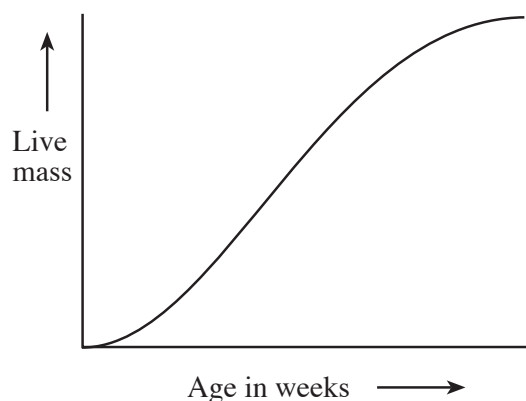
- A. Glycerate 3-phosphate is the first product of CO_2 fixation.
- B. Malate is the last product of CO_2 fixation.
- C. Hexose monophosphates are unstable and break down into glycerate 3-phosphate.
- D. Glycerate 3-phosphate is converted to triose phosphate.
- E. Triose phosphates are formed after glycerate 3-phosphate.

34. A biologist discovered that a species of moth is capable of flying in a straight line at night because it keeps a constant angle (80°) between its body axis and the direction of moon light using photoreceptors as a tool. If the moth encounters a bright light on a dark night, what kind of flight path of the moth will be expected in relation to the light source?

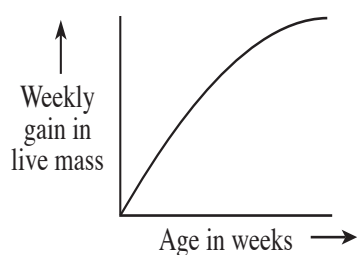


35. Spines (modified leaves) and thorns (modified stems) on plants look similar. Both provide protection from herbivores. However, not all plants with spines or thorns have descended from a recent common ancestor. Which of the following statements best describes how this information provides evidence for evolution by natural selection?
- It shows that different organisms sometimes look alike.
 - It shows that herbivores are the strongest selection force on organisms.
 - It shows that a variety of structures can be effective in protecting an organism from herbivores.
 - It shows that environmental pressures can cause unrelated species to change in similar ways.
 - It shows that spines and thorns provide the best protection from herbivores.

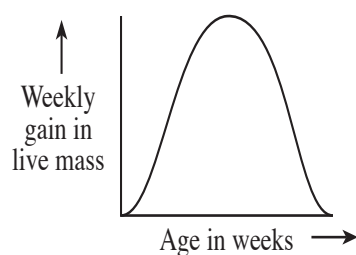
36. The graph shows how the live mass of a sheep changes as it develops.



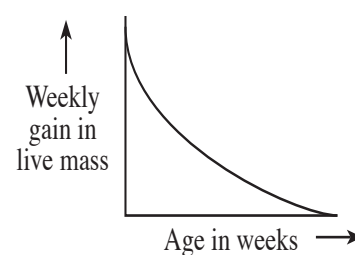
Which one of the following graphs (A – E) correctly shows the rate of change of live mass of the sheep over the same period?



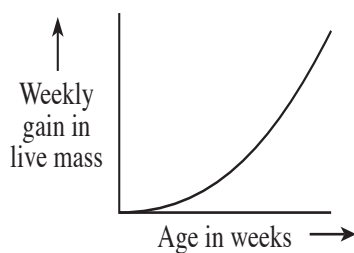
A



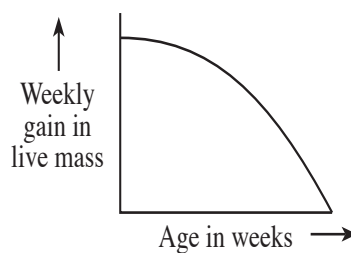
B



C



D



E

Use the following information to answer questions 37 – 44.

Ratites are birds named for their flat “raft-like” sternum that lacks a keel. As a result it cannot provide sufficient anchorage for flight muscles to effectively generate the power required for flight. Cassowary (Australia and Papua New Guinea), Emu (Australia), Rhea (South America), Ostrich (Africa), Kiwi (New Zealand), and extinct Moa (New Zealand) are all examples of ground dwelling, flightless ratites. Given their large, flightless nature, biologists have proposed that they have all descended from a common ancestor present in ancient Gondwana before it broke apart. The exact timing and evolutionary origin of the Moa and Kiwi in New Zealand have been greatly debated in the scientific literature.



Geological History of Gondwana

- ∞ 180 mya Africa breaks free from Antarctica and India
- ∞ 130 mya South America breaks free of Africa
- ∞ 80 mya Zealandia breaks free
- ∞ 60 mya New Zealand separates from Australia
- ∞ 40 mya Australia separates from Antarctica
- ∞ 30 mya South America breaks from West Antarctica (Antarctica freezes over)

Flying Cousins

Ratites are one of only two groups of birds belonging to the “old jaw” *Paleognaths* originating in Gondwana, the other comprises the 47 living Tinamou species of Central and South America. Tinamou species are generally ground dwelling, though they have wings that allow for limited flight.

It is generally accepted that loss of flight in birds is due to the development of successful foraging behaviours and diminished predation on eggs and nests.

Fossil Evidence

Examination of the oldest known Moa fossils, dating from 19 million years ago, determined they had thickened leg bones and no wing structures at all. At least two species of flightless Moa were present in New Zealand at this time.

The oldest Tinamou fossils in South America are 10 million years old. The oldest Kiwi fossil dates back 1 million years. Though diminished in size, kiwis have wings and flight feathers. Kiwis are the only known bird to have nostrils at the end of their beaks and the only ratite with two functioning ovaries.

37. Scientists have proposed that Moa and Kiwi share an immediate common ancestor.

Which of the following statements would **BEST** support this hypothesis?

- A. They are both found in New Zealand.
- B. They are both flightless birds.
- C. Kiwi and Moa are not found outside of New Zealand.
- D. Without help, Kiwi are likely to go extinct.
- E. Oldest Kiwi fossils are much younger than the oldest Moa fossils.

38. According to the estimated break up of Gondwanaland the **BEST** hypothesis is that?

- A. Ostrich and Cassowary are the most distantly related ratites.
- B. Tinamou and Cassowary are the most distantly related ratites.
- C. Kiwi evolved from Moa.
- D. Tinamou and Moa are the most closely related ratites.
- E. Moa evolved from Ostriches.

39. Proportional to their body size, Kiwi have the largest egg of all the ratites. Which of the following inferences about Kiwi is **LEAST** likely to be true?

- A. Kiwi have evolved from a much larger species.
- B. Having two ovaries allows them to produce larger eggs.
- C. Kiwi have been flightless for a very long time.
- D. Larger eggs allow for better survival of Kiwi chicks.
- E. Larger eggs evolved after flightlessness.

40. Tinamou are the only group of Paleognath birds that have the ability to fly. Which of the following is **LEAST** likely to account for their flying ability?

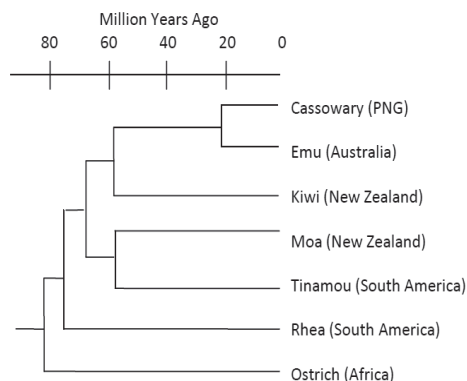
- A. A common ancestor became isolated from other Paleognaths prior to them becoming flightless.
- B. The rich biodiversity of South America provided a selective advantage for flying.
- C. Possessing wings provide benefits for Tinamou that are unrelated to flying.
- D. Possessing wings allows Tinamou to escape from ground dwelling predators.
- E. Tinamou evolved from a flightless bird that regained the ability to fly.

Use the following additional information to answer questions 41 – 44.

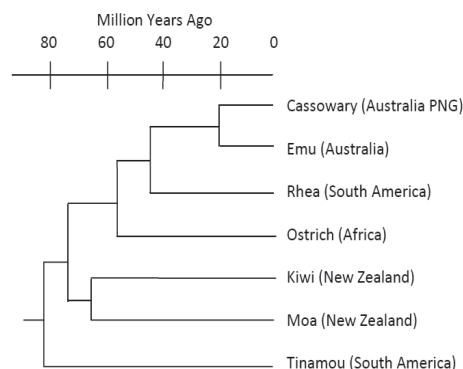
Geological analysis suggests the initial separation of New Zealand from Gondwana took place approximately 80 million years ago. However, it is hypothesised that full separation was not complete until 60 million years ago. Some scientists propose that a common ancestor of the Moa and the Kiwi (a proto-Moa) floated away from Gondwana during this time. Others propose that Moa and Kiwi arrived in New Zealand at two different times.

Four possible phylogenetic trees, describing different possible evolutionary relationships within the ratites, are shown below page. Use these trees to answer the following three questions (41 – 43).

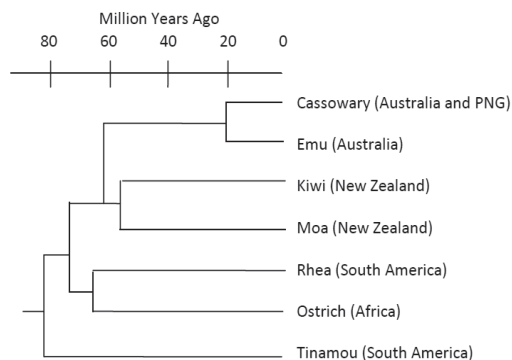
Tree 1



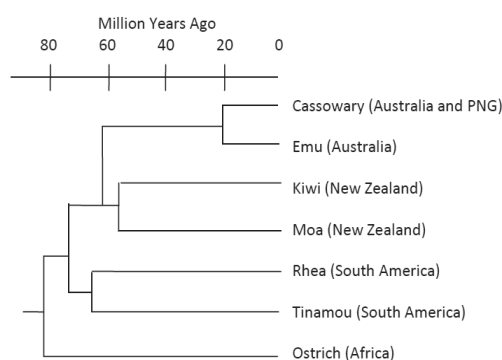
Tree 2



Tree 3



Tree 4

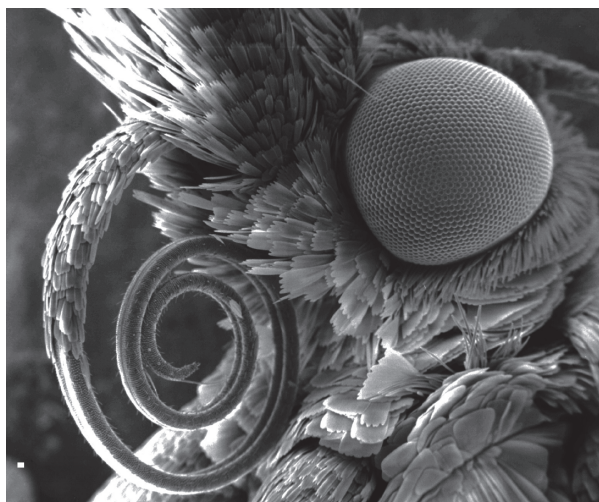


41. Which tree is most consistent with present day locations of Paleognath species?

- A. Tree 1
- B. Tree 2
- C. Tree 3
- D. Tree 4

42. Which tree incorporates mitochondrial DNA evidence showing that the Cassowary shared a common ancestor with Kiwi 60 mya and with Moa 70 mya.
- A. Tree 1
 - B. Tree 2
 - C. Tree 3
 - D. Tree 4
43. Which tree would support the hypothesis of a proto-Moa ancestor flying to New Zealand?
- A. Tree 1
 - B. Tree 2
 - C. Tree 3
 - D. Tree 4
44. Which of the following provides the **BEST** evidence for two distinct migrations?
- A. Moa fossils are much older than Kiwi fossils.
 - B. DNA analysis estimates that Moa and Kiwi each evolved into flightless species approximately 60 mya.
 - C. Mitochondrial evidence suggests that Kiwi and Moa split from a common ancestor 80 mya.
 - D. Moa have no wings, Kiwi still possess flight feathers.
45. Cell Y expresses the gene for an enzyme to digest peroxide, generates ATP and then synthesises a protein for export, in that order. Which of the following options best describes the locations of this sequence of events?
- A. Nucleus, mitochondrion, ribosome.
 - B. Endoplasmic reticulum, nucleus, Golgi apparatus.
 - C. Peroxisome, mitochondrion, ribosome.
 - D. Peroxisome, nucleus, ribosome.

46. The SEM photomicrograph below shows the compound eye of a moth in great detail with a scale bar on the bottom left hand corner. The scale bar represents 200 μm .



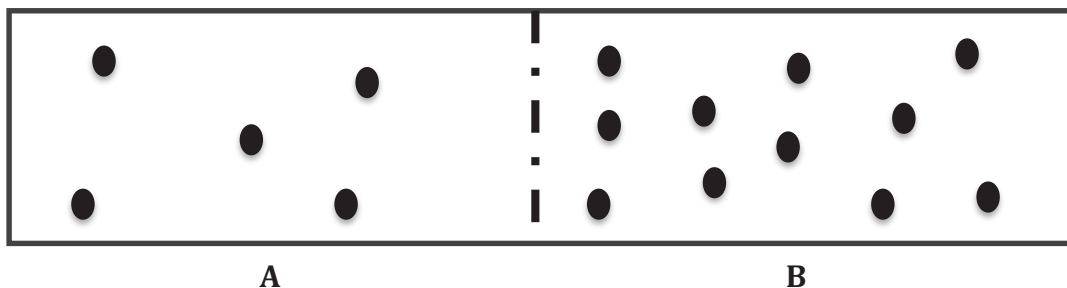
What is the best estimate of the maximum horizontal width of the moth's eye?

- A. 550 μm
 - B. 600 μm
 - C. 650 μm
 - D. 700 μm
 - E. 750 μm
47. Which of the following is (are) a function(s) of blood?
- i. Gas transport
 - ii. Hormone transport
 - iii. Heat transport
- A. i only.
 - B. ii only.
 - C. iii only.
 - D. ii and iii only.
 - E. i, ii, and iii

SECTION B: TRUE/FALSE QUESTIONS

USE THE ANSWER SHEET PROVIDED

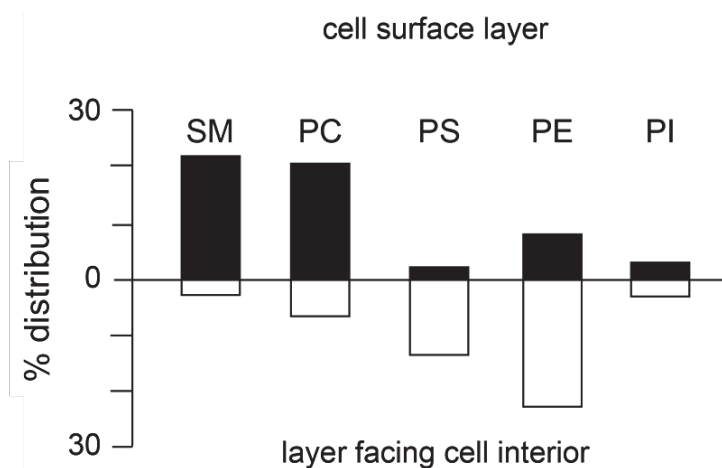
Use the following diagram to answer questions 48 and 49. It represents a container with 2 sides (A and B) separated by a membrane (dashed line). Both sides contain water (blank area) and particles (black circles).



48. Suppose the membrane separating side A from B is permeable to both water and the particles. Determine whether the following statements are true (T) or false (F) and enter them in the **answer sheet**. (1.5 marks)
- A. No osmosis will occur.
 - B. Osmosis will occur and water will move from side A to side B.
 - C. Osmosis will occur and water will move from side B to side A.
49. Suppose the membrane separating side A from B is permeable to water but impermeable to the particles. Determine whether the following statements are true (T) or false (F) and enter them in the **answer sheet**. (1.5 marks)
- A. No osmosis will occur.
 - B. Osmosis will occur and water will move from side A to side B.
 - C. Osmosis will occur and water will move from side B to side A.

Use the following information and graph to answer question 50.

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.



50. Determine which of the following statements are true (T) or false (F). **(2 marks)**

- 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.

51. Recent DNA profiling has confirmed that the Thylacine (*Thylacinus cynocephalus*), commonly known as the Tasmanian tiger, was evolutionarily related to other Australian marsupial dasyuromorphians. This was confirmed by phylogenetic analysis of sequenced remnant DNA, including mitochondrial DNA. With regards to mitochondrial DNA, determine whether the following statements are true (T) or false (F) and enter them in the **answer sheet. (2 marks)**

- A. It is an example of epigenetic inheritance.
- B. All proteins required by the mitochondria are transcribed from it.
- C. It comes from both parents.
- D. It is a circular segment of DNA.

52. Determine which statements below are true (T) or false (F) with regards to DNA replication and enter them in the **answer sheet. (1 mark)**

- A. Occurs in the nucleus.
- B. Involved in protein synthesis.
- C. Requires free nucleotides.
- D. Involves complementary base pairing.

53. Determine which statements below are true (T) or false (F) with regards to mRNA synthesis and enter them in the **answer sheet. (1 mark)**

- A. Occurs in the nucleus.
- B. Involved in protein synthesis.
- C. Requires free nucleotides.
- D. Involves complementary base pairing.