

2013 VCE Biology Trial Examination



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- Teachers and students are reminded that for the purposes of school requirements and external assessments, students must submit work that is clearly their own.
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VICTORIAN CERTIFICATE OF EDUCATION

Year 2013

STUDENT NUMBER

Letter

Figures									
Words									

BIOLOGY

Trial Written Examination

Reading time: 15 minutes

Writing time: 2 hours 30 minutes

QUESTION AND ANSWER BOOK

Structure of book

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
A	40	40	40
B	12	12	70
			Total 110

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.
- No calculator is allowed in this examination.

Materials supplied

- Question and answer book of 40 pages.
- Answer sheet for multiple-choice questions.

Instructions

- Write your **student number** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- All written responses must be in English.

At the end of the examination

- Place the answer sheet for multiple-choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

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VCE BIOLOGY 2013 Trial Written Examination

MULTIPLE-CHOICE ANSWER SHEET

Student Name _____

Student Number _____

Signature _____

If your name or number on this sheet is incorrect, notify the Supervisor.
Use a **PENCIL** for **ALL** entries. For each question, shade the box that indicates your answer.
All answers must be completed like **THIS** example.



Marks will **NOT** be deducted for incorrect answers.
NO MARK will be given if more than **ONE** answer is completed for any question.
If you make a mistake, **ERASE** the incorrect answer. **DO NOT** cross it out.

ONE ANSWER PER LINE

ONE ANSWER PER LINE

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

SECTION A – Multiple-choice questions

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** for the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Questions 1 and 2 relate to the following diagram of a plant cell as seen with an electron microscope.

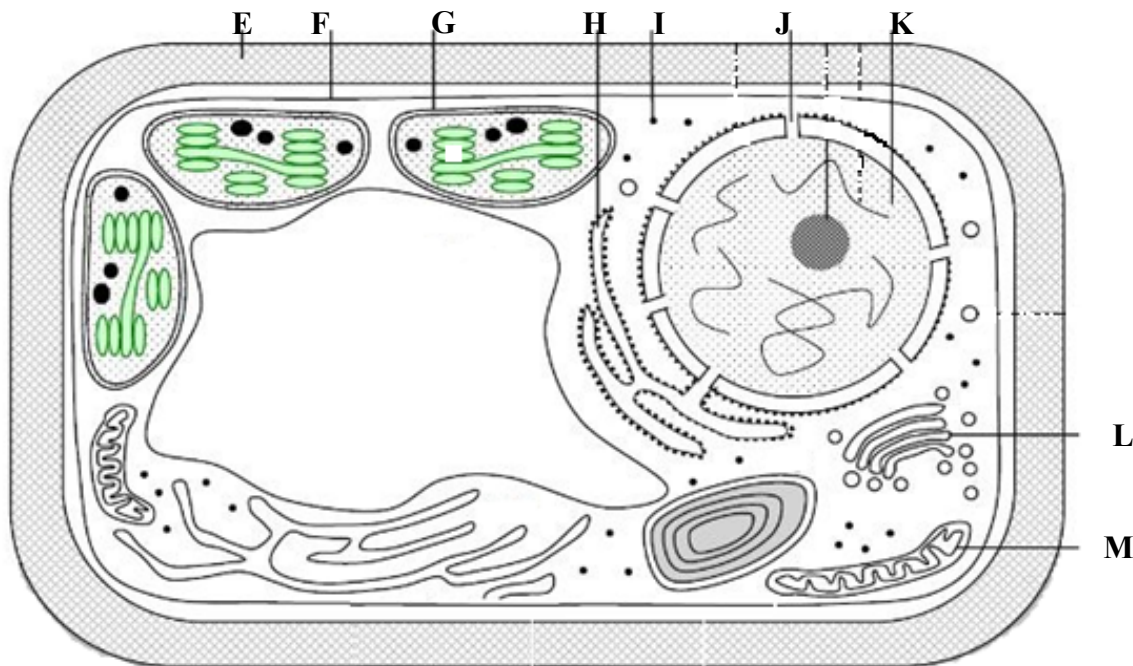


Diagram from

http://cronodon.com/BioTech/Plant_Bodies_Cells.html

Question 1

The structure(s) that is/are involved in polypeptide synthesis are

- A. structures F and H.
- B. structures J and K.
- C. structures H and I.
- D. structures L and M.

Question 2

The structures or areas that contain DNA include

- A. structures E, F and K.
- B. structures F, G and H.
- C. structures G, H and L.
- D. structures G, M and K.

Question 3

The biomacromolecules that best represent polysaccharides include

- A. glucose and starch.
- B. cellulose and sucrose.
- C. glycogen and ribose.
- D. starch and glycogen.

The next 2 questions refer to the diagram below that represents 2 amino acids joining to form a dipeptide

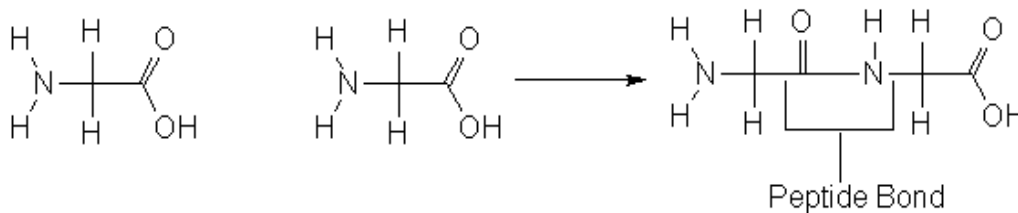


Diagram from:

<http://peptidesynthesisindia.blogspot.com.au/2011/08/peptide-bond-definition-of-peptide-bond.html>

Question 4

This reaction is an example of a

- A. catabolic reaction.
- B. hydrolysis reaction.
- C. condensation reaction.
- D. energy releasing reaction.

Question 5

The peptide bond forms part of a protein's

- A. primary structure.
- B. secondary structure.
- C. tertiary structure.
- D. quaternary structure.

Question 6

The following diagram represents a single strand of DNA

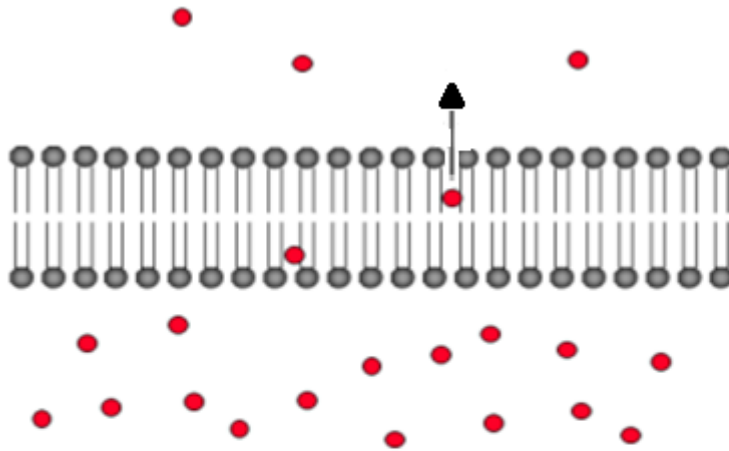
5'ACTTAGGACCATG3'

Each letter in the sequence illustrated represents a

- A. deoxyribose sugar.
- B. nitrogenous base.
- C. single nucleotide.
- D. phosphate.

Question 7

The diagram below represents a substance moving across a cell membrane.



<http://bit.ly/bSnxvY>

The following statement that is most consistent with the diagram is

- A. The substance is non polar.
- B. The substance is moving due to facilitated diffusion.
- C. The molecules that are diffusing are large.
- D. The process illustrated would be passive.

Question 8

A cell's proteome

- A. is identical to the same cell's genome.
- B. is the same throughout the cells existence.
- C. varies from cell to cell within the same organism.
- D. provides a blueprint for the cell's genome.

The next two questions relate to following graph which illustrates the rate of reaction of a typical mammalian cellular enzyme when exposed to different temperatures.

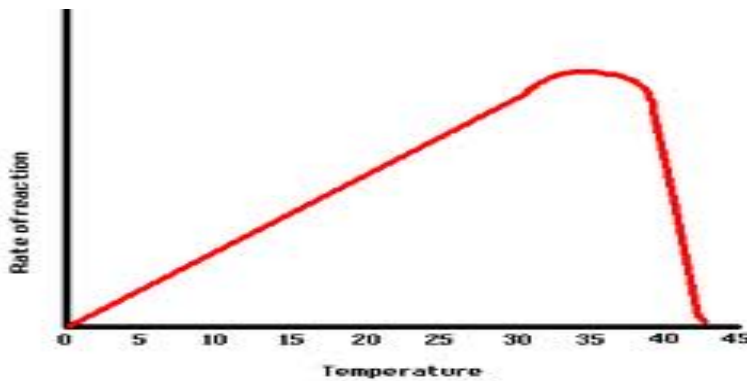


Diagram from

<http://www.woisd.net/moodle/mod/resource/view.php?id=44>

Question 9

If you were to conduct an experiment similar to this one,

- A. your independent variable would be the rate of reaction.
- B. your dependent variable would be the amount of enzyme used.
- C. your independent variable would be the result obtained at 0°C.
- D. your dependent variable would be the rate of reaction.

Question 10

The results of this experiment indicate that

- A. the activity of the enzyme at 5°C is the same as the activity of the enzyme at 40°C.
- B. the optimum temperature for this enzyme to function in is 36°C ($\pm 1^\circ\text{C}$).
- C. most of the enzyme was used up at 36°C.
- D. the fastest change in the rate of reaction was between 0°C and 30°C.

Question 11

The following diagram is of a chloroplast. Structures X, Y and Z are all associated with the process of photosynthesis.

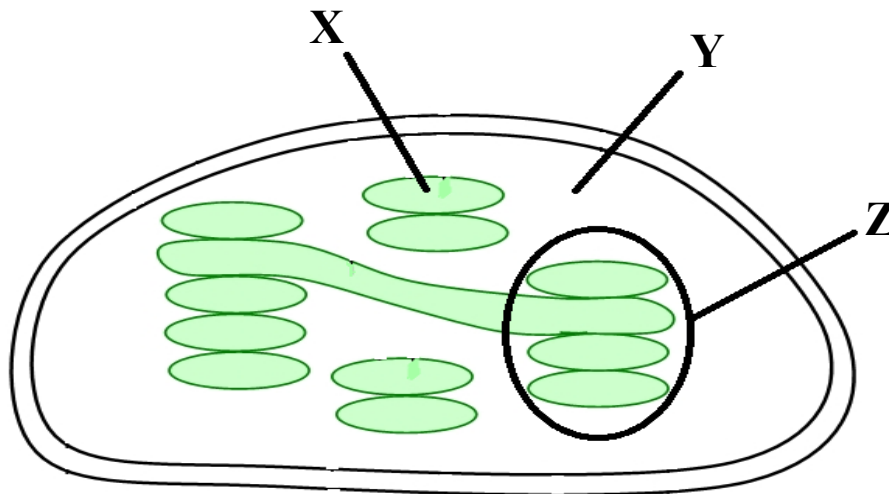


Diagram from

http://cronodon.com/BioTech/Plant_Bodies_Cells.html

The following comment that is **correctly** associated with structures X, Y and Z is

- A. The light dependent reaction occurs in structures X and Z.
- B. The light independent reaction occurs in structure X and Y.
- C. Carbon fixation occurs within structure X and Z.
- D. Structures X and Z absorb green light wavelengths to drive photolysis of water.

Question 12

A synapse functions due to

- A. neurotransmitters from the dendrite diffusing towards receptors on the axon.
- B. the narrow space across the synaptic cleft allowing neurotransmitters to diffuse and bind quickly to receptors on the post synaptic membrane.
- C. the pre-synaptic membrane and post-synaptic membrane being in direct contact with each other.
- D. calcium ion stimulated exocytosis from the post synaptic membrane.

Question 13

Multiple sclerosis is an autoimmune disease that leads to the degeneration of the myelin sheath around axons. The diagram below illustrates how a normal myelinated axon changes as a result of this devastating disease.

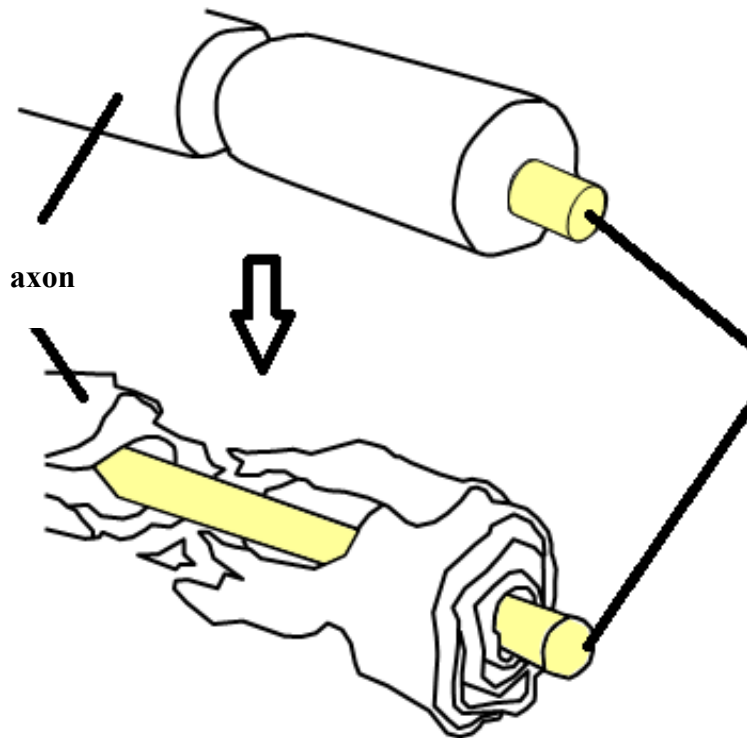


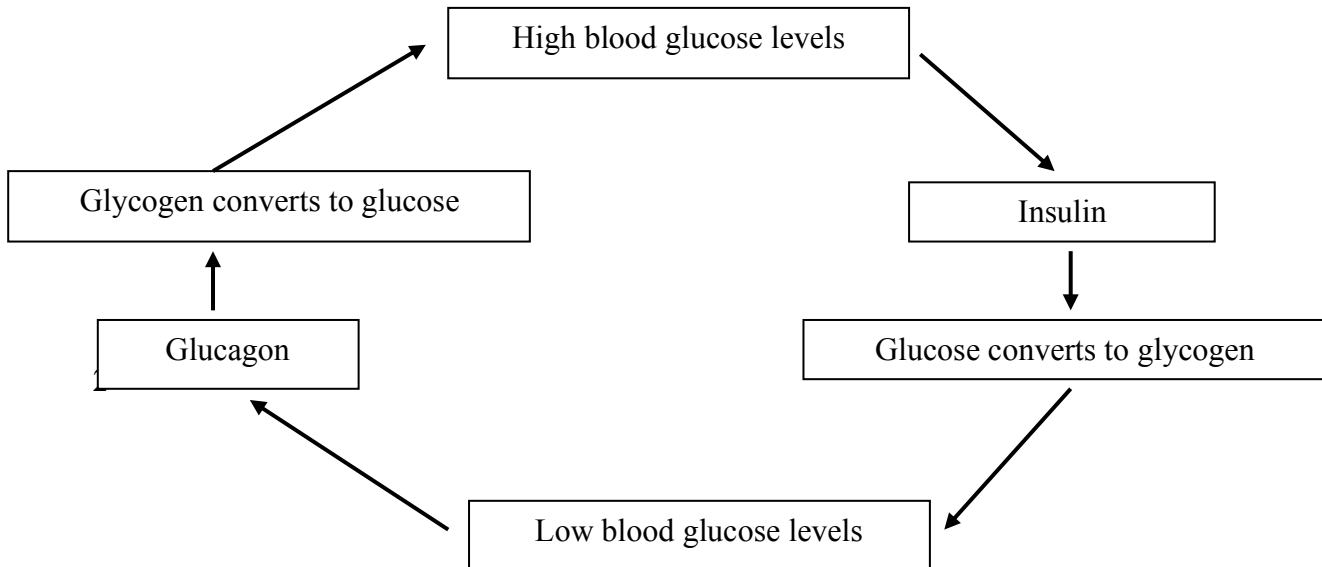
Diagram from

<http://www.finetech-medical.co.uk/PatientsCarers/WhatisMultipleSclerosisMS/tabid/89/language/en-GB/Default.aspx>

Symptoms of this disease could include

- A. raised levels of neurotransmitters.
- B. faster nerve responses.
- C. loss of muscle control in the legs.
- D. making more myelin.

The following two questions refer to the diagram below that illustrates how blood glucose levels in the blood are regulated.



Question 14

The stimulus for the production of glucagon by the pancreas would be

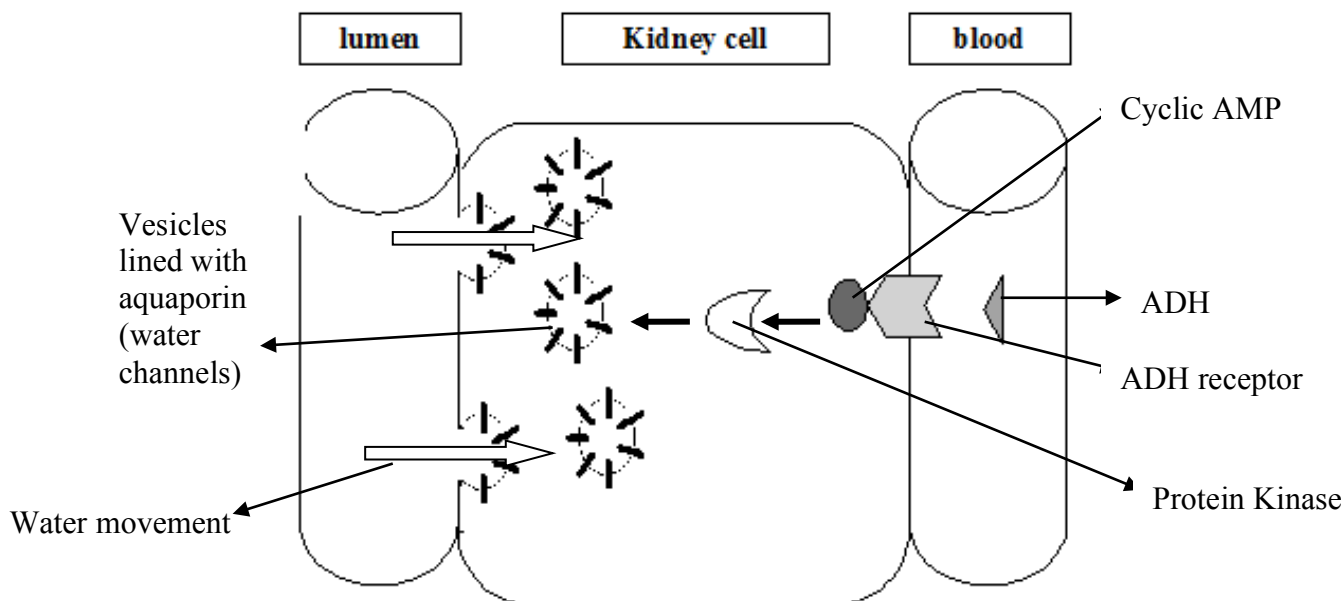
- A. low blood glucose levels.
- B. high insulin levels.
- C. raised glucose stores.
- D. high blood glucose levels.

Question 15

The following statement that would lead to **negative feedback** in this situation would be

- A. As the blood glucose levels increase, the amount of glucagon secreted would increase.
- B. As the blood glucose levels decrease, the amount of glucagon secreted would increase.
- C. As the blood glucose levels decrease, the amount of insulin secreted would increase.
- D. As the blood glucose levels increase, the amount of insulin secreted would decrease.

The following two questions refer to the diagram below that illustrates how ADH (Anti Diuretic Hormone) acts on kidney collecting duct cells to maintain the body's water balance.



Question 16

The ADH in the blood binds to the ADH receptor which, via a series of intracellular changes, leads to water moving from the lumen into the kidney cell. This process is known as

- A. signal transduction.
- B. apoptosis.
- C. enzyme activation.
- D. signal amplification.

Question 17

The general effect of the response of the body to raised levels of ADH would be

- A. diluted blood.
- B. more concentrated blood.
- C. no change in the concentration of salts in the blood.
- D. less aquaporin in contact with the lumen.

Question 18

A patient presents to a doctor with a severe bacterial infection. The best course of action that the doctor should prescribe would be

- A. broad spectrum antiseptics.
- B. a particular type of antibiotic.
- C. bed rest as no medication is possible for bacterial infections.
- D. vaccination.

Question 19

The clonal expansion theory was first proposed over 30 years ago and explained the basis behind the adaptive immune response. Some of the steps involved in this response are listed below but they are not in the correct order.

1. Memory cells remain in the body.
2. Plasma cells produce antibodies.
3. Antigens displayed by macrophages.
4. Specific B cell differentiate.
5. Antibodies neutralise the antigen.
6. Specific B cell binds with antigen.
7. Specific B cell clones.

The correct order of steps that best explains the clonal expansion theory would be

- A. 1, 2, 3, 4, 5, 6, 7.
- B. 3, 5, 6, 2, 1, 7, 4.
- C. 3, 6, 7, 2, 5, 4, 1.
- D. 3, 6, 7, 4, 2, 5, 1.

Question 20

A hiker was trekking at Mt. Baw Baw and was bitten by a tiger snake on the ankle. At the nearest hospital, he was injected with anti-venom that rapidly led to a full recovery. The anti-venom is an example of

- A. natural active immunity.
- B. artificial active immunity.
- C. natural passive immunity.
- D. artificial passive immunity.

Question 21

The following diagram represents a group of cells from the root tip of a garlic plant. These cells are undergoing mitosis. Four cells (1 to 4) are highlighted

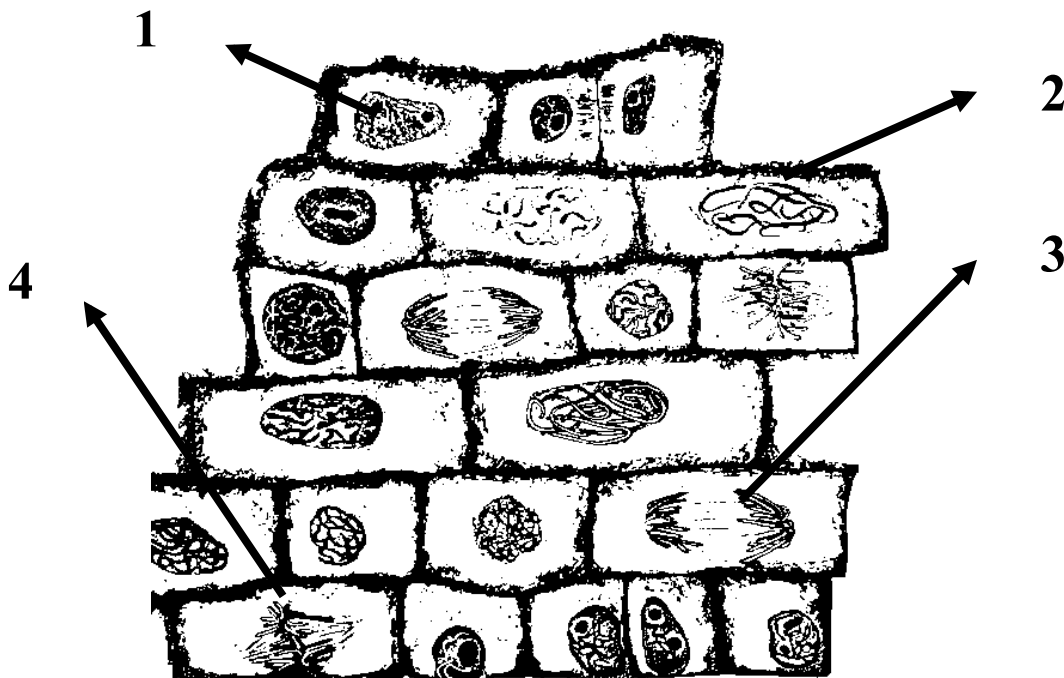


Diagram from: http://www.uq.edu.au/_School_Science_Lessons/9.3.69.GIF

The statement that correctly identifies the stage of mitosis as well as what is occurring during that stage is

- A. Stage 1 is anaphase because the nuclear membrane is still visible.
- B. Stage 2 is interphase because the chromosomes are visible and the nuclear membrane is no longer visible.
- C. Stage 3 is anaphase because the sister chromatids are moving in opposite directions to each other.
- D. Stage 4 is telophase because the cells are about to form a cell plate in the middle of the cell.

Question 22

The diagram below is of a DNA replication fork.

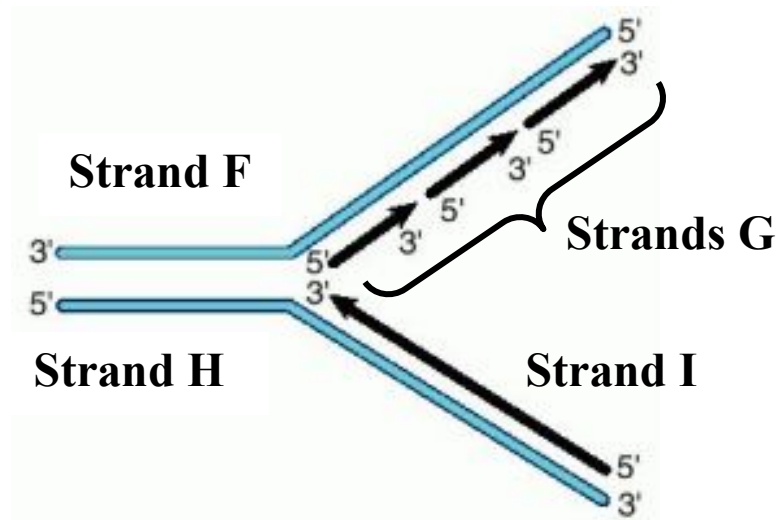


Diagram from: <http://medicaldictionary.thefreedictionary.com/Replication+fork>

The following statement that best represents the DNA replication fork is

- A. Strands **G** represent the leading strand and strand **I** the lagging strand.
- B. Strands **F** and **H** are the result of semi-conservative replication.
- C. DNA replication occurs in mitosis but not in meiosis.
- D. Strand **I** is synthesised in the 3' to 5' direction.

Question 23

The donkey has a diploid number of 62 and the horse a diploid number of 64. A mule is the offspring of a horse and donkey. The diploid number of the mule would be

- A. 62.
- B. 63.
- C. 64.
- D. 126.

Question 24

The information in the table below relates to the genome size and the number of genes in 5 different organisms.

Organism	Genome Size (base pairs)	Gene Number
<i>E. coli</i> (bacteria)	4,639,221	4,377
Yeast (fungus)	12,495,682	5,770
<i>A. thaliana</i> (plant)	115,409,949	18,000
Dogs (animal)	2,400,000,000	19,300
Humans	3,300,000,000	21,000

From this information it would be reasonable to conclude that

- A. as the genome size increases, the number of genes present also increases.
- B. the size of the genes in humans would be larger than the genes in *E. coli*.
- C. a dog is more complicated than a yeast.
- D. the *E. coli* genes would all be found in the plant.

Question 25

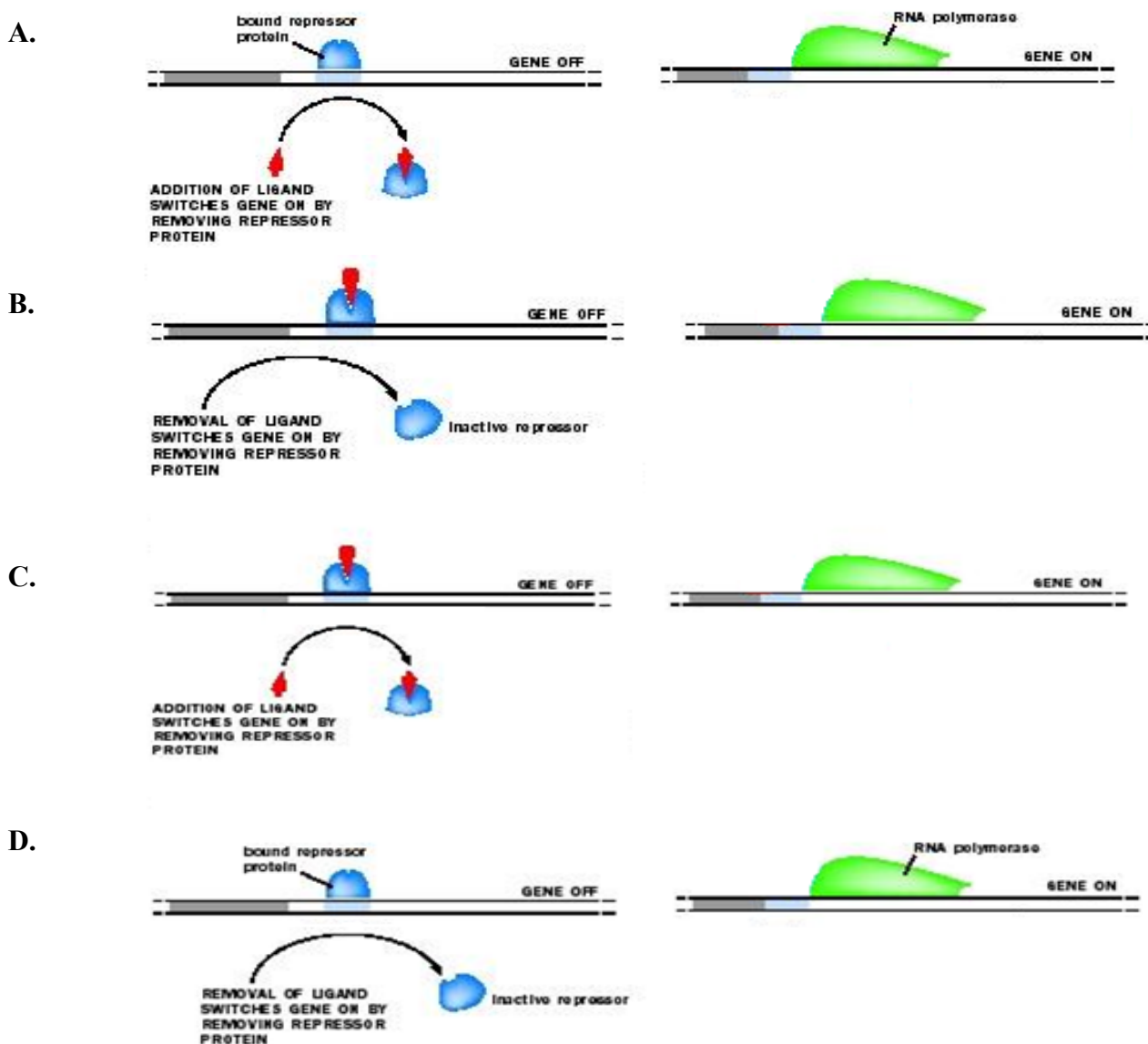
The tRNA anticodons that would bind to the mRNA at the ribosome, as part of the process of translation of the following pair of DNA triplets, would be

3' TACGGG 5'

- A. 3'UAC5' and 3'CCC5'
- B. 3AUG5' and 3'CCC5'
- C. 3'UAC5' and 3'GGG5'
- D. 3'AUG5' and 3'GGG5'

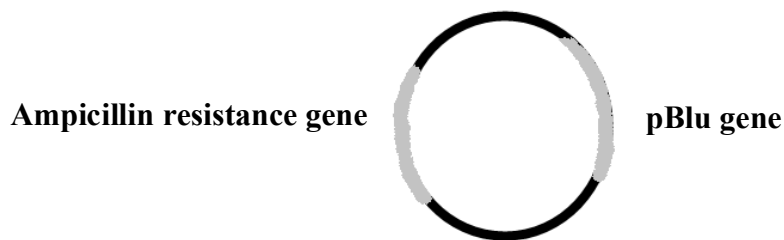
Question 26

There are 2 main models of gene control, one of which involves a ligand being removed from a repressor protein, which detaches from the operator section of the gene and allows it to be expressed. The diagram that correctly illustrates this model is



Question 27

The pBlu plasmid is occasionally used for the bacterial transformation of *E.coli*. A diagram of the pBlu plasmid is shown below. The ampicillin resistance gene produces a protein that confers resistance against the antibiotic ampicillin in bacteria. The pBlu gene produces a protein, β galactosidase, that, when in the presence of an artificial chemical (x-gal), turns the single bacterial colony blue (normally the bacterial colonies are white). There is a restriction enzyme binding site for *ecoR*1 within the ampicillin resistance gene AND another restriction enzyme binding site for *hind* III within the pBlu gene.



A small volume of these plasmids was mixed with *hind* III, ligase and a gene from another species that had been extracted using *hind* III as well. After this procedure, *E.coli* bacteria were added to complete the bacterial transformation.

Culture plates with x-gal and ampicillin (on either or none) were used to select the bacteria that had been successfully transformed. The plate that would enable you **clearly** to observe transformed bacteria would include

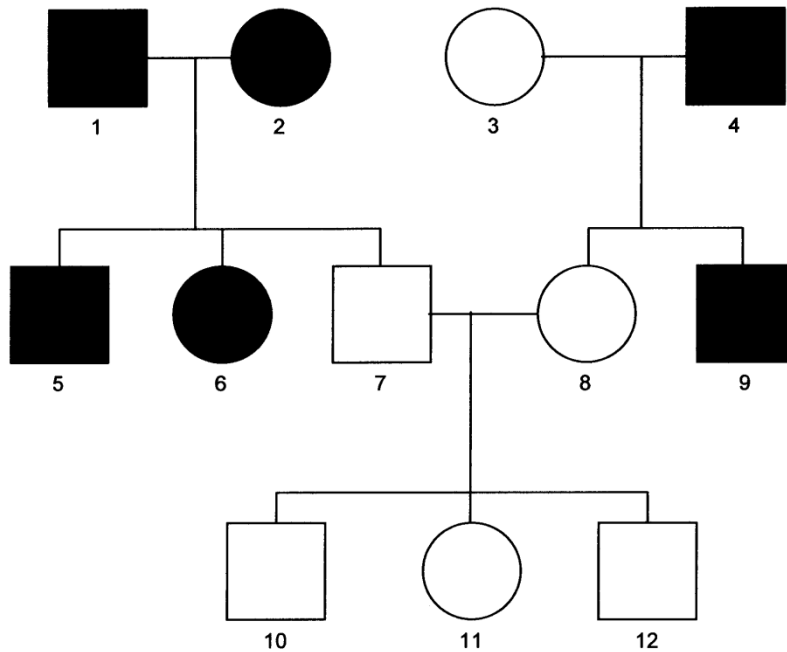
- A. culture plates prepared without ampicillin or x-gal were completely covered with white *E.coli* colonies.
- B. culture plates prepared with ampicillin but no x-gal were partially covered with white *E.coli* colonies.
- C. culture plates prepared without ampicillin but with x-gal were completely covered with blue *E.coli* colonies.
- D. culture plates prepared with ampicillin and x-gal were partially covered with some blue and some white *E.coli* colonies.

Question 28

A male who has blood type AB would have _____ allele(s) with respect to this single gene in his somatic cells after S phase of the cell cycle. The number that correctly completes the sentence is

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

The next two questions refer to the following pedigree illustrating the inheritance of Huntington's disease, which is a neurological condition that usually expresses itself later in life.



Question 29

The pattern of inheritance illustrated in the pedigree below is

- A. sex-linked dominant.
- B. autosomal dominant.
- C. sex-linked recessive.
- D. autosomal recessive.

Question 30

The chance that individual 6 is heterozygous for Huntington's disease is

- A. 0%.
- B. 25%.
- C. 50%.
- D. 66%.

The next two questions refer to the following information.

The diagram below illustrates the loci and allele combination of 4 genes found on 3 human chromosomes (6, 12 and 14)

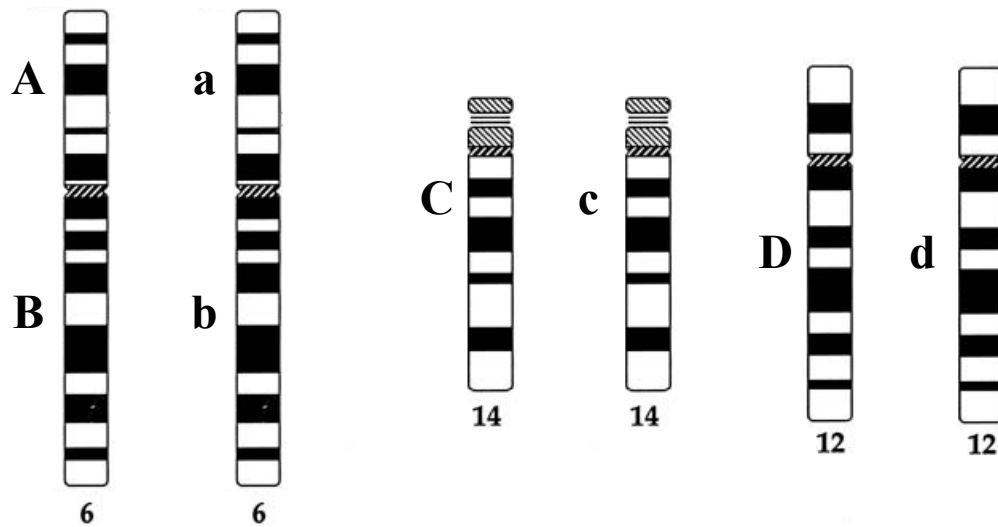


Diagram from:

<http://www.glowm.com/resources/glowm/cd/pages/v5/ch096/framesets/001f.html?SESSID=enk6tt4vd0dnffse20lvsogu1>

Question 31

Based on the alleles present as well as their location, the genotype that best represents this individual is

- A. AaBbCcDd.
- B. Ab/aB CcDd.
- C. AB/ab CcDd.
- D. Aa/Bb CcDd.

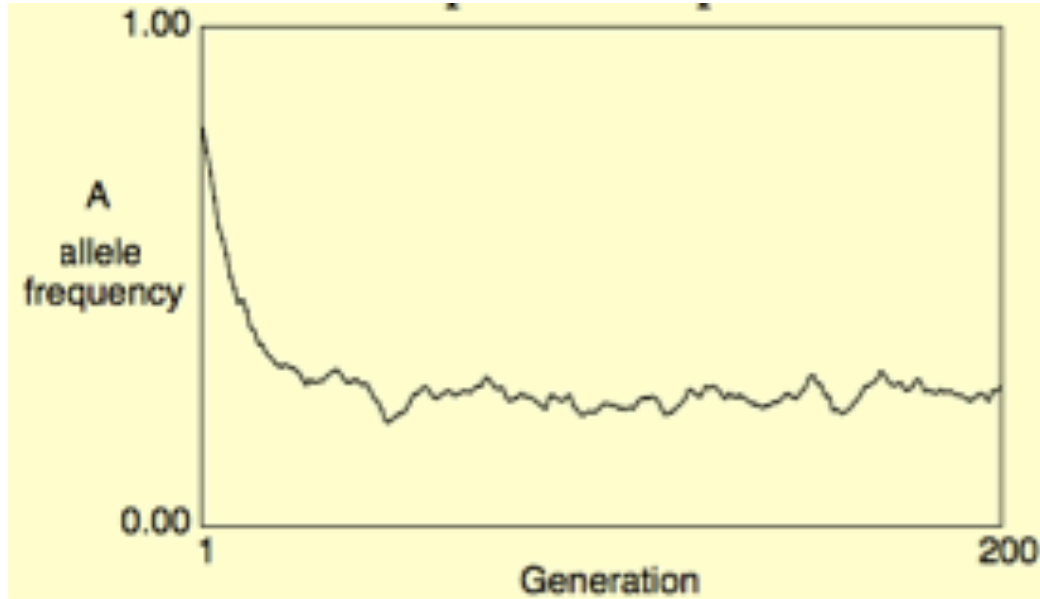
Question 32

During meiosis, recombination would most likely occur between

- A. genes A and B.
- B. genes C and D.
- C. genes A and C.
- D. genes B and D.

Question 33

Nematode worms can cause disease in humans. There is a gene called the Gpi gene in nematodes that affect their development. There are 2 forms of the Gpi gene, drug sensitive (A) and drug resistant (a). A group of 500 nematodes were exposed to an experimental drug for many generations to see the effect that the drug had on the nematode Gpi gene pool. The graph below illustrates the changes observed.



As a result of this study, the allele frequency illustrated changed because

- A. the drug resistant allele provided a selective advantage to the nematode.
- B. the drug sensitive allele provided a selective advantage to the nematode.
- C. nematodes that possessed the drug sensitive allele mutated to the drug resistant form.
- D. the drug resistant allele provided a selective disadvantage to the nematode.

Question 34

Natural selection acts on

- A. the phenotype.
- B. the genotype.
- C. particular alleles.
- D. the individuals who better adapt to the changed environment.

Question 35

Two areas from quarries separated by 50 km were found to contain a large number of fossils as illustrated in the diagram below.

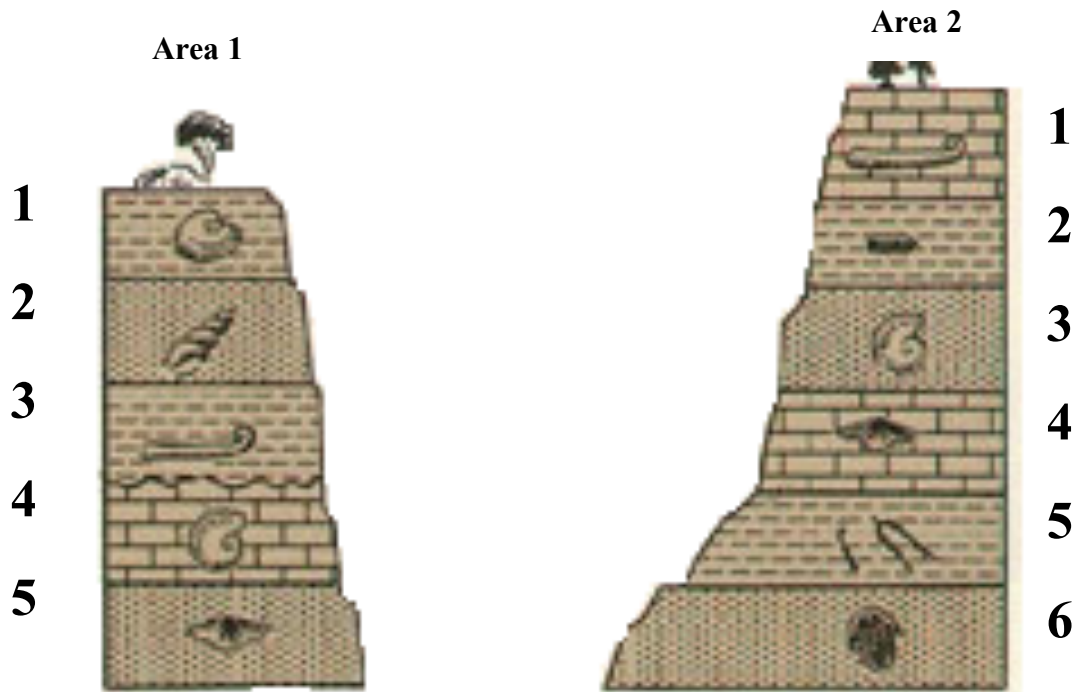


Diagram from

<http://www.uvm.edu/perkins/evolution/qanda/?Page=time/faunal.html&SM=time/timemenu.html>

The oldest fossils from either area would be

- A. layer 5 from area 1.
- B. layer 6 from area 2.
- C. layer 1 from area 1.
- D. layer 1 from area 2.

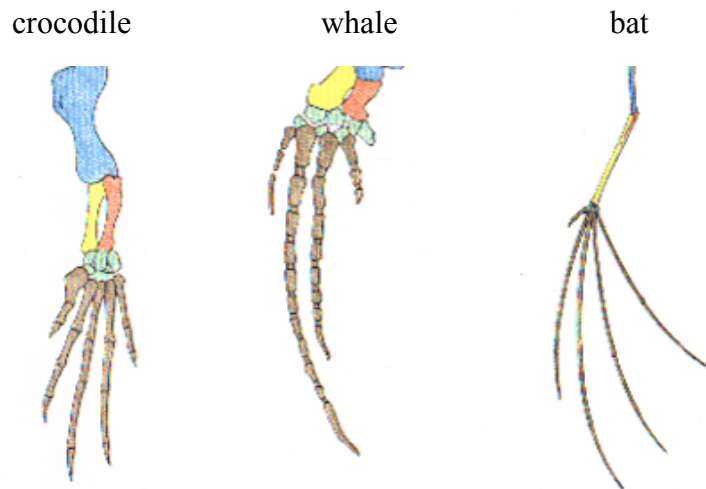
Question 36

A lump of unrecognisable organic matter (thought to be food) was located in a clay bowl thought to have been in use about 5,000 to 30,000 years ago. The half-life of carbon-14 is 5730 years and carbon dating was applied to the organic material. The amount of carbon-14 that would normally have been present in the organic material would have been about 0.1g, but it was found to contain about 0.01g instead. The actual age of the organic material would be closest to

- A. 5,730 years old.
- B. 11,460 years old.
- C. 17,190 years old.
- D. 22,920 years old.

Question 37

The forearms of 3 vertebrates are illustrated below.

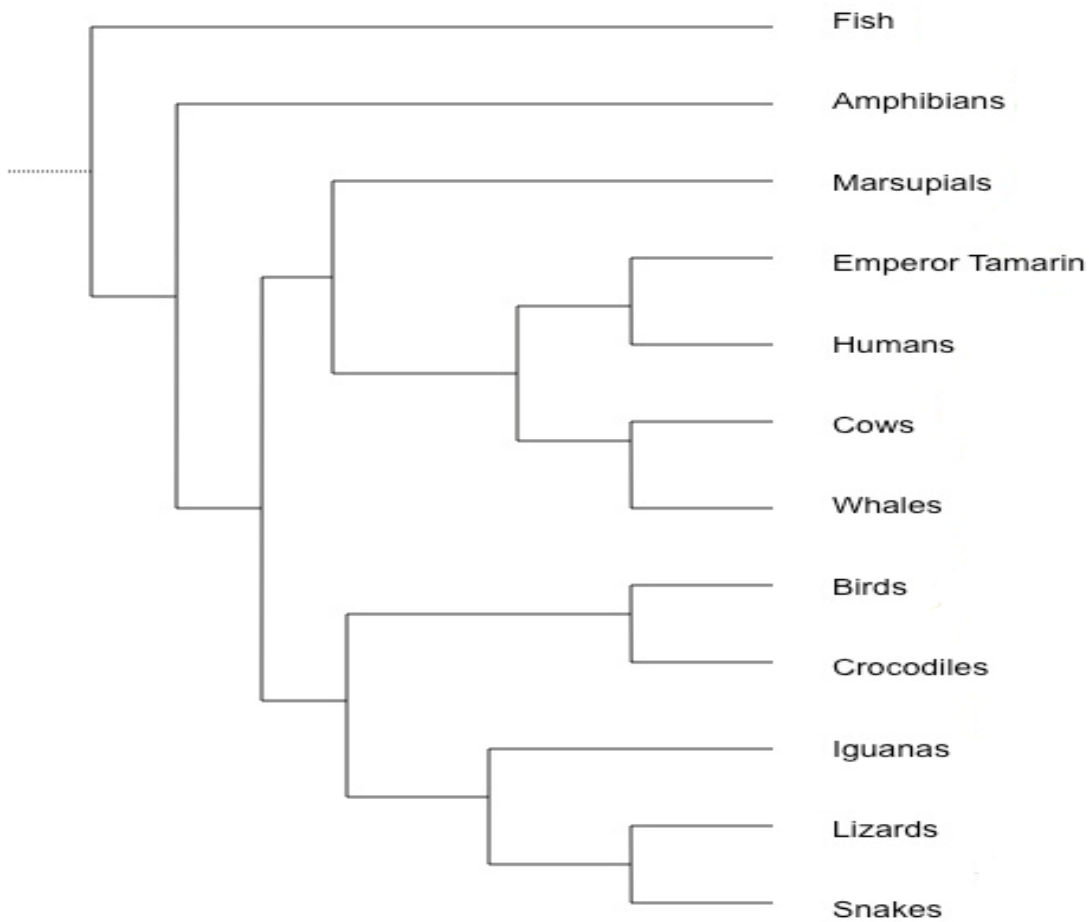


The location and type of bones in each forearm provides evidence of

- A. convergent evolution due to the structural homology in the forearms.
- B. divergent evolution due to the structural analogy in the forearms.
- C. convergent evolution due to the structural analogy in the forearms.
- D. divergent evolution due to the structural homology in the forearms.

Question 38

The evolution of vertebrates is well documented and a cladogram illustrating the relationship between some of them is illustrated below.



Which groups of the following vertebrates are most closely related to each other?

- A. Humans and cows.
- B. Crocodiles and birds.
- C. Fish and snakes.
- D. Whales and marsupials.

Question 39

The first hominin to master fire was

- A. *Australopithecus africanus*.
- B. *Homo habilis*.
- C. *Homo erectus*.
- D. *Homo neanderthalensis*.

Question 40

Somatic cell gene therapy promises to cure several autosomal recessive disorders, such as cystic fibrosis and haemophilia. If the human trials are successful, these diseases will no longer cause the pain and suffering they currently do. The following statement that best represents a possible impact these types of technologies have on the gene pool is

- A. The frequency of these alleles will increase due to the improved survival rate of sufferers once they are cured.
- B. The frequency of these alleles will remain steady because it is only somatic cells that are being genetically altered.
- C. The frequency of these alleles will decrease because the sufferers are cured and so they will no longer pass the faulty alleles onto the next generation.
- D. The frequency of these alleles will increase because the therapy will alter the genotype of the individuals being treated.

**End of 2013 Kilbaha VCE Biology Trial Examination
Multiple Choice Questions**

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SECTION B – Short answer questions**Instructions for Section B**

Answer all questions in the spaces provided. Write using black or blue pen.

Question 1 (5 marks)

Salmon spend most of their adult life in the open ocean, where they reach sexual maturity, but lay their eggs in gravel beds at the upper reaches of (freshwater) streams. When the eggs hatch, the young salmon spend several months migrating downstream to the ocean where they remain for some 3-5 years. When mature, the adult salmon return to the mouth of the stream where they hatched (they remember the taste/smell of the water in the stream), migrate upstream to its headwaters, spawn, and die.

Like nearly all vertebrates, the salmon is an excellent osmoregulator. However, like virtually all osmoregulators, the salmon is never in true equilibrium with its surroundings. The following table illustrates the solute concentrations of their body fluids as well as the environments to which they are exposed.

	Salmon Body Fluids	Ocean Water	Fresh Water
Total Solute Concentration	1.0%	3.5%	0.1%
Proportion of the total solute that is NaCl	50%	99%	trace

- a. i. When the salmon migrates from the streams into the ocean, are the fish going from a hypertonic to a hypotonic environment **OR** from a hypotonic to a hypertonic environment? Explain your answer.

2 marks

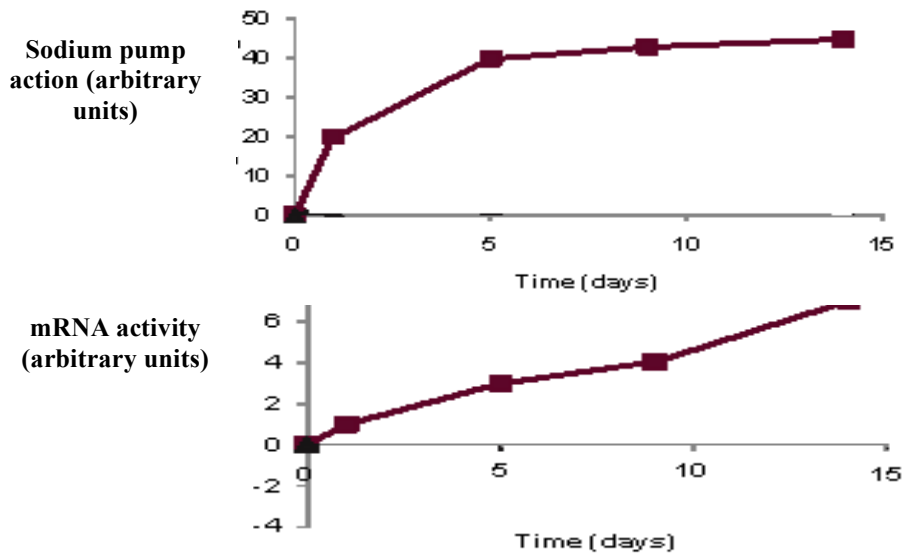
- ii. Use the data to show that the solutes in the salmon body fluids are not only NaCl.

1 mark

Question 1 (continued)

Without any adaptations that deal with this change in environmental conditions the salmon would not survive.

An experiment was conducted investigating the action of the sodium pumps and mRNA activity in gill cells when the salmon were exposed to fresh water. The graphs below show the results.

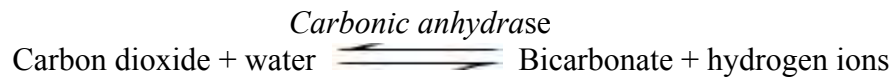


b. Use the graphs to explain how salmon survive when they move from the ocean to fresh water.

2 marks

Question 2 (7 marks)

Carbonic anhydrase is an enzyme that catalyzes the reaction illustrated below. It makes carbon dioxide more soluble in the bloodstream and this aids its transportation to the lungs where, using the same enzyme, the bicarbonate is converted back into carbon dioxide which can be exhaled.



- a. i. What type of biomolecule is carbonic anhydrase? 1 mark

- ii. What structural feature does carbonic anhydrase have that enables it to catalyse this specific reaction? 1 mark

The role of carbonic anhydrase varies in different tissues. Because water is involved, it can influence the water content of cells in the eyes and kidneys. Disease can occur if carbonic anhydrase at these locations is not functioning properly. For instance, if too much fluid builds up in the eye, it can lead to glaucoma, a primary cause of blindness.

- b. Use this information to explain how fluid could build up in the eye. 1 mark

A drug was designed as a competitive inhibitor of carbonic anhydrase and it successfully reduced the amount of fluid made in the eyes by 40% to 60%. Because the eye was making less fluid, the pressure in the eye was lowered and the risk of blindness was reduced.

- c. Draw a diagram that illustrates the action of the drug. 2 marks

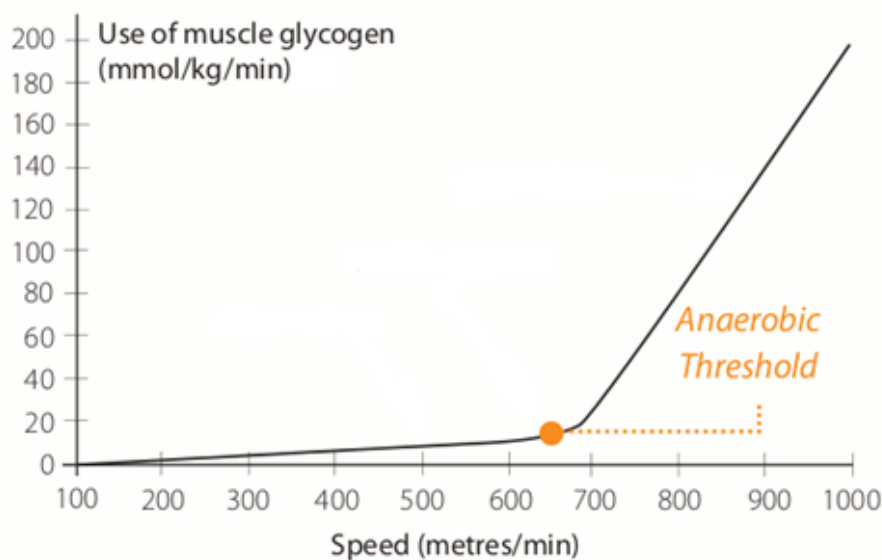
Question 2 (continued)

- d. When trialling drugs such as these, what factor(s) would the scientists who designed the drug need to take into account before it could be placed on the market.

2 marks

Question 3 (6 marks)

The horse-racing industry is a multimillion dollar business, which combines the genetics of thoroughbred racehorses with the scientific application of training. A study was conducted investigating the relationship between the metabolism of muscle glycogen and the speed of racehorses. The results of this study are provided below.



Graph from: <http://www.reverdy.uk.com/documentation/muscular-physiology>

- a. How much muscle glycogen is being metabolised when a horse is travelling at 900 metres/min?

1 mark

There is a significant change in the metabolism of muscle glycogen when horses run at speeds in excess of 650 metres per minute. The moment the change occurs is referred to as the **Anaerobic Threshold**.

- b. Using your knowledge and the information provided, define **Anaerobic Threshold**.

2 marks

Question 3 (continued)

- c. What are two differences between anaerobic and aerobic respiration in the muscle tissue of a horse?

2 marks

- d. A racehorse trainer got a racehorse to train in short repetitive bursts above the anaerobic threshold. The horse would gallop at 650 metres per minute for 3 minutes, then slow down to 300 metres per minute for 6 minutes. This cycle was repeated for 1 hour. Describe how this method of training could lead to a racehorse that could run faster over a long distance.

1 mark

Question 4 (4 marks)

Cuscuta pentagona is a parasitic plant that gets its food from plants such as tomatoes. In order to live, it attaches itself to a tomato plant and sucks off the nutrients provided by the host by burrowing an appendage into the plant's vascular system. When the *cuscuta* grows, it moves its shoot tip in small circles, probing the surroundings the way we do with our hands when we are blindfolded. If the *cuscuta* is next to a tomato plant, it grows in the direction of the tomato plant. This is unusual because this behaviour seemed due to a pheromone-like chemical and pheromones are generally restricted to the animal kingdom.

- a. Define the term pheromone.

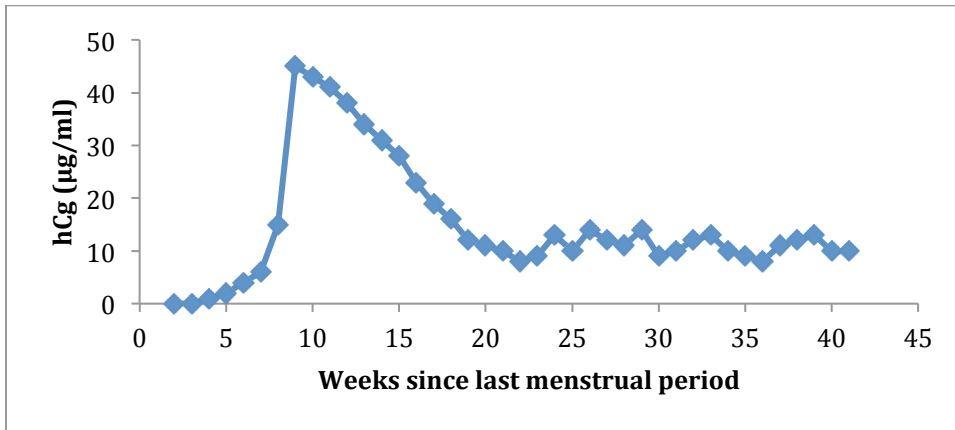
1 mark

- b. Design an experiment that would test the hypothesis
'That a chemical released from the tomato plant causes the *cuscuta* to grow towards it'
In your answer show an understanding of the independent and dependent variables. You may use a well-labelled diagram to help answer the question.

3 marks

Question 5 (6 marks)

Most chemical tests for early pregnancy look for the presence of human chorionic gonadotropin (hCG) in the blood or urine. The graph below shows the changes in hCG over the time frame of a typical pregnancy.



- a. Discuss why **false negative** pregnancy tests are quite common less than 4 weeks after conception.

2 marks

- b. The action of hCG (a protein) is different when compared with a steroid such as progesterone. Complete the table below by listing two differences in the action of both types of hormones.

2 marks

	Hormone	
	hCG	progesterone
Difference 1		
Difference 2		

Question 5 (continued)

A home pregnancy test kit is available and it consists of a monoclonal antibody that has been produced against hCG. These antibodies are embedded onto a test strip that will change colour in the presence of hCG. Monoclonal antibodies are produced using tumour cell/B cell hybrids.

c. Discuss the importance of these two cells in generating a monoclonal antibody.

B cell:

1 mark

Tumour cell:

1 mark

Question 6 (5 marks)

The MMR vaccine is a vaccine against measles, mumps, and rubella. The vaccine is a mixture of three live attenuated viruses, administered via injection. All three diseases were drastically reduced when the vaccines were first administered to the general population in the 1960s.

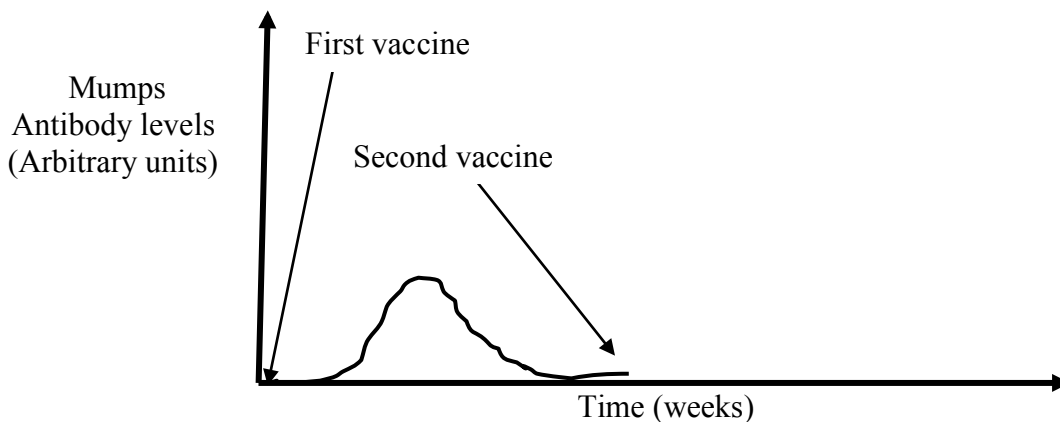
- a. Using your understanding of the immune system, discuss why the MMR vaccine contains 3 attenuated viruses

2 marks

There are usually 2 doses administered, which provide a long lasting immunity.

- b. Complete the graph below to illustrate the level of mumps antibodies in the blood of a vaccinated person after the second dose.

2 marks



Measles is endemic worldwide. Of the 66 cases of measles reported in the U.S. in 2005, more than half were attributable to one unvaccinated individual who acquired measles during a visit to Romania.

- c. List two groups within the American community who would be susceptible to measles if there has been a vaccination program trying to protect the community against these 3 diseases.

1 mark

Question 7 (6 marks)

Friedreich’s ataxia is a rare genetic disorder affecting 1 in 50,000 people around the world. The disease occurs when parents who show no symptoms of the disease have a child with it. The symptoms of the disease usually appear before 20 years of age with progressive staggering and frequent falling. On average, after 10-15 years with the disease, patients are usually wheelchair bound and require assistance with all activities of daily living.

a. What is the pattern of inheritance for Friedreich’s ataxia?

1 mark

Consider two disease free parents who have one child with Friedreich’s ataxia.

b. What is the chance that these parents would have of conceiving another child with the disease?

1 mark

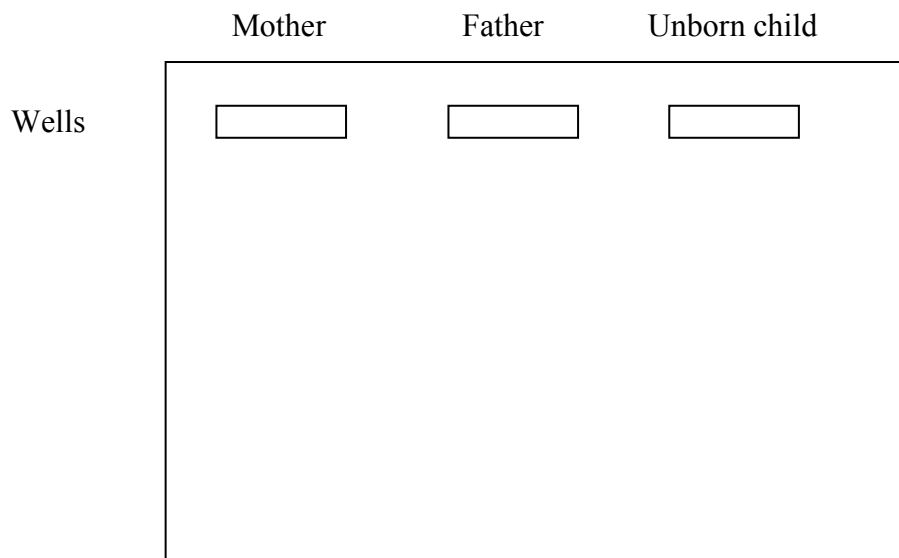
Individuals without the disease are able to produce a protein called frataxin. Sufferers carry a mutation within the frataxin gene that has many GAA repeat codes within one of the introns of the gene, which leads to the gene not being expressed at all. This information led to the development of a genetic test for Friedrich’s ataxia. The testing involves PCR and gel electrophoresis.

c. Discuss how PCR can produce many copies of the frataxin gene.

2 marks

A mother and father without the disease chose to have an unborn child genetically tested for the disease because they already had one child with the disorder.

d. Use the gel below to show the genetic profile of the mother, father and unborn child if the child was also diagnosed with Friedrich’s ataxia.



Question 8 (6 marks)

Drosophila melanogaster have many genes. The list below illustrates some of them and the various alleles assigned to represent them and their relationship with each other. The genes listed are all autosomal.

Curly Wing (C)	straight wing (c)
Barr Eyes (B)	normal eyes (b)
Normal Wings (V)	vestigial wings (v)
Normal Body (E)	ebony body (e)
Minute Bristles (M)	normal bristles (m)

- a. What is the phenotype of a drosophila fly that has the genotype of VvBbMM?

1 mark

- b. An individual drosophila fly has the genotype **CE/ce**.

This genotype illustrates that the genes being investigated are linked. Draw the arrangement of the alleles on chromosomes as seen in metaphase I of meiosis, if there was crossing over between the 2 genes.

2 marks

Question 8 (continued)

A test cross was carried out with the fly in part **b.** to determine the closeness of the linked genes. The results obtained were as follows.

	Curly wing Normal body	Curly wing Vestigial body	Straight wing Normal body	Straight wing Ebony body
Numbers of offspring	234	65	54	264

- c. If the gene coding for bristle length was linked with **both** the curly wing gene and the body colour gene, predict the results by completing the punnet square below of a test cross of a fly with the genotype **CM/cm** if the genes were further apart than the curly wing and body colour genes.

	Curly wing Minute bristles	Curly wing Normal bristles	Straight wing Minute bristles	Straight wing Normal bristles
Numbers of offspring	225			

1 mark

- d. Barr eyes and vestigial wing phenotypes are independently inherited. Heterozygous Barr Eye/vestigial wing flies with Barr eyes were crossed. Predict the proportion of offspring that would be homozygous at both gene loci. Justify your answer.

2 marks

Question 9 (5 marks)

Cytochrome c is an important enzyme in cell respiration. Amino acid 18 -25 of the *cytochrome c* enzyme of 4 organisms was investigated. The similarities and differences in those amino acids are listed in the table below.

Organism	Amino acid name and position in <i>cytochrome c</i>						
	18	19	20	21	22	23	24
Human	phe	iso	met	lys	cys	ser	glu
Rhesus monkey	phe	iso	met	lys	cys	ser	glu
Horse	phe	val	glu	lys	cys	ala	glu
Wheat	phe	lys	thr	lys	cys	ala	ser

- a. Use the information provided to discuss which organism is most closely related to human. 1 mark

The codon sequences for all amino acids are listed on the table below

		SECOND POSITION							
		U	C	A	G				
FIRST POSITION	U	phe	ser	tyr	cys	U	THIRD POSITION		
		leu		stop	stop	A			
	C	leu	pro	his	arg	U			
				glu		C			
		A		iso	thr	asp		ser	A
				met		lys		arg	G
	G	val	ala	asp	gly	U			
				glut		C			
						A			
						G			

Diagram from: <http://www.uic.edu/classes/bios/bios100/lecturesf04am/lect14.htm>

Question 9 (continued)

- b. i.** Use the codon list on the previous page to write a possible DNA **template** sequence for the wheat at positions 18-24 of the *cytochrome c* enzyme. Show the steps involved in reaching your answer.

2 marks

- ii.** If the ancestor to all of the 4 organisms had the amino acid **val** at position 19, give the **most probable** type of mutation that led to a different amino acid at position 19 in the monkey compared to the horse. Explain your answer.

2 marks

Question 10 (5 marks)

The traditional karyotyping method may be superseded with multicolour FISH (fluorescence in situ hybridization) probes to 'paint' each chromosome pair a different colour. Digital processing of the resulting karyotype enables the accurate identification of a variety of chromosomal abnormalities.

a. Define a DNA probe

2 marks

This new form of biotechnology makes diagnosing chromosomal translocations much easier than it was using the traditional method of karyotype interpretation.

b. How would a translocation be observed in a karyotype using multicolour FISH probes?

1 mark

The source of the chromosomes used for multicolour FISH probe biotechnology is usually in metaphase. Prior to the chromosomes becoming visible, the cells are in interphase.

c. Describe the events during the interphase part of the cell cycle that leads to the production of chromosomes.

2 marks

Question 11 (7 marks)

The evolutionary progression from ocean to land in the ancestral marine vertebrates is a subject area of great debate in palaeontology. A newly discovered species of lungfish, known as *Rhinodipterus*, was found in Western Australia and had features that make it a good candidate for one of the first organisms to be exposed to a terrestrial environment. A well-preserved skull was found which had a number of features that are important to its air-gulping behaviour. These included a long mouth cavity and cranial ribs that are attached to the base of the skull.

- a. State one condition that could have led to the fossilization of *Rhinodipterus* and explain how this would assist in the preservation of it.

1 mark

The fossilised remains of the *Rhinodipterus* show that it lived about 375 million years ago.

- b. How would a palaeontologist measure that *Rhinodipterus* is about 375 million years old?

2 marks

This theory proposes that the environmental factor that led ancient fish to leave the water and evolve into the first air-breathing animals on land was oxygen levels. A global drop in oxygen levels in the ocean occurred around the time the *Rhinodipterus* existed and structurally it may have been able to hold a bubble of air in its mouths for longer than other fish (as can modern lungfish).

- c. How could holding a bubble of air in the mouth lead to the evolution of air breathing animals?

3 marks

Question 11 (continued)

This is counter to the previously accepted theory that fish evolved the ability to breathe air **after** they moved to freshwater habitats. There is common agreement that two features would be needed for successful land habitation. The argument is which came first; ‘limbs before lungs’ OR ‘lungs before limbs’.

- d. Describe the evidence that would be needed to support the ‘limbs before lungs’ theory.

1 mark

Question 12 (8 marks)

Mitochondrial DNA studies show that humans emerged from ancestral hominins about 200,000 years ago.

- a. What evidence would anthropologists look for when comparing mtDNA in humans that could suggest a 200,000 year ago divergence?

2 marks

Homo neanderthalensis is our closet hominin ancestor and evidence of them dates from 300,000 years ago to 30,000 years ago. The relationship between *Homo neanderthalensis* and *Homo sapiens* has been extensively studied and discussed. With the discovery of DNA from *Homo neanderthalensis*, hybridisation studies have been conducted to compare the mtDNA of both species.

- b. Describe how DNA hybridisation studies would be conducted in this situation.

2 marks

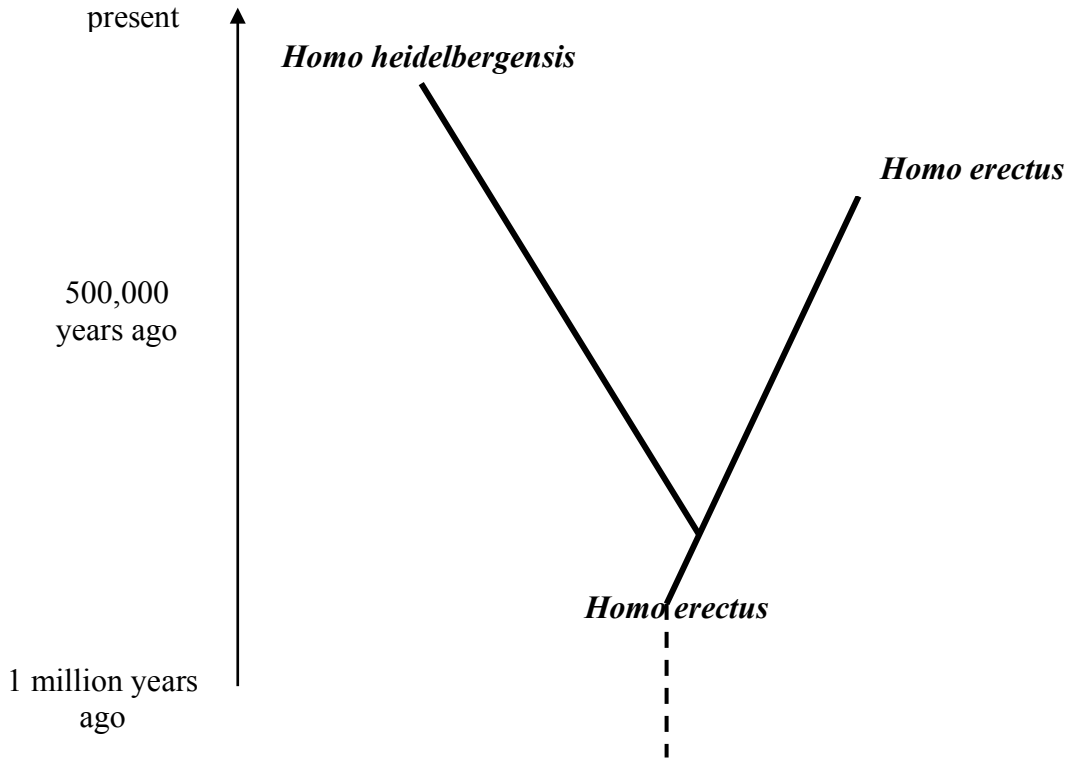
Originally Neanderthals were thought to be an ancestor to modern humans but the results of the hybridization studies provided evidence that disputed this original claim. This is another example of quantitative evidence being stronger than qualitative evidence.

- c. What DNA hybridization result would illustrate that modern humans and neanderthals were different species?

2 marks

Question 12 (continued)

It is currently accepted that *Homo heidelbergensis* is the ancestor to both modern humans and neanderthals. *Heidelbergensis* lived about 700,000 to 200,000 years ago. The evolutionary tree below illustrates the relationship of ergastor with some earlier hominins.



- d. Based on all the information provided, complete the evolutionary tree to include both *Homo sapiens* and *Homo neanderthalensis*.

2 marks

End of questions for the 2013 Kilbaha VCE Biology Trial Examination

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