Student Number								

2024 YEAR 10 YEARLY EXAMINATION

Science

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using black pen
- Draw diagrams using pencil
- Calculators approved by NESA may be used
- Formulae for motion:

$v = u + at$
$s = ut + \frac{1}{2}at^2$
$v^2 = u^2 + 2as$

Total Marks:

75

Section I – 20 marks (pages 1-9)

- Attempt Questions 1–20
- Allow about 35 minutes for this section

Section II – 55 marks (pages 10-22)

- Attempt questions 21-34
- Allow about 1 hour and 25 minutes for this section

Section I

20 marks
Attempt Questions 1–20
Allow about 35 minutes for this section

Use the multiple-choice answer sheet for Questions 1–20.

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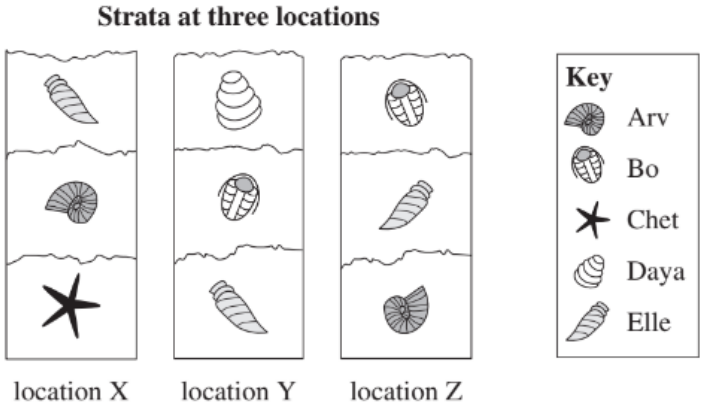
1. When two hydrogen atoms come together and form a molecule, the type of bond which holds them together is:
   (A) always of the ionic type.
   (B) sometimes ionic, but more often of the covalent type.
   (C) always of the covalent type.
   (D) either ionic or covalent, depending on the conditions under which they joined.

2. The reaction between hydrogen and oxygen to produce water is correctly represented by which balanced equation?
   (A) $2H_2\,(g) + O_2(g) \rightarrow 2H_2O(l)$
   (B) $H_2(g) + O_2(g) \rightarrow H_2O(l)$
   (C) $2H_2(g) + 2O_2(g) \rightarrow 2H_2O(l)$
   (D) $\frac{1}{2}H_2(g) + O_2(g) \rightarrow H_2O(l)$

3. Identify the equation that correctly shows the decomposition of hydrogen chloride (HCl) gas.

   (A) $CaCO_3\,(s) + 2HCl\,(aq) \rightarrow CaCl_2\,(aq) + H_2O\,(l) + CO_2\,(g)$
   (B) $2HCl\,(g) \rightarrow H_2\,(g) + Cl_2\,(g)$
   (C) $2Al\,(s) + 6HCl\,(aq) \rightarrow 2AlCl_3\,(aq) + 3H_2\,(g)$
   (C) $H_2\,(g) + Cl_2\,(g) \rightarrow 2HCl\,(g)$

4. A team of geologists analysed rock strata from three separate locations (X, Y and Z). The fossils found in each stratum were named after the geologist who discovered it. The results of the analysis are shown in the diagram below.



What is the youngest fossil?

(A) Elle
(B) Daya
(C) Chet
(D) Bo

5. Which one of the following scenarios is an example of Newton's First Law?

(A) When equal forces are applied to move a car and a bus, the bus accelerates more slowly than a car from rest.
(B) when a magician pulls a tablecloth extremely quickly from a table, the plates and cups remain on the table.
(C) When a bus slams on the brakes, standing passengers are thrown backwards.
(D) When a rocket is fired from a launch pad, gases are rapidly pushed out behind it and the rocket propels forward.

Use the following solubility table to answer question 6

Nitrates, NO_3^-	All **soluble**
Chlorides, Cl^-	All **soluble** except AgCl, $PbCl_2$
Sulfates, SO_4^{2-}	All **soluble** except $BaSO_4$, $PbSO_4$, $CaSO_4$
Hydroxides, OH^-	All **insoluble** except KOH, NaOH
Carbonates, CO_3^{2-}	All **insoluble** except K_2CO_3, Na_2CO_3

6. Which of the following chemical reactions is a precipitation reaction?

i. Silver nitrate solution mixed with calcium chloride solution

ii. Potassium sulfate solution mixed with iron (II) nitrate solution

iii. Calcium nitrate solution mixed with sodium sufate solution

(A) i, ii and iii

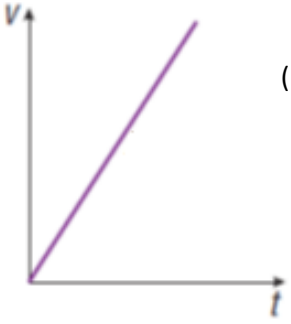
(B) i and iii

(C) i and ii

(D) ii and iii

7. Which graph represents an object that has positive acceleration?

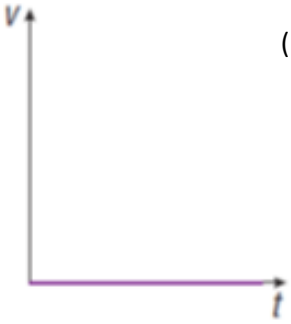
(A))



(B)



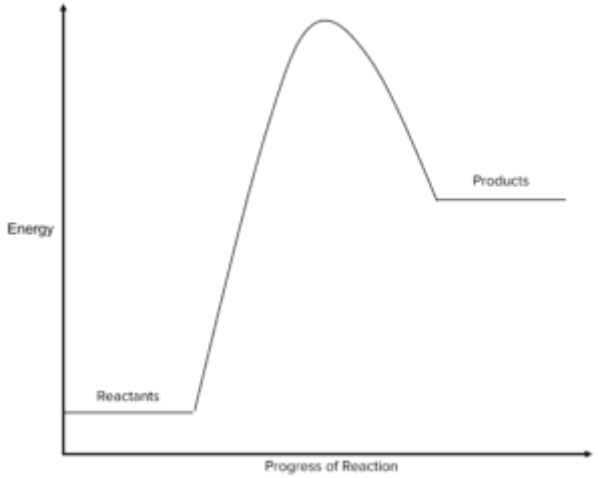
(C)



(D)



Refer to energy profile diagram given below to answer question 8



8. Which row of the table correctly identifies the type of chemical reaction and the energy change that occurred for this energy profile diagram?

	Type of chemical reaction	***Energy change occurred***
(A)	Combustion	Energy is released
(B)	Exothermic reaction	Energy is absorbed
(C)	Endothermic reaction	Energy is absorbed
(D)	Combustion reaction	Energy is absorbed

9. A cart is pushed with force F. Ignoring any friction, what is the acceleration of the same cart when it is pushed with a force $\frac{F}{2}$?

(A) a

(B) $\frac{a}{2}$

(C) $2a$

(D) ma

10. What is a section of DNA that codes for a protein called?

(A) Gene

(B) Chromosome

(C) Ribosome

(D) Plasmid

11.

DNA chain	A	B	C	D
T–	T	A	A	A
A–	C	T	T	T
G–	G	G	C	G
T–	A	C	A	C
A–	A	T	T	T
A–	T	A	T	A
C–	G	C	G	C
G–	C	G	C	G

Which of the columns shows the correct sequence that would link with the incomplete DNA chain?

(A) A
(B) B
(C) C
(D) D

12. An organism that has had part of another species' genetic information transferred into its own is referred to as:

(A) a genome.
(B) transgenic.
(C) a hybrid.
(D) a clone.

13. Which statement is consistent with current scientific theories of evolution?

(A) Organisms have not changed over long periods of time.
(B) Organisms have changed over long periods of time from simple to complex.
(C) Organisms have changed over long periods of time from complex to simple.
(D) Organisms only change when mutations occur.

14. Colour blindness is a sex-linked trait caused by a recessive allele. If a normal-visioned parents have a colour-blind son, what are the genotypes of the parents?

	Male parent	*Female parent*
(A)	X^CY	$X\ ^CX^c$
(B)	X^CY	$X\ ^c\ X^c$
(C)	X^CY	$X\ ^CX^C$
(D)	$X\ ^cY$	$X\ ^CX^c$

15. A woman who has cystic fibrosis marries a man who does not have this disorder but whose mother did. The gene for cystic fibrosis is recessive. If they have 2 children, what is the probability that their children have the disorder?

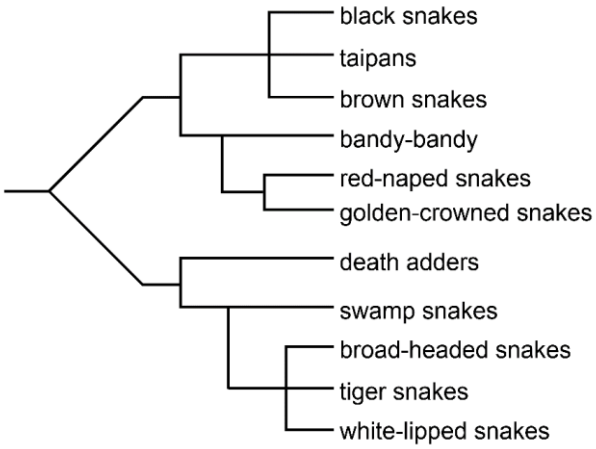
(A) 100%

(B) 25%

(C) 50%

(D) No chance

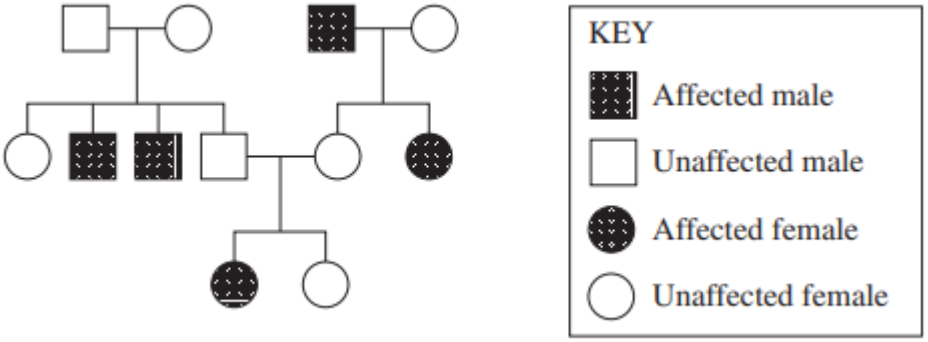
16. The phylogenetic tree below represents one view of the evolutionary relationships between some Australian venomous snakes.



From this diagram, which type of Australian venomous snake from the list below shares the most recent common ancestry with taipans?

(A) Brown snakes
(B) Death adders
(C) Tiger snakes
(D) Bandy-bandy

17. An inherited characteristic in a family is mapped in the pedigree shown.



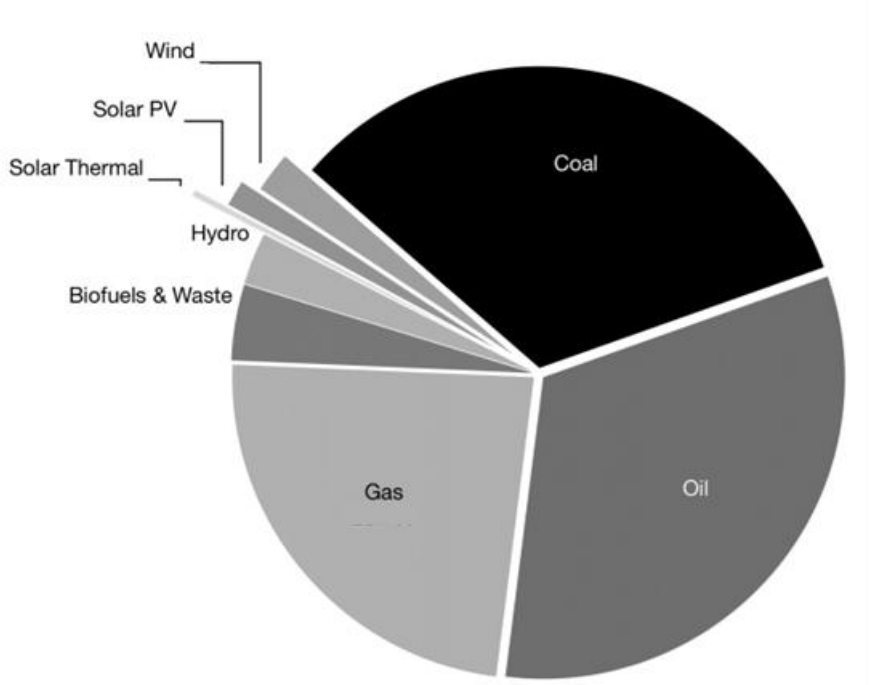
Inheritance of the characteristic is:

(A) Recessive, non-sex linked
(B) Sex-linked recessive
(C) Dominant, non-sex linked
(D) Sex-linked dominant

18. Fraternal twins occur when two fertilised eggs develop independently to produce two offspring. Which of the following explains the different phenotypes of two twins?

(A) Variations occur in the gametes due to random assortment of chromosomes.
(B) Gametes fuse to form fertilised eggs with the same type of alleles.
(C) Environmental may differ in the fallopian tubes.
(D) Gametes may transfer alleles to other gametes.

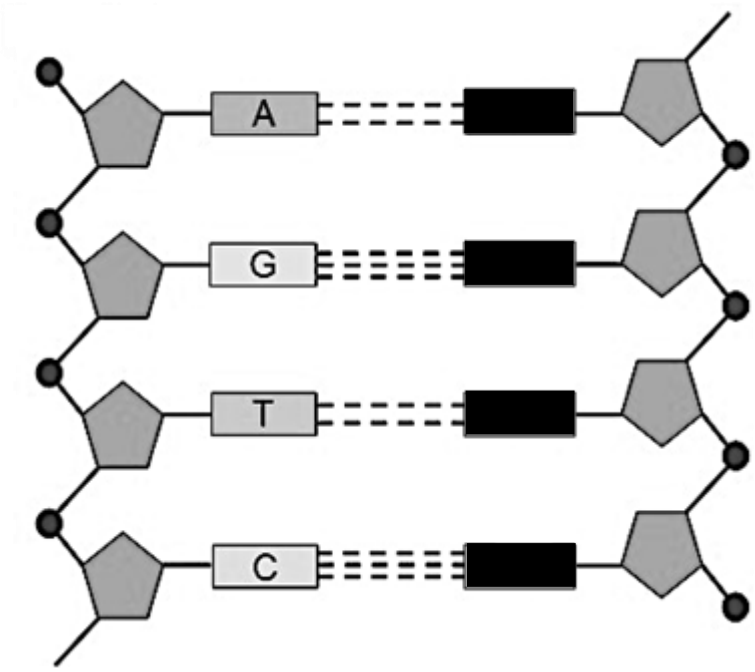
19. The diagram shows fuels used for energy production in Australia.



Which choice best indicates the approximate contribution of gas sources to our energy supplies?

(A) 19%
(B) 24%
(C) 33%
(D) 79%

20. The diagram below shows part of a DNA sequence.



Which of the following statements is correct?

	Type of bonds that occur between nitrogen bases	**Components that make a nucleotide**
(A)	Two hydrogen bonds between guanine and cytosine	A ribose sugar, nitrogen base and a phosphate
(B)	Three hydrogen bonds between guanine and cytosine	A deoxyribose sugar, nitrogen base and a phosphate
(C)	Two hydrogen bonds between adenine and cytosine	A hexose sugar, nitrogen base and a phosphate
(D)	Two hydrogen bonds between thiamine and adenine	An amino acid, nitrogen base and a phosphate

2024 Yearly Examination

Student Number								

Science Section I – Multiple Choice Answer Sheet

Instructions for answering questions in Section I

- Complete your answers in either blue or black pen
- Multiple choice

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample 1: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ○ **B** ○ **C** ○ **D** ●

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ○ **B** ○ **C** ○ **D** ⊗

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word ***correct*** and drawing an arrow as follows.

A ○ **B** ○ **C** ⊗ **D** ⊗ ← correct

1.	A ○	B ○	C ○	D ○
2.	A ○	B ○	C ○	D ○
3.	A ○	B ○	C ○	D ○
4.	A ○	B ○	C ○	D ○
5.	A ○	B ○	C ○	D ○
6.	A ○	B ○	C ○	D ○
7.	A ○	B ○	C ○	D ○
8.	A ○	B ○	C ○	D ○
9.	A ○	B ○	C ○	D ○
10.	A ○	B ○	C ○	D ○
11.	A ○	B ○	C ○	D ○
12.	A ○	B ○	C ○	D ○
13.	A ○	B ○	C ○	D ○
14.	A ○	B ○	C ○	D ○
15.	A ○	B ○	C ○	D ○
16.	A ○	B ○	C ○	D ○

17.	A ○	B ○	C ○	D ○
18.	A ○	B ○	C ○	D ○
19.	A ○	B ○	C ○	D ○
20.	A ○	B ○	C ○	D ○

2024 Year 10 Final Examination

Student Number								
Section I /20								
Section II /55								
Total /75								

Science

Section II Answer Booklet

55 marks
Attempt Questions 21-34
Allow about 1 hours 25 minutes for this section

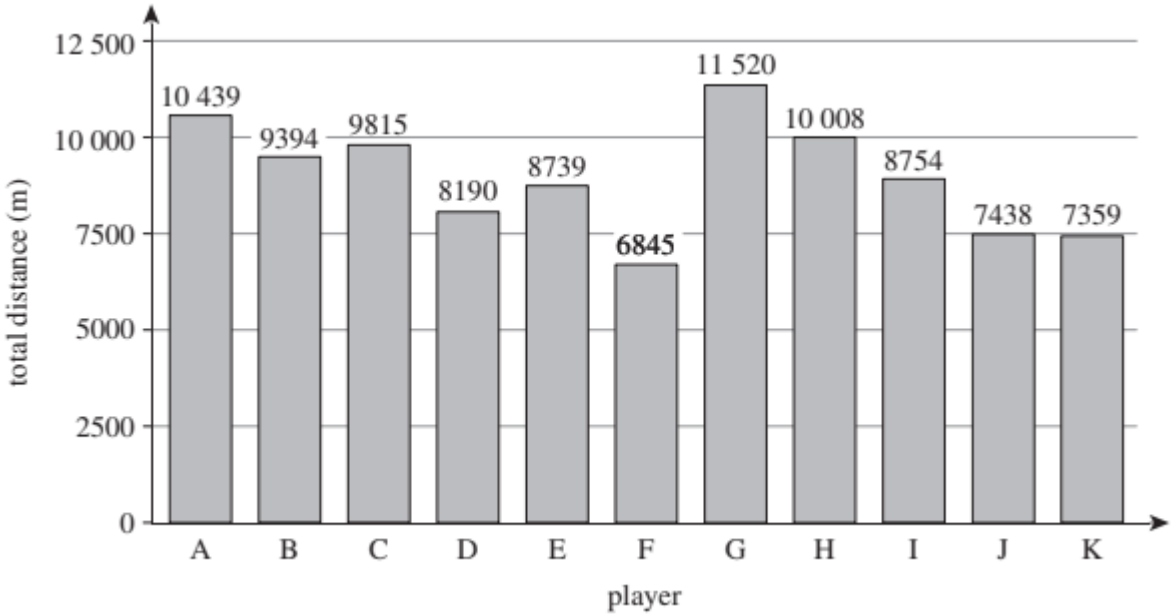
Instructions

- Write your student number at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of the response.
- Show all relevant working in questions involving calculations.
- **Extra writing paper is available at the back** of the booklet.
  If you use extra paper, clearly indicate that you used extra paper at the question.

Question 21 (2 marks)

Athletes are monitored during matches with global positioning satellite (GPS) equipment. The athletes wear a locator beacon under their shirt. The data that are measured for each athlete include the total distance travelled, maximum speed, high intensity running and sprint distance. This enables coaches to analyse and manage workloads and compare player performances.

The following data were monitored during a one-day cricket match.



Calculate the difference between the distance travelled by player G and player F and show your working.

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Question 22 (7 marks)

a. A train initially travelling at 5 m/s accelerates at the constant rate of 2 m/s^2 for 10 seconds. Calculate its final speed. (2 marks)

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b. Fred is travelling at a speed of 54 km/h. Suddenly he sees a cat that is 50 m in front of him. His reaction time is 2 seconds, and he uses another 3 seconds to apply brakes to decelerate his car at 5 ms^{-2} to bring it to a complete stop. Use a calculation to justify whether he will collide with the cat. (3 marks)

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c. Light travels at approximately 299 792 km/s. It takes 8 minutes and 20 seconds for light from the Sun to Reach Earth.

Calculate the distance between the Earth and the Sun. Show your working. (2 marks).

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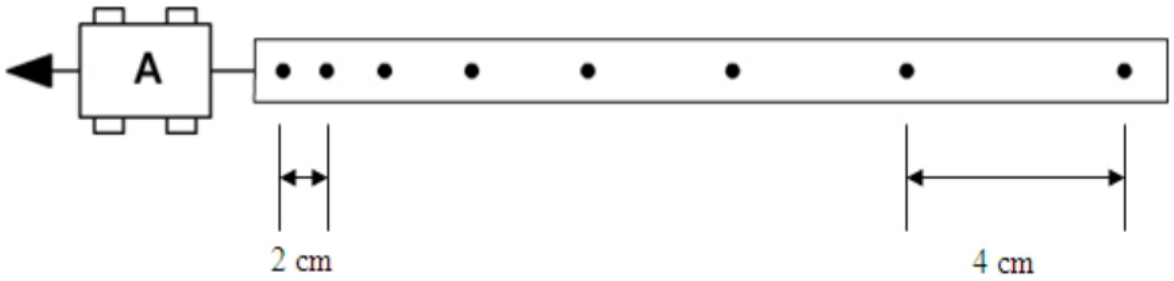
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Question 23 (4 marks)

Analyse the following ticker timer tape. Find out the initial velocity, final velocity and acceleration.



Initial velocity. . . . . .

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Final velocity . . . . . .

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Acceleration . . . . . .

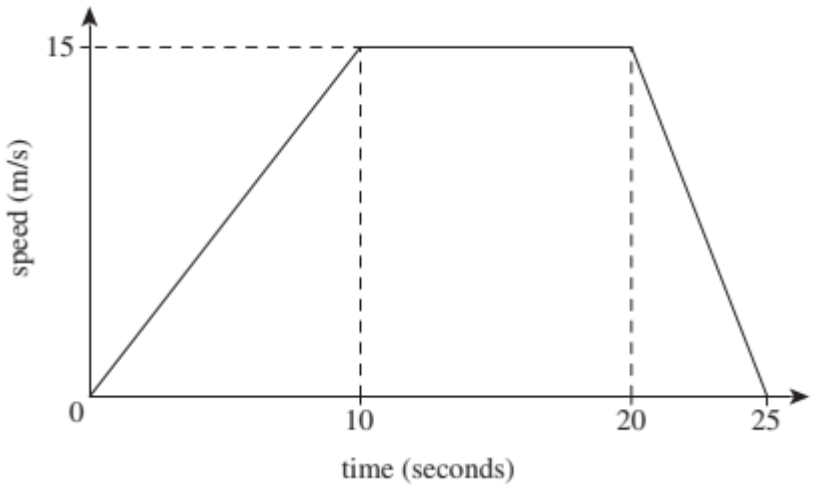
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Question 24 (2 marks)
The following diagram shows a speed versus time graph for a motorcycle travelling between two stop signs.



Using data from the graph describe the changes to the motorcycle's motion over the 25 seconds shown.

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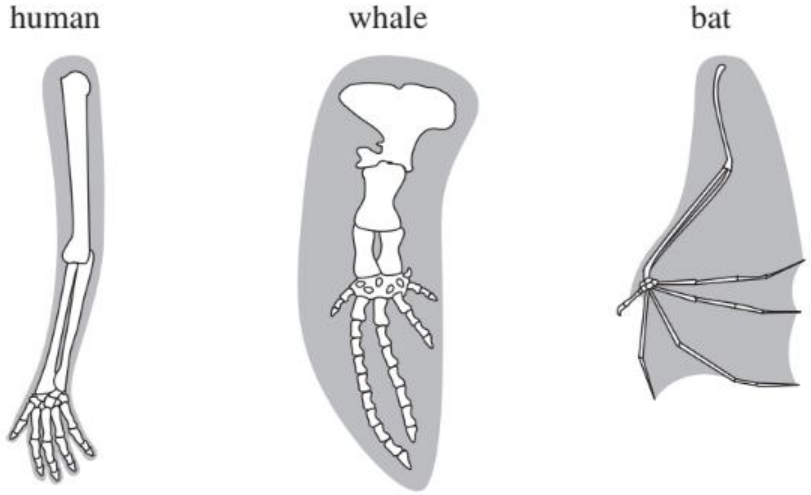
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Question 25 (3 marks)

The following diagram shows the pentadactyl limbs of a human, whale and bat.



With reference to the diagrams, discuss how comparative anatomy can provide evidence for evolution.

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Question 26 (4 marks)

Explain the terms divergent and convergent evolution, using examples.

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Question 27 (4 marks)

Some bacteria, termed superbugs, are resistant to multiple antibiotics. The rise of superbugs is said to be one of the major challenges facing human health.

Explain the processes that give rise to superbugs.

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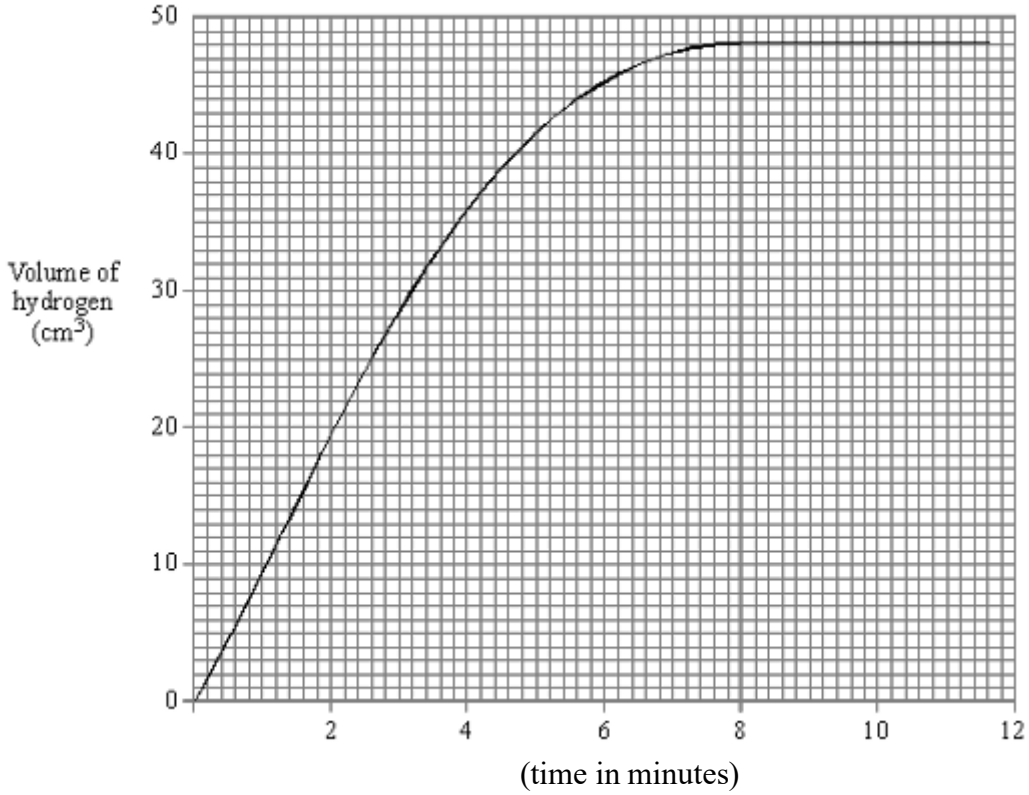
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Question 28 (5 marks)

The graph given below shows the amount of hydrogen gas produced when a certain mass of a solid piece of iron metal reacts with a certain volume of dilute hydrochloric acid with time.



a. Calculate the rate of chemical reaction at time 4 minutes. Show your working. (2 marks)

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b. Draw a line on the graph to show the production of hydrogen gas with time when the same mass of iron in powder form was added. Explain your answer. (3 marks)

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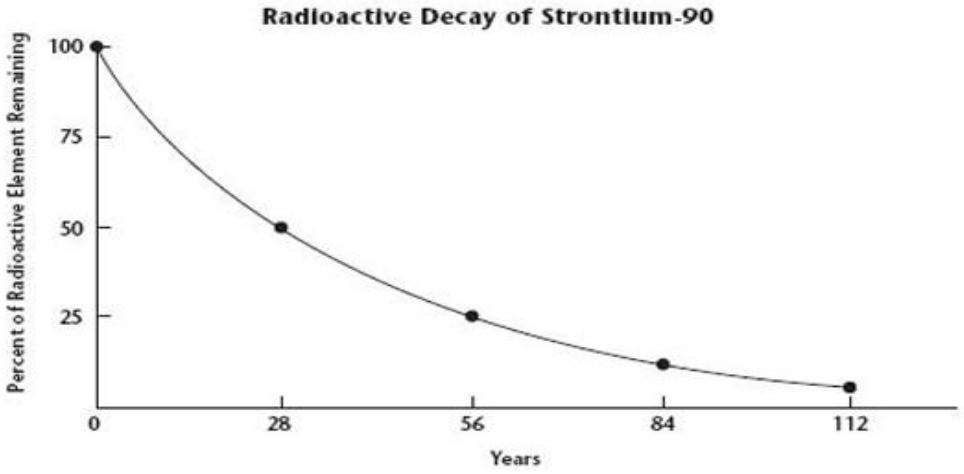
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Question 29 (3 marks)

The diagram given below shows the decay of Strontium-90 with time.



a. Determine the half-life period of Stronitium-90. (1 mark)

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b. What percentage of strontium-90 remains after a period of 42 days? (1 mark)

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c. Give one reason why this radioisotope is not suitable to determine the age of fossils. (1mark)

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Question 30 (4 marks)

The allele for red flower colour is dominant over white flower colour. What would be the ratio of phenotypes and genotypes when a heterozygous red flower coloured plant is crossed with a white coloured flower plant? Show your working. (4 marks)

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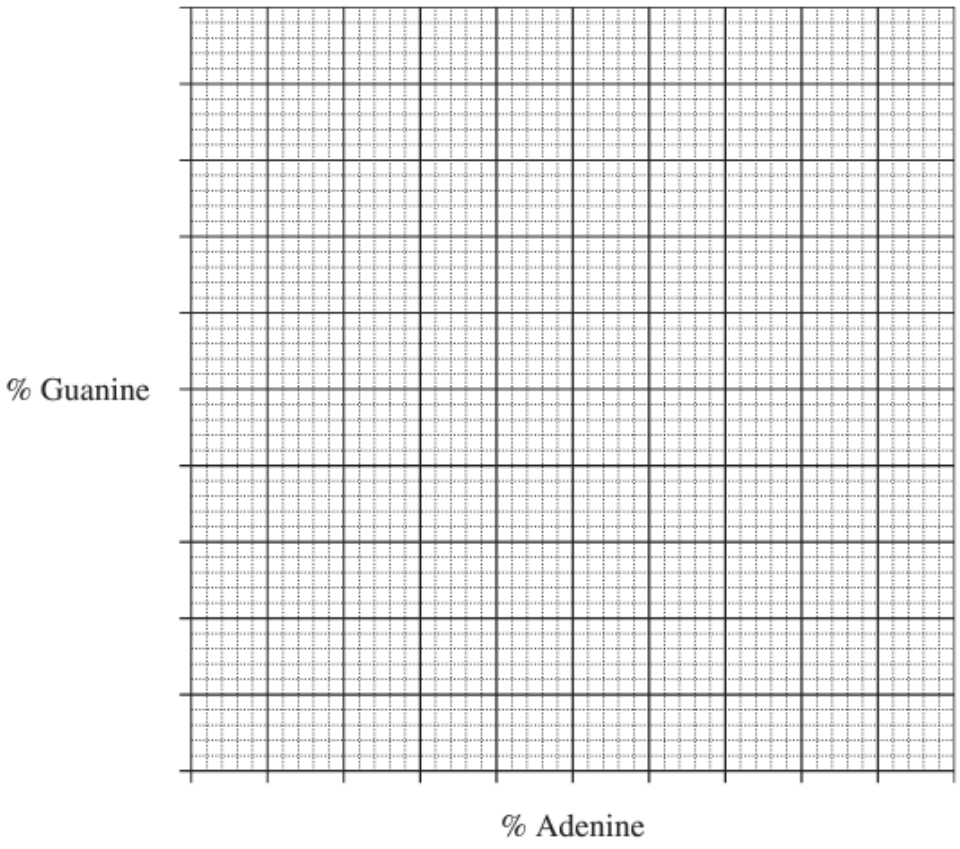
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Question 31 (4 marks)

Students conducted preliminary experiments to analyse the DNA base composition of five different species. The table shows the experimental data collected.

Species	*% Adenine*	*% Guanine*
A	38	12
B	26	22
C	8	40
D	20	32
E	33	18

a. On the grid provided, plot the % Guanine against % Adenine of the species analysed and draw a suitable line of best fit. (3 marks)



b. Identify the relationship shown by the data. (1 mark)

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Question 32 (5 marks)

A non-infectious disease was observed in a mother and her four sons who live with her. She has no daughters. The father of these children does not have the disease and does not live with them. The woman's parents and her two sisters do not have the disease. A geneticist suspects that the disease is inherited.

a. Draw a pedigree using the information provided above in the space below. (4 marks)



a. From the evidence, what indicates that the disease could be the result of a recessive allele and not be sex-linked? (2 marks)

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Question 33 (3 marks)

a. Define a mutation. (1 mark)

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b. Identify the type of mutation that has occurred in the following DNA strand. Give a reason. (2 marks)

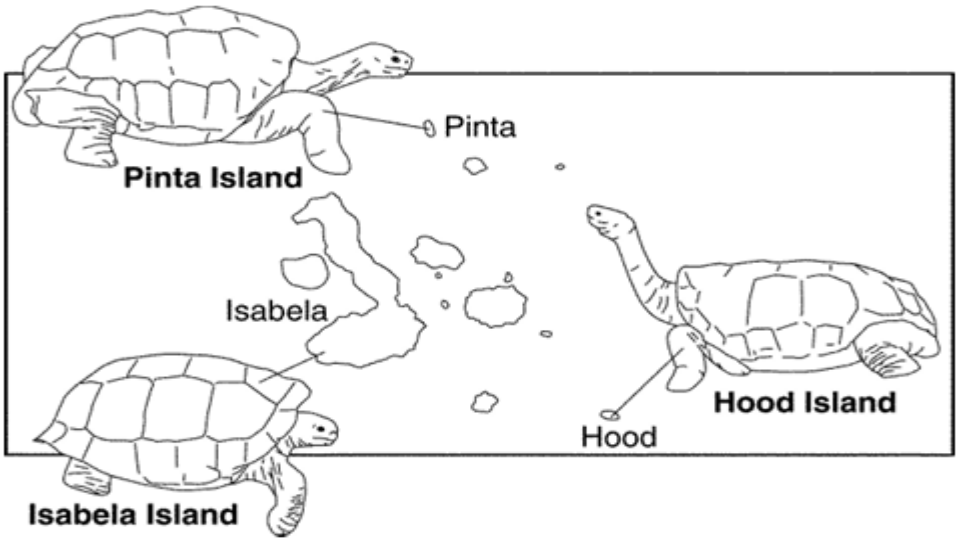
Original strand	Mutated strand
GGCGGTCTATTA	GGCGGTCTAGTTA

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Question 34 (5 marks)

The picture below shows the existence of three species of tortoise on three islands with different environmental conditions.



a. Identify a trait that differs among three species of tortoises that can be used as evidence to support the theory of evolution by natural selection. (1 mark)

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b. Vegetation on islands can vary. Rocky islands with very wet conditions have layers of algae growing. Some islands have very delicate low height grass growing. Some islands have very sparce hard to reach vegetation. Determine which island is likely to have each type of vegetation. (3 marks)

Pinta island . . . . . .

. . . . . .

Isabela island. . . . . .

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Hood island. . . . . .

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c. Identify and outline the type of evolution that might have led to the survival of three types of tortoises.

(1 mark)

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End of Examination

Extra paper

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Student Number								

2024 YEAR 10 YEARLY EXAMINATION

Science

General Instructions

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- Draw diagrams using pencil
- Calculators approved by NESA may be used
- Formulae for linear motion
  $v = u + at$
  $s = ut + ½ at^2$
  $v^2 = u^2 + 2as$

Total Marks:

75

Section I – 20 marks (pages 1-8)

- Attempt Questions 1–20
- Allow about 35 minutes for this section

Section II – 55 marks (pages 11-18)

- Attempt questions 21-31
- Allow about 1 hours and 25 minutes for this section

Section I

20 marks
Attempt Questions 1–20
Allow about 35 minutes for this section

Use the multiple-choice answer sheet for Questions 1–20.

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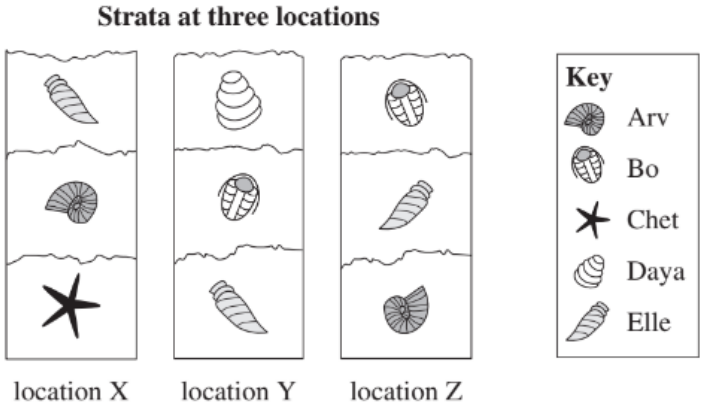
1. When two hydrogen atoms come together and form a molecule, the type of bond which holds them together is:
   (A) always of the ionic type.
   (B) sometimes ionic, but more often of the covalent type.
   (C) always of the covalent type.
   (D) either ionic or covalent, depending on the conditions under which they joined.

2. The reaction between hydrogen and oxygen to produce water is correctly represented by which balanced equation.
   (A) $2H_{2\,(g)} + O_{2\,(g)} \rightarrow 2H_2O_{(l)}$
   (B) $H_{2(g)} + O_{2\,(g)} \rightarrow H_2O_{(l)}$
   (C) $2H_{2(g)} + 2O_{2(g)} \rightarrow 2H_2O_{(l)}$
   (D) $\frac{1}{2}H_{2(g)} + O_{2(g)} \rightarrow H_2O_{(l)}$

3. Identify the equation that correctly shows the *decomposition* of hydrogen chloride (HCl) gas.

   (A) $CaCO_3\,(s) + 2HCl\,(aq) \rightarrow CaCl_2\,(aq) + H_2O\,(l) + CO_2\,(g)$
   (B) $2HCl\,(g) \rightarrow H_2\,(g) + Cl_2\,(g)$
   (C) $2Al\,(s) + 6HCl\,(aq) \rightarrow 2AlCl_3\,(aq) + 3H_2\,(g)$
   (C) $H_2\,(g) + Cl_2\,(g) \rightarrow 2HCl\,(g)$

4. A team of geologists analysed rock strata from three separate locations (X, Y and Z). The fossils found in each stratum were named after the geologist who discovered it. The results of the analysis are shown in the diagram below.



What is the youngest fossil?
   (A) Elle
   (B) Daya
   (C) Chet
   (D) Bo

5. Which one of the following scenarios is an example of Newton's First Law?

(A) When equal forces are applied to move a car and a bus, the bus accelerates more slowly than a car from rest.

(B) when a magician pulls a tablecloth extremely quickly from a table, the plates and cups remain on the table.

(C) When a bus slams on the brakes, standing passengers are thrown backwards.

(D) When a rocket is fired from a launch pad, gases are rapidly pushed out behind it and the rocket propels forward.

Use the following solubility table to answer question 6

Nitrates, NO_3^-	All **soluble**
Chlorides, Cl^-	All **soluble** except AgCl, $PbCl_2$
Sulfates, SO_4^{2-}	All **soluble** except $BaSO_4$, $PbSO_4$, $CaSO_4$
Hydroxides, OH^-	All **insoluble** except KOH, NaOH
Carbonates, CO_3^{2-}	All **insoluble** except K_2CO_3, Na_2CO_3

6. Which one of the following chemical reactions is a precipitation reaction?

i. Silver nitrate solution mixed with calcium chloride solution

ii. Potassium sulphate solution mixed with iron (II) nitrate solution

iii. Calcium nitrate solution mixed with sodium sulphate solution

(A) i, ii and iii

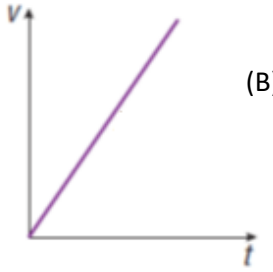
(B) i and iii

(C) i and ii

(D) ii and iii

7. Which graph represents an object that has positive acceleration?

(A))



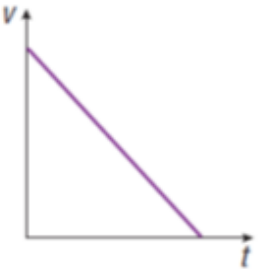
(B)



(C)

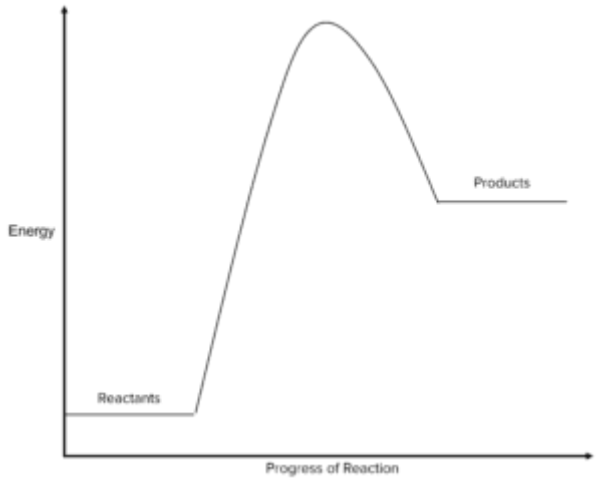


(D)



Answer is A

Refer to energy profile diagram given below to answer question 8



8. Which type of chemical reaction is represented by above energy profile diagram and what energy change occurs during this reaction.

	Type of chemical reaction	Energy change occurred
(A)	Combustion	Energy is released
(B)	Exothermic reaction	Energy is absorbed
(C)	**Endothermic reaction**	**Energy is absorbed**
(D)	Combustion reaction	Energy is absorbed

9. A cart is pushed with force F. Ignoring any friction, what is the acceleration of the same cart when it is pushed with a force $\frac{F}{2}$?

(A) a

(B) $\boldsymbol{\frac{a}{2}}$

(C) $2a$

(D) ma

10. What is a section of DNA that codes for a protein called?

(A) Gene

(B) Chromosome

(C) Ribosome

(D) Plasmid

11. DNA chains contain adenine (A), cytosine (C), guanine (G) and thymine (T). These link together in a specific sequence, as shown in the left of the diagram.

	DNA chain	A	B	C	D
A–T	T–	T	A	A	A
G–C	A–	C	T	T	T
C–G	G–	G	G	C	G
T–A	T–	A	C	A	C
T–A	A–	A	T	T	T
A–T	A–	T	A	T	A
C–G	C–	G	C	G	C
G–C	G–	C	G	C	G

C is the correct answer

Which of the columns on the right of the diagram shows the correct sequence that would link with the incomplete DNA chain?

(A) A
(B) B
(C) C
(D) D

12. An organism that has had part of another species' genetic information transferred into its own is referred to as:

(A) a genome.
(B) transgenic.
(C) a hybrid.
(D) a clone.

13. Which statement is consistent with current scientific theories of evolution?

(A) Organisms have not changed over long periods of time.
(B) Organisms have changed over long periods of time from simple to complex.
(C) Organisms have changed over long periods of time from complex to simple.
(D) Organisms only change when mutations occur.

14. Colour blindness is a sex-linked trait caused by a recessive allele. If a normal -visioned parents have a colour-blind son. What is the parents' genotype?

	Male parent	Female parent
(A)	**X^CY**	**$X\ ^CX^c$**
(B)	X^CY	$X\ ^c\ X^c$
(C)	X^CY	$X\ ^CX^C$
(D)	$X\ ^cY$	$X\ ^CX^c$

15. A woman who has cystic fibrosis marries a man who does not have this disorder but whose mother did. The gene for cystic fibrosis is recessive. If they have 2 children, what is the probability that their children have the disorder.

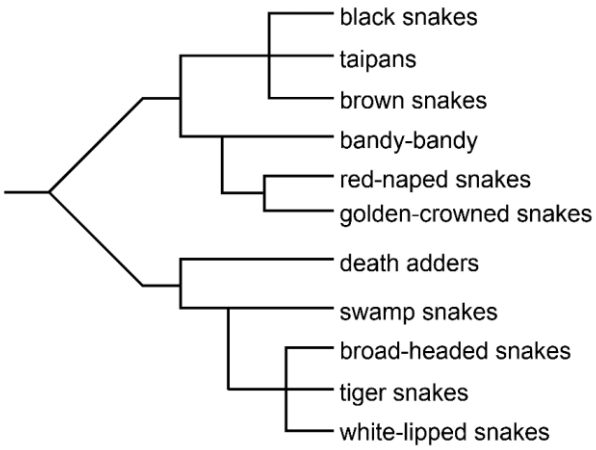
(A) 100%

(B) 25%

(C) 50%

(D) No chance

16. The phylogenetic tree below represents one view of the evolutionary relationships between some Australian venomous snakes.



From this diagram, determine which one of the following shares the most common ancestry with taipans.

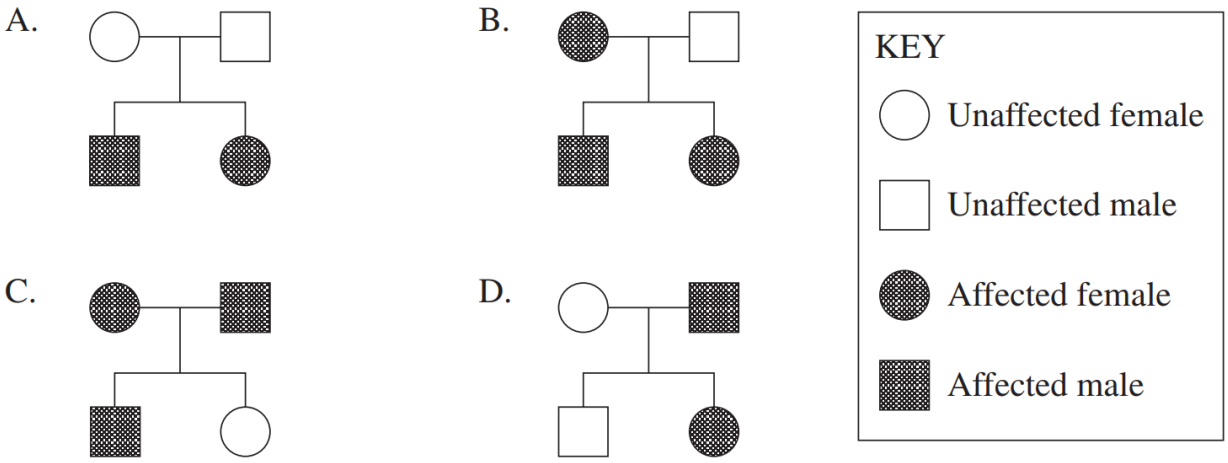
(A) Red napped snake

(B) Death adder

(C) Tiger snake

(D) Bandy bandy

17. Which human pedigree shows inheritance of a dominant, sex-linked characteristic?

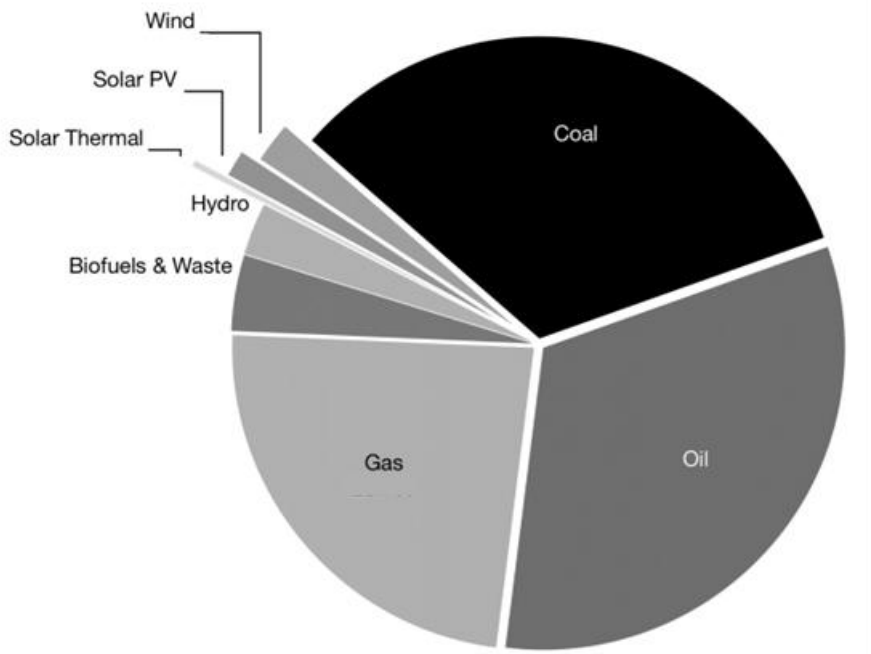


B or D is the correct answer

18. Fraternal twins occur when two fertilised eggs develop independently to produce two offsprings. Which of the following explains different phenotypes of two twins?

(A) Variations occur in the gametes due to random assortment of chromosomes.
(B) Gametes fuse to form fertilised eggs with same type of alleles.
(C) Environmental may differ in the fallopian tubes.
(D) Gametes may transfer alleles to other gametes.

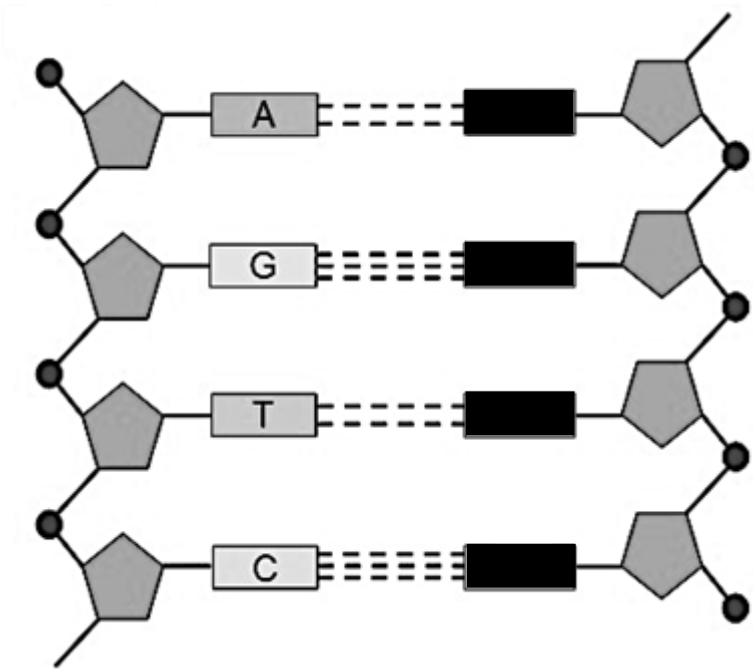
19. The diagram shows fuels used for energy production in Australia.



Which choice best indicates the approximate contribution of gas sources to our energy supplies?

(A) 19%
(B) 24%
(C) 33%
(D) 79%

20. The diagram below shows part of a DNA sequence.



Which of the following statements is correct?

	Type of bonds that occur between nitrogen bases	**Components that make a nucleotide**
(A)	Two hydrogen bonds between guanine and cytosine	A ribose sugar, nitrogen base and a phosphate
(B)	**Three hydrogen bonds between guanine and cytosine**	**A deoxyribose sugar, nitrogen base and a phosphate**
(C)	Two hydrogen bonds between adenine and cytosine	A hexose sugar, nitrogen base and a phosphate
(D)	Two hydrogen bonds between thiamine and adenine	An amino acid, nitrogen base and a phosphate

2024 Yearly Examination

Student Number								

Science Section I – Multiple Choice Answer Sheet

Instructions for answering questions in Section I

- Complete your answers in either blue or black pen
- Multiple choice

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample 1: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ○ **B** ○ **C** ○ **D** ●

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ○ **B** ○ **C** ○ **D** ⊗

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word ***correct*** and drawing an arrow as follows.

A ○ **B** ○ **C** ⊗ **D** ⊗ ← correct

1.	A ○	B ○	C ○	D ○
2.	A ○	B ○	C ○	D ○
3.	A ○	B ○	C ○	D ○
4.	A ○	B ○	C ○	D ○
5.	A ○	B ○	C ○	D ○
6.	A ○	B ○	C ○	D ○
7.	A ○	B ○	C ○	D ○
8.	A ○	B ○	C ○	D ○
9.	A ○	B ○	C ○	D ○
10.	A ○	B ○	C ○	D ○
11.	A ○	B ○	C ○	D ○
12.	A ○	B ○	C ○	D ○
13.	A ○	B ○	C ○	D ○
14.	A ○	B ○	C ○	D ○
15.	A ○	B ○	C ○	D ○
16.	A ○	B ○	C ○	D ○
17.	A ○	B ○	C ○	D ○
18.	A ○	B ○	C ○	D ○
19.	A ○	B ○	C ○	D ○
20.	A ○	B ○	C ○	D ○

2024 Year 10 Final Examination

Student Number								
Section I /20								
Section II /55								
Total /75								

Science

Section II Answer Booklet

55 marks
Attempt Questions 21-31
Allow about 1 hours 25 minutes for this section

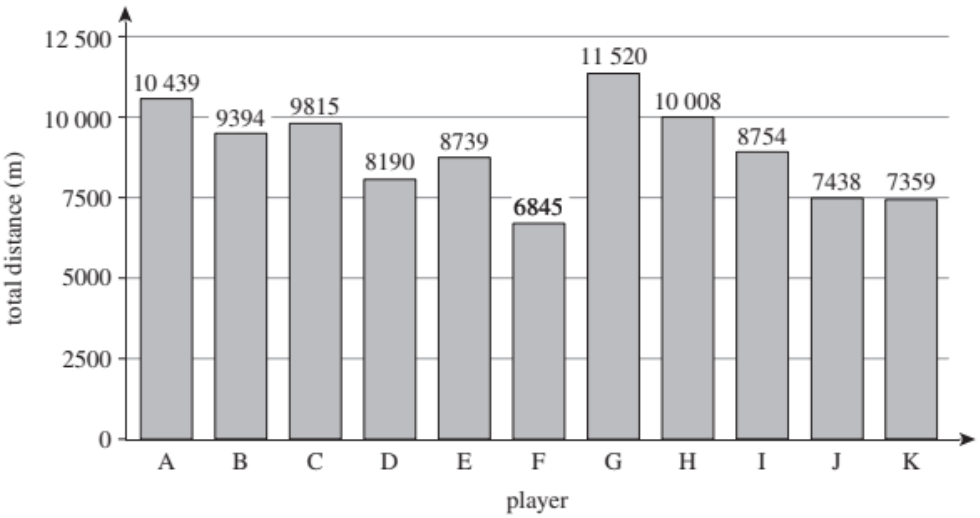
Instructions

- Write your student number at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of the response.
- Show all relevant working in questions involving calculations.
- **Extra writing paper is available at the back** of the booklet.
  If you use extra paper, clearly indicate that you used extra paper at the question.

Question 21 (2 marks)

Athletes are monitored during matches with global positioning satellite (GPS) equipment. The athletes wear a locator beacon under their shirt. The data that are measured for each athlete include the total distance travelled, maximum speed, high intensity running and sprint distance. This enables coaches to analyse and manage workloads and compare player performances.

The following data were monitored during a one-day cricket match.



Calculate the difference between the distance travelled by player G and player F and show your working.
Difference in distance travelled = 11520 -6845 = 4675 metres

Question 22 (7 marks)

a. A train initially travelling at 5 m/s accelerates at the constant rate of 2 m/s^2 for 10 seconds. Calculate its final speed. (3 marks)

u = 5m/s a= 2m/s^2 t = 10s
Formula v =u +at 1 mark
Substitution v = 5 + 10x2 (1 mark) If direct calculation give 2 marks
V= 25 m/s (1 mark) value and units

b. Fred is travelling at a speed of 54 km/hour. Suddenly he sees a cat at 50 metres. His reaction time is 2 seconds, and he uses another 3 seconds to apply brakes to decelerate his car at 5 ms^{-2} to bring it to a complete stop. Use your calculations to find out if he would be able to save the cat. (4 marks)

Car speed = 54 km/hour = 15m/s
Car will travel 15 x2 =30 metre during 2 second reaction time 1 mark

Distance travelled during braking time which is 3 seconds
Formula used s=ut + ½ at^2 a = -5m/s^2 s = 15x3 - ½ x 5x3x3 = 45 - 22.5 = 22.5 m (1 mark)
Total distance car will travel = 30 + 22.5 = 52.5 m (1 mark)

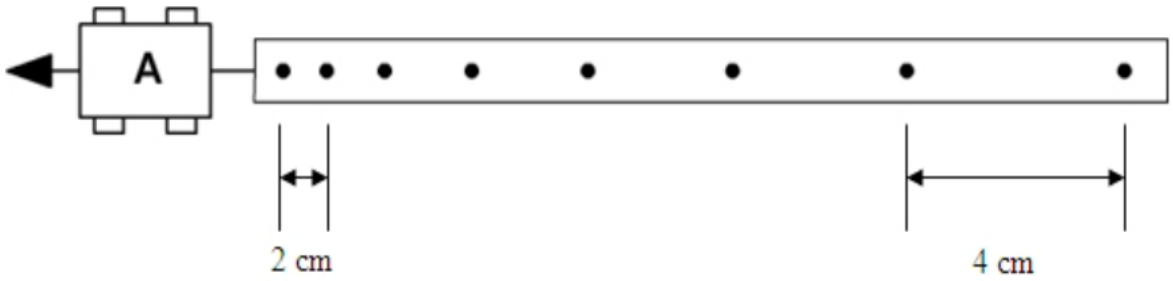
Fred will not be able to save cat as cat is at 50 m distance. (1 mark)

c. Light travels at approximately 299 792 km/s. It takes 8 minutes and 20 seconds for light from the Sun to Reach Earth.
Calculate the distance between the Earth and the Sun. Show your working. (2 marks).

Time taken in seconds = 8x60 + 20 = 500 seconds
Speed = 299792km/second
Distance = speed X time taken
Distance travelled in 500 seconds = 299792 x500 = 149896000 km or 1.49896 x 10^8 km OR 1.5 x 10^8 km

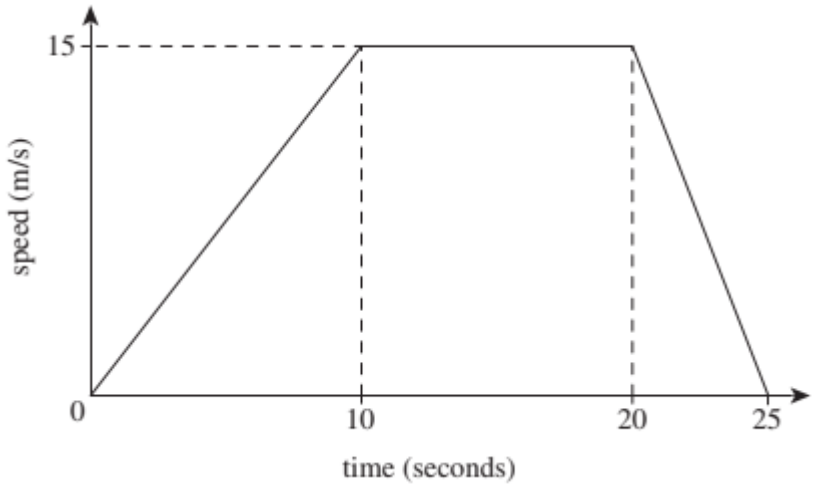
Correctly substituted values in the formula 1 mark
Correct answer up to 2-4 decimal places (1 mark
Question 23 (4 marks)

Analyse the following ticker timer tape. Find out the initial velocity, final velocity and acceleration.



Initial velocity. . . . . .
Distance travelled s = 2 cm Ticker timer makes 50 dots in 1 second time taken to move one dot = 1/50 = 0.02 s So u = 2/0.02 = 100 cm/s 0r 1 m/s 1 mark
Final velocity . . . . . .
Distance travelled s = 4 cm Ticker timer makes 50 dots in 1 second time taken to move one dot = 1/50 = 0.02 s So v = 4/0.02 = 200 cm/s or 2m/s 1 mark
Acceleration . . . . . .
v = u + at 200 = 100 + 7 x 0.02 a
a = 100/(7 x0.02) = 714.28 cm/s^2 = 700 cm/s^2 or 7 m/s^2 (1 mark for correct answer and 1 mark for some working shown

Question 24 (2 marks)
The following diagram shows a speed versus time graph for a motorcycle travelling between two stop signs.



Using data from the graph describe the changes to the motorcycle's motion over the 25 seconds shown.

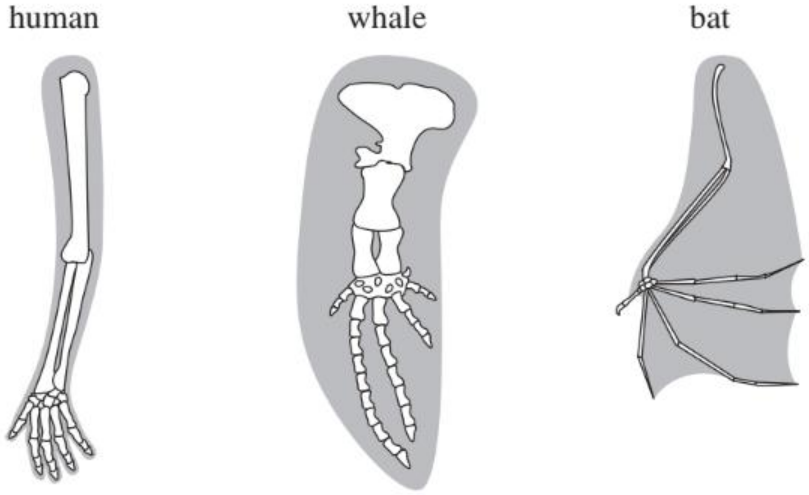
- **From 0-10 seconds there is constant increase in the speed of object as such object undergo uniform acceleration.**
- **Between 10-20 seconds the object speed remains the same. As such object have zero acceleration.**
- **Between 2- -25 seconds, the speed of object decreases at a constant rate to zero. Hence object has uniform deceleration until it comes to rest at 25 second's time.**

All three outlines 2 marks
0-2 statements 0-1 mark

OR some relevant information is given (1 mark)

Question 25 (3 marks)

The following diagram shows the pentadactyl limbs of a human, whale and bat.



With reference to the diagrams, discuss how comparative anatomy can provide evidence for evolution.

- The limbs of three different animals have same structural plan and are made of same type of bones, humerus, radius, ulna, carpals, metacarpals and digits or phalanges. This indicates that they all originated from a common ancestor.
- Different bones in the limbs of human, whale and bat are of different sizes, thickness and weight. This is due to different selection pressure imposed due to different environments. This shows that organisms with better adaptations can survive and dominate in an environment created by natural processes.

Criteria	marks
• Identified that all limbs are made on same plan and are made of same type of bones • States that same structural plan of limbs indicate that they evolved from a common ancestor. • States the there are variations in the size, lengthy and thickness of bones. • States that variations in bone structure points to selection of each organism living in a specific environment well suited to the structure	3
Any point missed out in the criteria less 1 mark OR SOME RELEVANT INFORMATION GIVEN	0-2

Question 26 (4 marks)

Explain the terms divergent and convergent evolution, using examples.

Divergent evolution occurs when a group of organisms with similar structural traits and originated from a common ancestor. The variations in structures ideal to suit an environment survive. Example: Any suitable example such as Darwin's finches etc.

Convergent evolution occurs when differ t groups of organisms originated from different ancestors happen to face selection for similar traits when living in same environments.

Example: wings of insects, birds and bats etc.

Criteria	marks
• Divergent evolution is correctly explained and emphasized on common ancestor due to same structural plan but variations due to different environments. • An example is given • Convergent evolution is correctly explained and emphasized on different ancestors but happen to have structures suited to a particular environment. • An example is given	4
Any point missed less 1 mark. OR SOME RELEVANT INFORMATION IS GIVEN	0-3

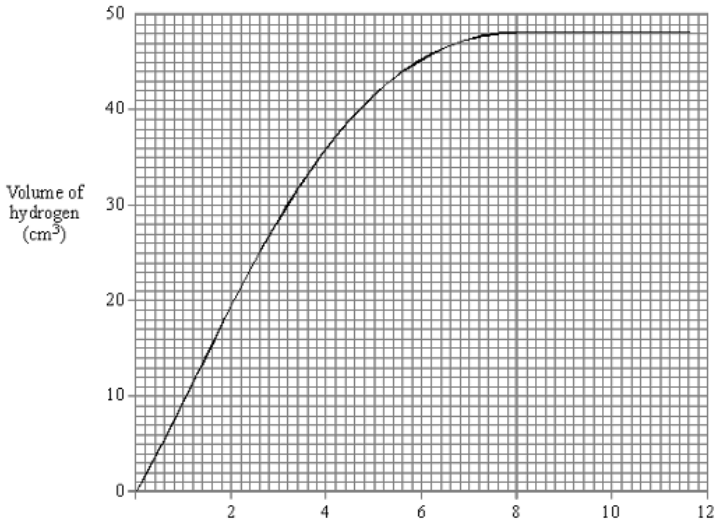
Question 27 (4 marks)

Some bacteria, termed superbugs, are resistant to multiple antibiotics. The rise of superbugs is said to be one of the major challenges facing human health.
Explain the processes that give rise to superbugs.

- The super bugs emerge due to a very large group of bugs with bugs having wider variations such as resistance and non-resistance to antibiotics existing.
- When bug population is exposed to a wider type of antibiotics, the non-resistant bugs are killed leaving a small number of bugs having resistance to antibiotics. This decreases the population of non-resistant bugs and increase the population of resistant bugs.
- Due to a smaller number of non-resistant bugs, the reproduction rate is low as such population increase is low. Resistant bugs due to their increased number high reproduction increase their number.
- If the frequency of antibiotics used by individuals increases even when it is unnecessary it speeds up above selection process and this leads to a stage when only super bugs remain in the population and antibiotics have no effect.

Criteria	marks
• States that there are wide variety of resistant and non-resistant bugs exist in original population. • States that when exposed to antibiotics, resistant ones are killed thus lowering their number while resistant ones survive and their number increase. • Reproduction rate of non-resistant lowers while those of resistant ones increases. • If this cycle is repeated many times/ frequencies of drugs use increases and overuse and misuse of drugs, a stage comes when hardly any non-resistant one exists while resistant ones populations dominate and drug become ineffective.	4
Any point not stated less 1 mark OR just one mark if some relevant information is given	0-3

Question 28 (5 marks)
The graph given below shows the amount of hydrogen gas produced when a certain mass of solid piece of iron metal reacts with a certain volume of dilute hydrochloric acid with time.



a. Calculate the rate of chemical reaction at time 4 minutes. Show your working. (2 marks)

Rate = gradient of curve at 4 minutes

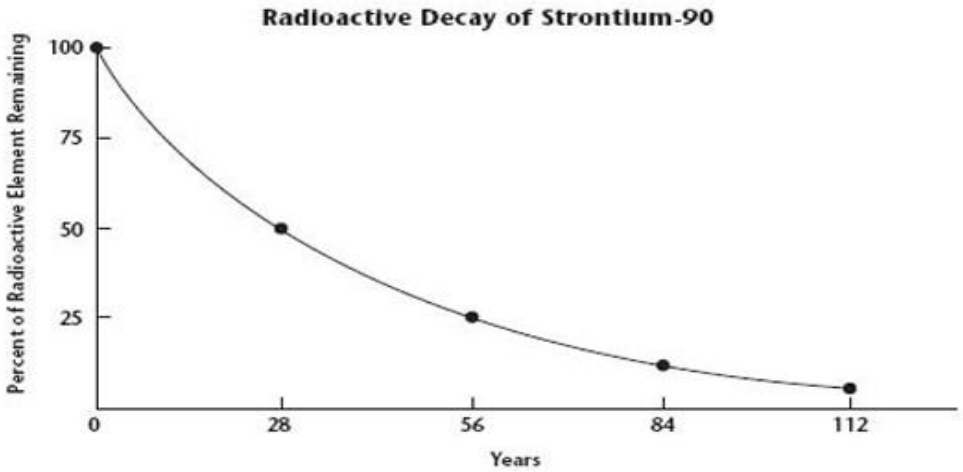
= 35-0/4-0 = 35/4 = 8.27 cm^3/minute (I mark for correct rate calculated with correct units and 1 mark for working shown.
Range accepted 7-9 cm^3/minute Both units and value correct 2 marks

b. Draw a line on the graph to show the production of hydrogen gas with time when same mass of iron in powder form was added. Explain your answer. (3 marks)

A curved line is drawn with on the graph of same shape but on the left of original curve. (1 mark)
Since mass of iron is same it will react with same amount of hydrochloric acid to produce same volume of hydrogen gas. (1 mark)
However, the surface area of iron and hence total number of iron atoms that will react is greater in powdered iron. The reaction rate will be greater and hence curve will be steeper. (1 mark)

Question 29 (3 marks)

The diagram given below shows the decay of Strontium-90 with time.



a. Determine the half-life period of Stronitium-90. (1 mark)

28 years

b. What percentage of strontium-90 remains after a period of 42 days? (1 mark)
100- 62.5 = 37.5%

c. Give one reason why this radioisotope is not suitable to determine age of fossils. (1mark)
Age of fossils can be hundreds of thousand or greater years. Strontium -90 has very short half life period and will decay very quickly. (1 mark)

Question 30 (4 marks)

Allele for red flower colour is dominant over white colour. What would be the ratio of phenotypes and genotypes when a heterozygous red flower coloured plant is crossed with white coloured flower plant. Show your working. (4 marks)
Genotype of heterozygous red flower colour plant parent = Rr
Genotype of white flower colour plant parent = rr

Gametes	**R**	**r**
r	**Rr (red)**	**rr (white)**
r	**Rr (red)**	**rr (white)**

OR

Gametes	**R**	**r**
r	**Rr (red)**	**rr (white)**

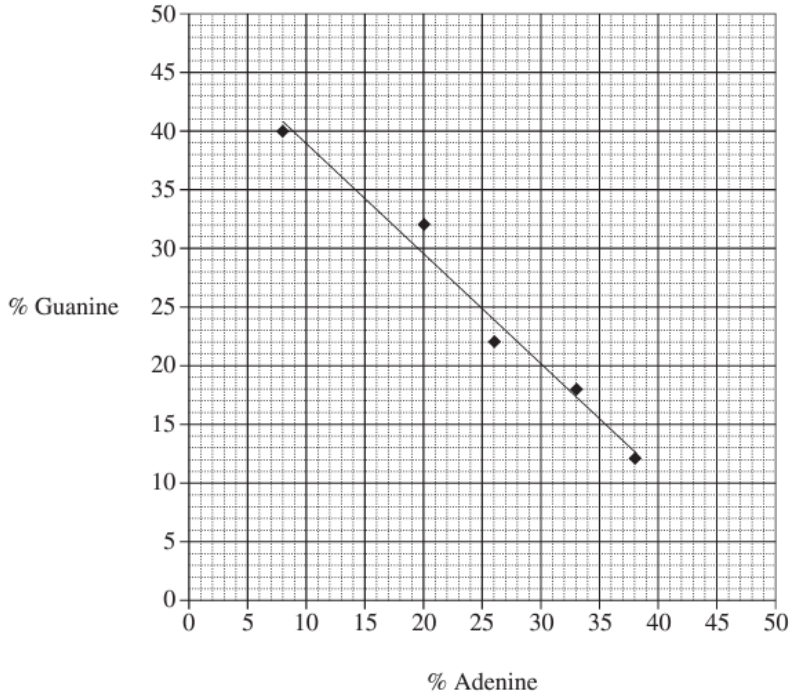
1 mark for correct gametes produced.
1 mark for correct Punnet square drawn
Ratio of phenotypes: 50% red and 50% white (1 mark)
Ratio of genotypes: 50% heterozygous red (Rr) and 50% homozygous white (rr) (1 mark)
Must state heterozygous red: homozygous white.

Question 31 (4 marks)

Students conducted preliminary experiments to analyse the DNA base composition of five different species. The table shows the experimental data collected.

Species	*% Adenine*	*% Guanine*
A	38	12
B	26	22
C	8	40
D	20	32
E	33	18

a. On the grid provided, plot the % Guanine against % Adenine of the species analysed and draw a suitable line of best fit. (3 marks)



Criteria	marks
• Correct continuous scale or use a stagger fit within the space of graph. • Correct labels and plotting points • A line of best fit that includes most points.	3
Any of above not correct or some relevant information is given	0-2

b. Identify the relationship shown by the data. (1 mark)

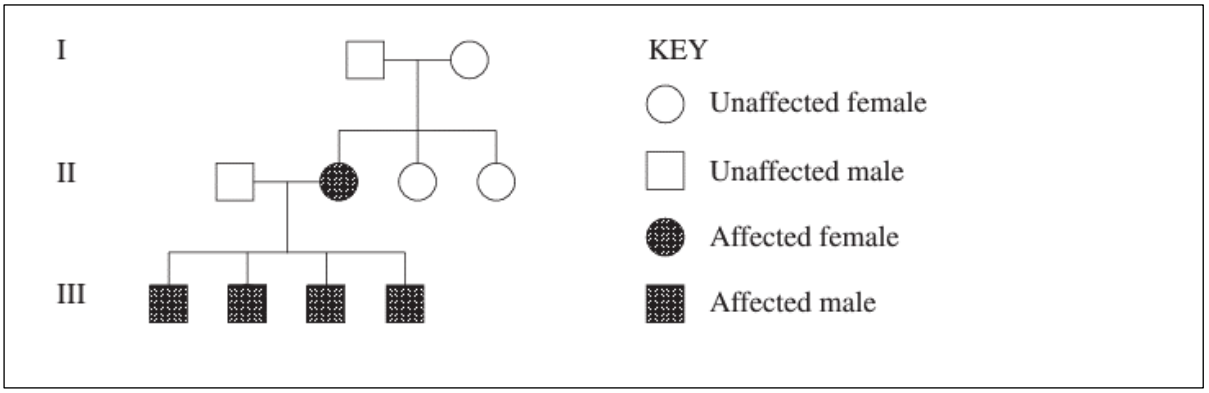
As the % of Adenine increases, the % of Guanine decreases and vice versa.
Negative correlation alone NOT ACCEPTED

Question 32 (5 marks)

A non-infectious disease was observed in a mother and her four sons who live with her. She has no daughters. The father of these children does not have the disease and does not live with them. The woman's parents and her two sisters do not have the disease. A geneticist suspects that the disease is inherited.

a. Draw a pedigree using the information provided above in the space below. (4 marks)

Criteria	marks
• Correct key is given • Correct symbols of parents of mother (generation I) • Correct symbols of mother, her husband and her two sisters (generation II) • Correct symbols of four sons (generation III)	4
Any of above is missing or some relevant information or wrong answer	0-3



a. From the evidence, what indicates that the disease could be the result of a recessive allele and not be sex-linked? (2 marks)

Marking guidelines (b):

Criteria	Marks
• Provides evidence that indicates why the gene is recessive • Provides evidence that indicates why the gene cannot be sex-linked	2
• Provides evidence that indicates why the gene is recessive OR • Provides evidence that indicates why the gene cannot be sex-linked	1

Sample answer:

The grandparents do not have the disease while the mother has the disease (recessive) and the disease is not found in the grandfather while the mother has the disease (not sex-linked).

No disease in grandparents /first generation

Question 33 (3 marks)

b. Define a mutation. (1 mark)
Mutation is a change in the genotype or genetic code in the genes in an individual.

c. Identify the type of mutation that has occurred in the following DNA strand. Give a reason. (2 marks)

Original strand	Mutated strand
GGCGGTCTATTA	GGCGGTCTAGTTA

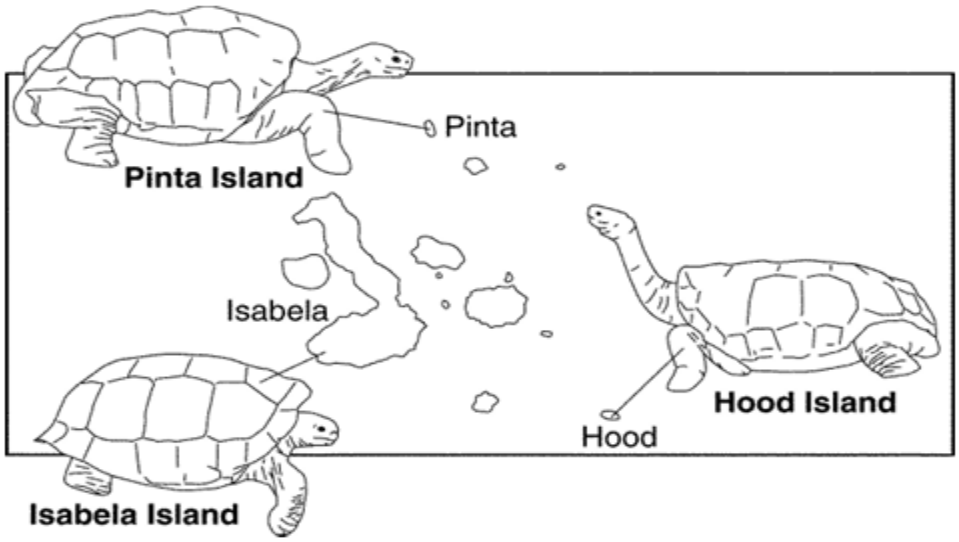
Type of mutation is insertion (point mutation)/frameshift mutation (1 mark)

The mutated strand has one extra nucleotide inserted (G nucleotide inserted between A and T)

(1mark)

Question 34 (5 marks)

The picture below shows the existence of three species of tortoise on three islands with different set of conditions.



a. Identify a trait that differs among three species of tortoises that can be used as evidence to support the theory of evolution. (1 mark)

Length of neck/

b. Vegetation on islands can vary. Rocky islands with very wet conditions may have layers of algae grown. Some islands have very delicate low height grass grown. Some islands have very sparce hard to reach vegetation. Determine which island is likely to have each type of vegetation. (3 marks)

Pinta island has low height grasses

Isabela island

Isabela island has rocky platform with green algae grown

Hood island
Hood island has low height shrub plants /sparce hard to reach vegetation

c. Identify and outline the type of evolution that might have led to the survival of three types of tortoises. (1 mark)

Divergent evolution/adaptive radiation /have common ancestor/ isolated and live in different environment/were subjected to different selection pressure (1 mark)

End of Examination

Extra paper

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Extra Paper

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