School Student Number: _____

North Sydney Boys High School

Science Faculty

Year 10 Science 2022

Assessment 3

General Instructions:

Reading time – 5 minutes
Working time – 1 hours and 30 minutes

- Write using black or blue pen
- Draw diagrams using pencil
- NESA approved calculators may be used
- This paper has three parts
- Write your student number at the top right corner of every page

Assessment Weightage

30% total weightage

- 25% Knowledge and Understanding (K&U)
- 5% Working Scientifically (WS)

Total Marks - 70

Part A: Knowledge & Understanding Multiple Choice

- Question 1 - 15
- 15 marks

Part B: Working Scientifically Multiple Choice

- Question 16 - 20
- 5 marks

Part C: K&U/ WS Written Response

- Question 21 - 28
- 40 marks KU
- 10 marks WS

KU – Part A Q1 – Q15	**/15**
WS - Part B Q16 – Q20	**/5**
KU – Part C Q21-Q26, Q28	**/40**
WS - Part C Q27	**/10**
Total	**/70**

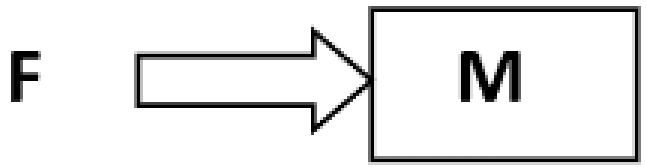
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School Student Number: _____

Part A [15 marks]

Knowledge & Understanding

Q1 A force F is acting on a block of mass M, causing it to accelerate.



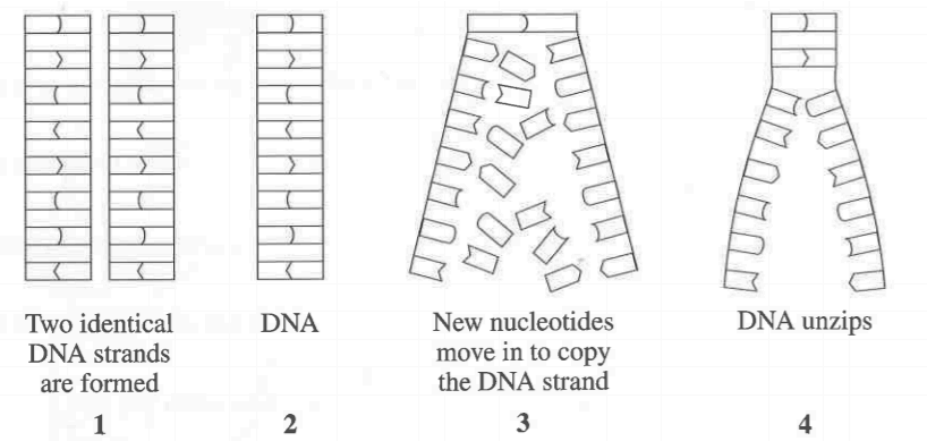
If the force stayed the same and the mass of the block was halved, its acceleration would:

A. Double
B. Stay the same
C. Halve
D. Decrease to zero

Q2 For a chemical reaction to occur, the atoms or ions or molecules must collide with sufficient energy for that reaction to occur. Select the one factor below that **DOES NOT** increase the rate of collision.

A. Add more solute (reactants) into a fixed volume of water
B. Breakdown the reactants from large pieces into smaller particles
C. Increase the volume of solution used
D. Use a Bunsen burner to heat up the reactants

Q3 The diagram represents a model of DNA replication. The steps are **NOT** in the correct order. Choose an answer that depicts the correct sequential order.



A. 1, 2, 3, 4

B. 2, 3, 4, 1

C. 2, 4, 3, 1

D. 4, 3, 2, 1

The following information is relevant for Questions 4 – 5.

Q4. A motorcycle that has a mass of 200 kg accelerates from 0 to 30 m/s in 3 seconds. The acceleration of the motorcycle is constant throughout the 3 seconds.

The force generated by the motorcycle during the first 3 seconds is

A. 10 N

B. 600 N

C. 2,000 N

D. 6,000 N

Q5. In reality, the thrust force generated would likely be more.

Which one of the following statements gives the best justification for this?

A. There are friction forces acting in the opposing direction
B. The inertia of the motorcycle resists the motion of the motorcycle
C. This is a consequence of Newton's Third Law
D. The motorcycle engine needs cleaning

Q6. When a piece of cobalt metal is added to a solution of lead (II) nitrate, a dark coloured precipitate is produced, and the solution changes colour. This reaction is represented by the chemical equation below.

$$Co_{(s)} + Pb(NO_3)_{2\,(aq)} \rightarrow Co(NO_3)_{2\,(aq)} + Pb_{(s)}$$

What is the type of reaction demonstrated in the equation above?

A. Combustion
B. Displacement
C. Decomposition
D. Acid-base neutralisation

Q7 Element X, which is in group 2 of the periodic table, reacts with Element Y, which is in group 16.

What is the formula of the compound produced?

A. X_2Y_3
B. X_2Y
C. XY_3
D. XY

Q8 When a multicellular organism grows, its cells do not just get bigger and bigger. What happens to the cells so that the organism can grow?

A. The cells begin to shrink.

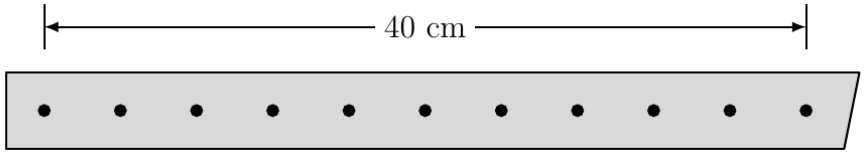
B. The DNA in the cells mutates.

C. The cells divide to form new cells.

D. The cells undergo natural selection.

Q9 In a science experiment, a ticker-timer is used to investigate the movement of a trolley.

Every second, the ticker-timer puts 40 dots on a tape (or 1 dot per 0.025 sec).



The speed at which the trolley was moving was

A. 1 cm/s

B. 10 cm/s

C. 60 m/s

D. 160 cm/s

Q10 Which of the following do not divide by mitosis?

A. Skin Cells

B. Liver Cells

C. Muscle Cells

D. Sperm Cells

Q11 A commercial drain cleaner contains hydrochloric acid. When a few drops of silver nitrate are added to a sample of the drain cleaner, a white precipitate is formed. What is the formula of the precipitate?

A. HCl
B. AgNO3
C. HNO3
D. AgCl

Q12 Choose the correct answer that lists the items from smallest to largest.

A. Chromosome, DNA, gene, chromosome, nucleus, cell, human body
B. DNA, gene, chromosome, nucleus, cell, human body
C. Gene, DNA, chromosome, nucleus, cell, human body,
D. DNA, chromosome, gene, nucleus, cell, human body

Q13 Dominic walks 3 m north, 3 m east and then 3 m south.
Which of the following correctly lists the total distance travelled and the total displacement?

	Total distance travelled	**Total displacement**
A	3 m	9 m
B	3 m	3 m
C	9 m	9 m
D	9 m	3 m

Q14 In a variety of garden peas, the allele for tall plants (T) is dominant over the allele for short plants (t). A cross between a tall plant and a short plant resulted in 50% of the offspring being short.

What were the genotypes of the parents?

A. TT and Tt
B. Tt and Tt
C. Tt and tt
D. TT and tt

Q15 On the weekend, Thomas was riding his bike to the local shops when a dog ran out in front of him. He slammed on his brakes and flew over the handlebars. Which of Newton's Laws is applicable when Thomas braked his bike immediately?

A. Newton's First law
B. Newton's Second law
C. Newton's Third law
D. None of them

Part B [5 marks]

Working Scientifically

Q16 What is the most appropriate piece of equipment to accurately measure 50 mL of water?

A. 100 mL Measuring Cylinder
B. 250 mL Measuring cylinder
C. 100 mL Beaker
D. 250 mL Beaker

Q17 What should scientists do if new evidence is discovered, or an observation is made that contradicts a theory that was previously believed and 'proven' to be correct?

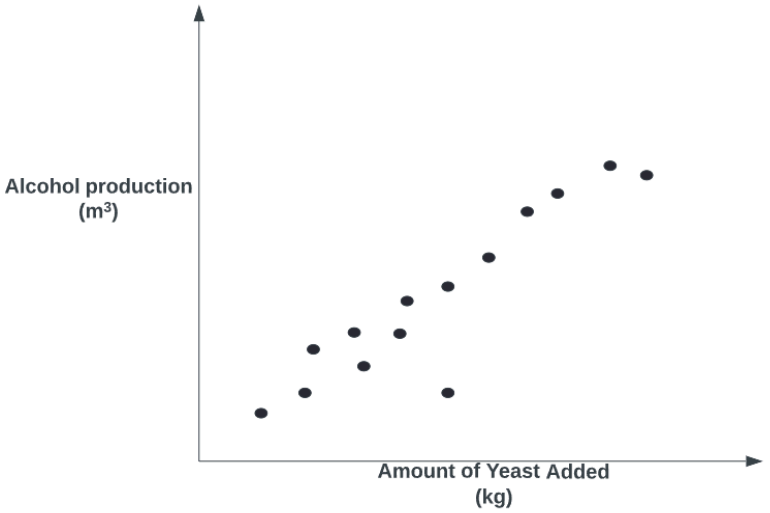
A. Re-check the evidence or observations, and if it is correct, modify the theory.
B. Reject any new evidence or observations, and keep accepting the previous theory.
C. Accept the new evidence or observations, and develop a new theory for it.
D. Accept the new evidence or observations and modify the theory.

Q18 The scale consistently measures the mass of objects to be 200 g less than their actual mass.

The scale is best described as

A. precise and accurate
B. precise, but not accurate
C. not precise, but accurate
D. not precise, nor accurate

Q19 Fourteen sugar fermentation experiments were performed to study the effect of a specific type of yeast provided on alcohol production. The graph below shows the relationship between the two variables: yeast amount added and alcohol production volume.



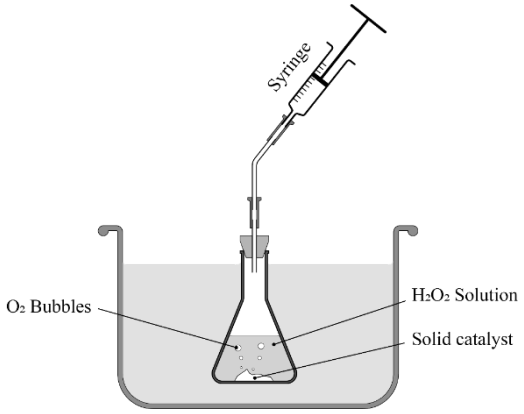
Which one of the following statements describes the relationship between the two variables correctly ?

A. The amount of yeast added has no effect on the alcohol volume produced
B. The alcohol volume increases with a decreasing amount of added yeast
C. The alcohol production volume increases in a linear trend as more amount of yeast is added
D. There is an exponential increase of alcohol production volume as more yeast is being added

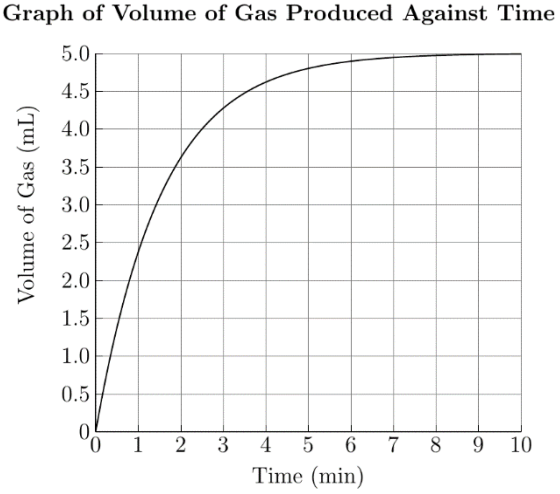
Q20 Hydrogen peroxide (H_2O_2) decomposes into water and oxygen gas as shown in the equation below.

$$2H_2O_{2\,(aq)} \rightarrow 2H_2O_{(l)} + O_{2\,(g)}$$

30 mL of hydrogen peroxide is placed in a conical flask along with an appropriate catalyst. The conical flask is then placed in a water bath at 30°C. The flask is sealed, and all the gas produced is collected in a syringe as shown in the diagram below.



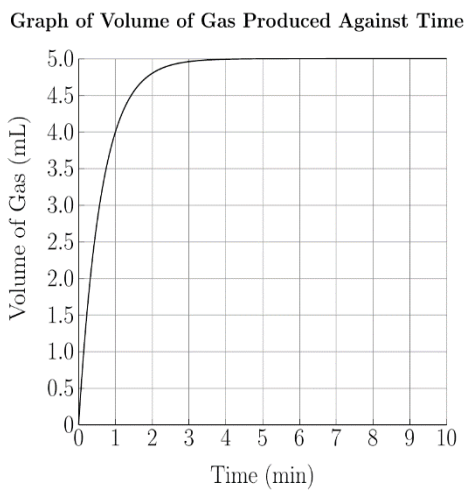
A graph of the volume of gas collected against time is shown below.



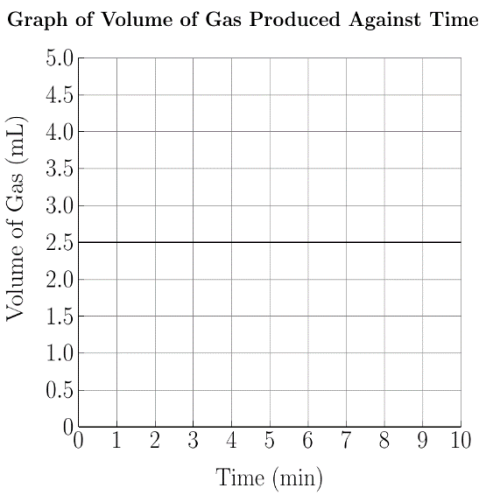
The experiment is repeated, but the flask is placed in a water bath at 60°C.

Which of the following best represents the graph of the volume of gas against time that would be obtained?

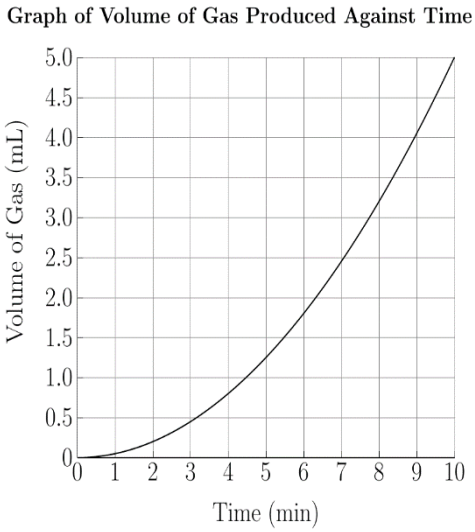
A.



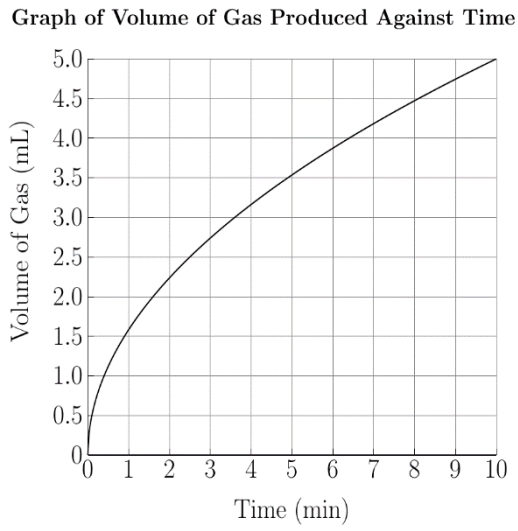
B.



C.



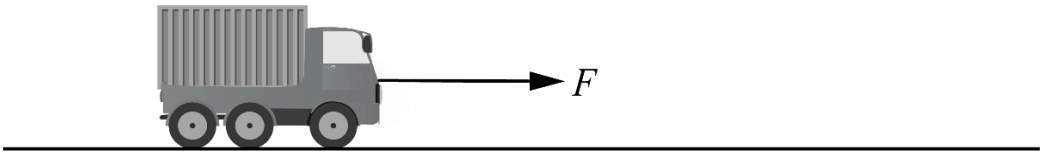
D.



Part C (50 marks)

Q21 [6 marks] **Marks**

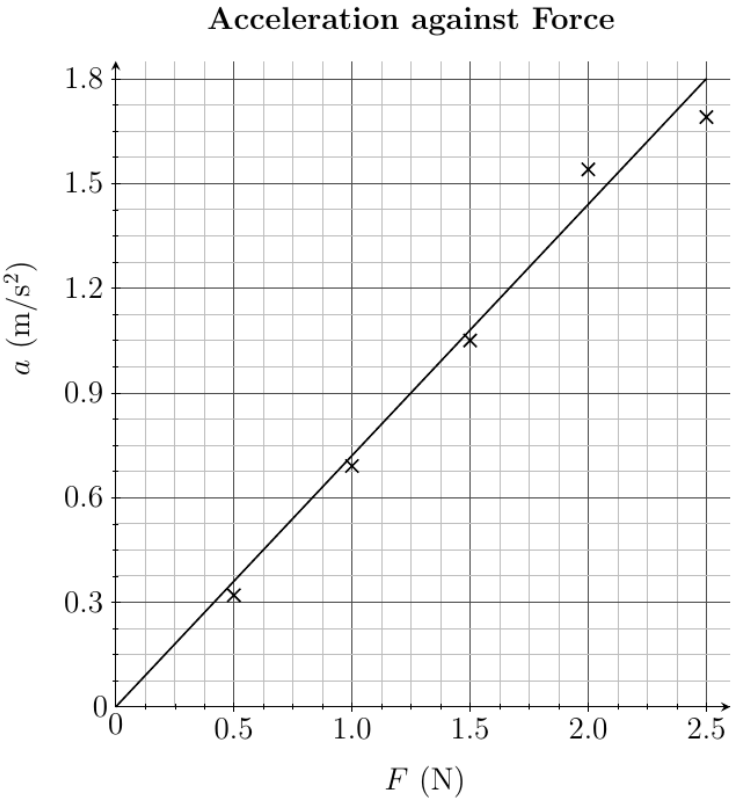
A science class was studying the acceleration of a toy truck that was pulled along a smooth track with a variable force, F. The set-up of this experiment is shown below.



The results obtained are shown in the table.

F **(N)**	***a*** **(m/s²)**
0.5	0.32
1.0	0.69
1.5	1.05
2.0	1.54
2.5	1.69

The graph below was plotted using the results.



(a) What is the independent variable in this experiment? **Marks [KU] 1**

_____

_____

_____

(b) It is given that $\boldsymbol{F = ma}$, where m is the mass of the toy truck. **[KU] 3**
Using the graph, determine the mass of the truck.

_____

_____

_____

_____

(c) State two things that can be done to improve the *reliability* of this experiment. **[KU] 2**

_____

_____

_____

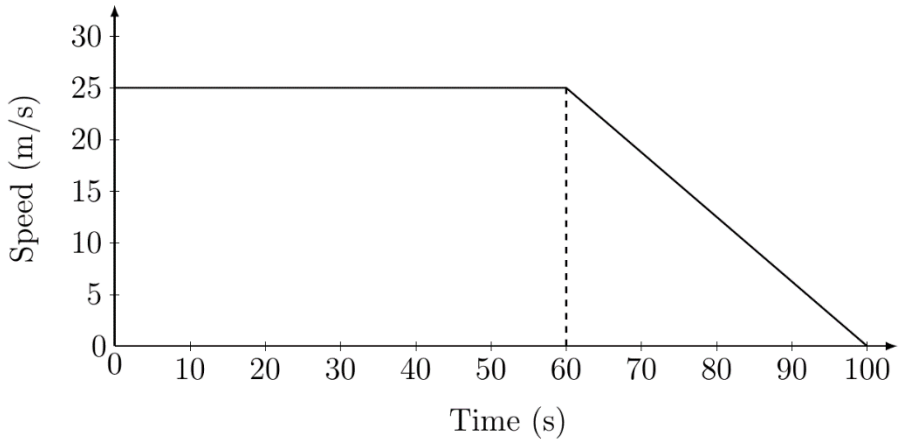
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Q22 [4 marks] **Marks**

The following speed-time graph shows part of a cyclist's journey.



(a) Calculate the average speed of the cyclist in the first 100 seconds. **[KU] 2**

_____

_____

_____

(b) Find the acceleration of the cyclist in the last 40 seconds. **[KU] 2**

_____

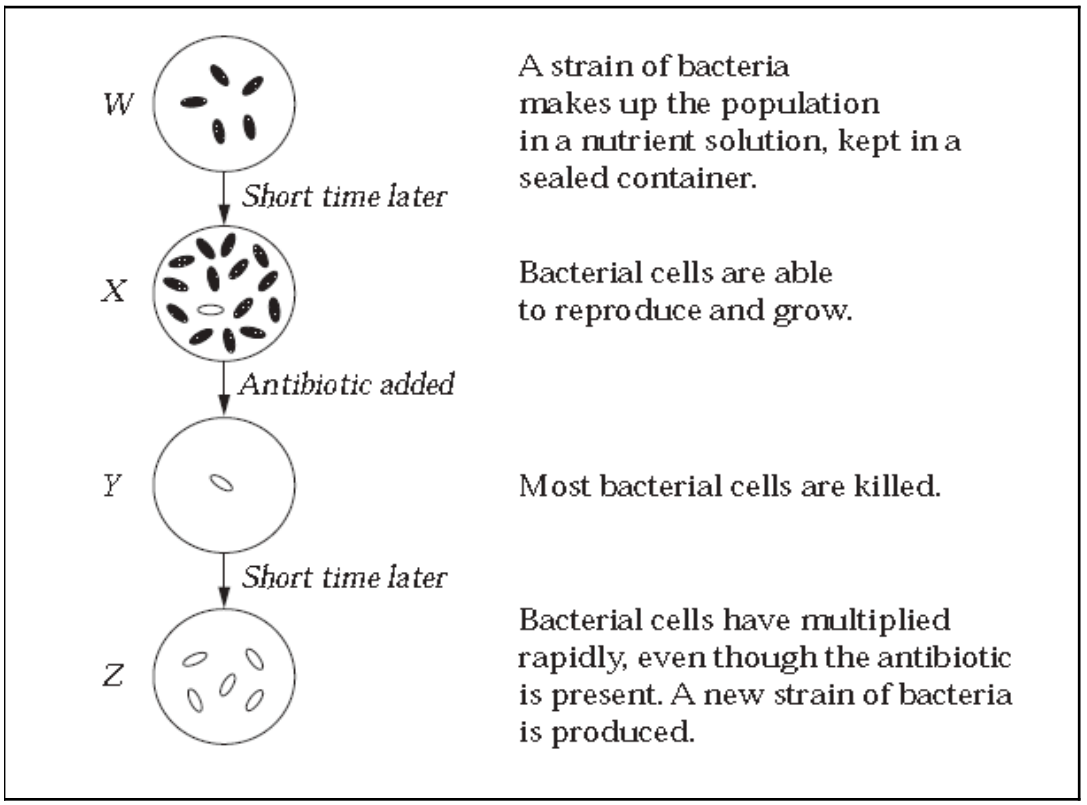
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Q23 [5 marks] **Marks**

The diagram shows natural selection in a bacterial population.



[KU] 3

(a) Using the information in the diagram, explain how the process of natural selection has occurred.

_____

_____

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_____

Marks

(b) DNA mutations can occur when an organism reproduces. Explain why such mutations may be an advantage for its survival. **[KU] 2**

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Q24 [5 marks]

Observe the following segment of DNA below.

Template strand: AAGTCTGCGAAATTGCACGTA
Coding strand: TTCTGACGCTTTAACGUGCAT

(a) Assuming that the template strand is correct, **circle** the two mistakes in the coding strand shown above, and **identify** what the correct base should be. **[KU] 2**

Mistake 1:

Mistake 2:

(b) During transcription, the template strand is copied into mRNA. What would the mRNA strand for the above segment of DNA be? **[KU] 1**

_____

_____

(c) Mutations often occur in DNA, and a point insertion or deletion can cause what is known as a frameshift mutation. **Marks [KU] 2**

Explain what a frameshift mutation is and the effect it may have on a protein.

_____

_____

_____

_____

Q25 [3 marks]

In an investigation, 10 ml of sodium chloride solution was mixed with 10 ml silver nitrate solution. The result was the formation of an insoluble white solid of silver chloride. **[KU] 1**

(Remember: all nitrates are soluble)

(a) Identify the type of chemical reaction that has occurred?

_____

(b) Write a balanced chemical equation for this reaction (include their respective state symbols). **[KU] 2**

_____

_____

Q26 [7 marks] **Marks**

Acid rain can corrode structures made of limestone and marble, both of which contain high proportions of calcium carbonate ($CaCO_3$). Vanessa is designing an experiment in order to model the corrosion of limestone by acid rain. She prepares four different beakers A, B, C, and D, each with 5 g of calcium carbonate chips inside.

Vanessa adds a different solution to each beaker. Each solution contains a different ratio of nitric acid (HNO_3) to water as shown in the table below.

Set-Up	**Solution added to each set-up**	
	Volume of Water (mL)	**Volume of Nitric Acid (mL)**
A	0	40
B	10	30
C	20	20
D	30	10

As soon as she pours the solution into the respective beaker, she starts the timer and measures the time taken for all the calcium carbonate to dissolve. Vanessa's measurements are recorded in the table below.

Set-Up	**Time Taken for all $CaCO_3$ to dissolve (s)**
A	8
B	25
C	48
D	87

(a) Write a word equation for the reaction between nitric acid and calcium carbonate. **[KU] 1**

_____

_____

(b) Referring to the kinetic model of matter, explain why increasing the concentration of nitric acid reduces the time taken for the limestone to dissolve. **Marks [KU] 3**

_____

_____

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_____

(c) Describe two variables that must be kept constant in order to ensure that a fair test is carried out. **[KU] 2**

_____

_____

_____

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(d) Apart from the corrosion of structures, describe one negative impact of acid rain on the surrounding environment. **[KU] 1**

_____

_____

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_____

Q27 [10 marks] **Marks**

A student carried out some experiments to place four metals, **V**, **W**, **Y** and **Z** in order of reactivity.

Key ✅ shows a reaction happened
❌ shows no reaction happened
➖ shows the experiment was not performed

	metal **V**	metal **W**	metal **Y**	metal **Z**
Solution of **V** nitrate	➖	❌	❌	❌
Solution of **W** nitrate	✅	➖	✅	✅
Solution of **Y** nitrate	✅	❌	➖	✅
Solution of **Z** nitrate	✅	❌	❌	➖

(a) Place the metals in order of reactivity, starting with the most reactive. **[KU] 2**

_____

(b) Metal Z reacts with nitric acid. What would you see when metal Z reacts with nitric acid? Explain your reasoning. **[KU] 2**

_____

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(c) Metal V reacts with HCl. What gas is produced from this reaction? And what test can be performed to identify the test. **Marks [KU] 2**

_____

_____

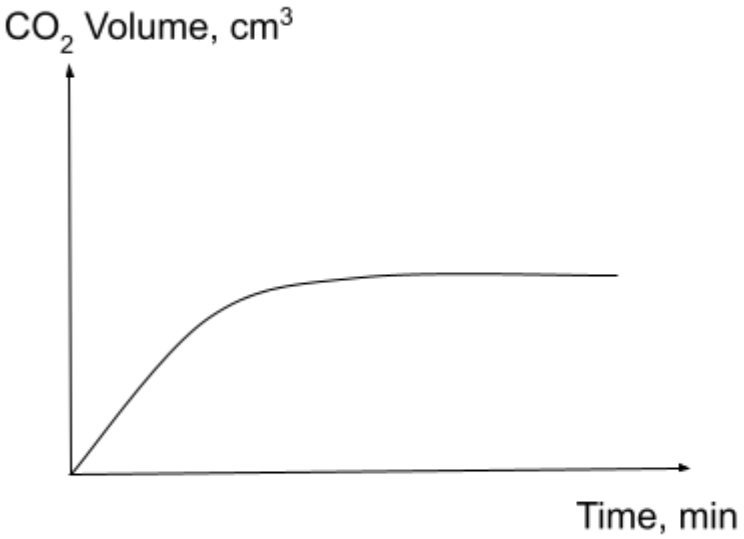
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(d) Metal V which is present in the form of carbonate chips, and 5g of this carbonate is added to 60mL of 2.0 mol/L of HCl. The graph shows CO2 is being produced over a period of time.



The experiment above,

(i) is repeated using the 60.0 cm3 of 1.0 mol/L hydrochloric acid. Add to the graph that you would expect. Label this graph A. **[2][KU]**

(ii) is repeated using the same mass of **powdered** metal **V** carbonate. Add to Figure B the graph that you would expect. Label this graph B. **[2][KU]**

Q27 [10 marks] **Marks**

A student performed an investigation to determine the relationship between the height an object is dropped from and the time it takes to fall.

His hypothesis was that doubling the height would double the time it takes to fall.

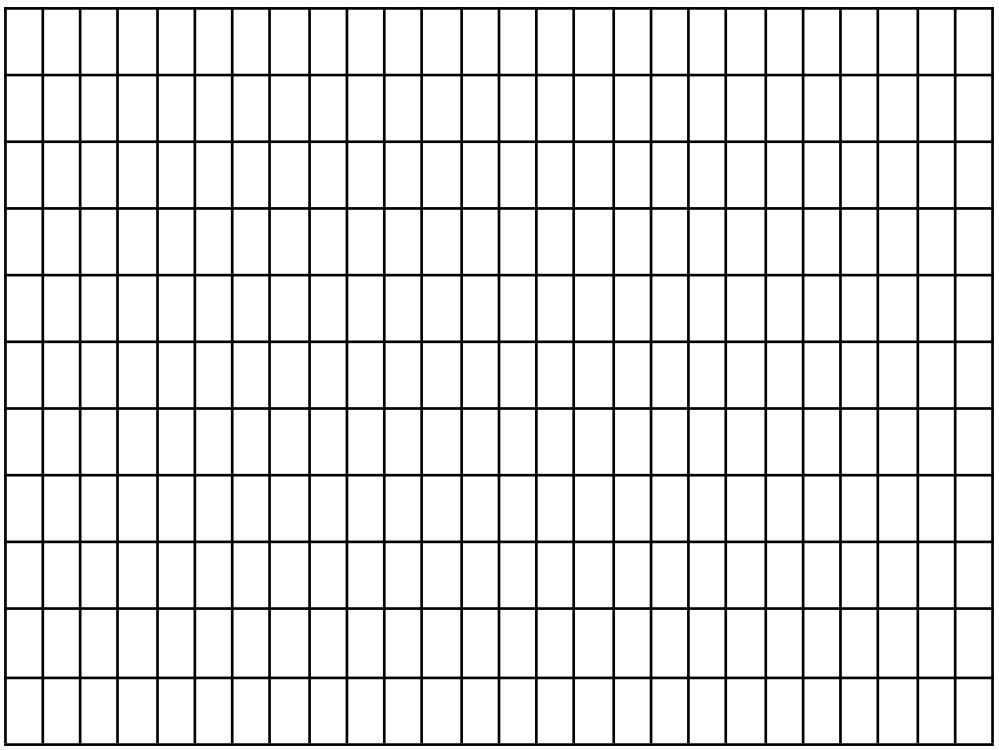
The student recorded the time taken to fall by dropping a rock various distances as measured by a tape measure and using a stopwatch to time the fall duration.

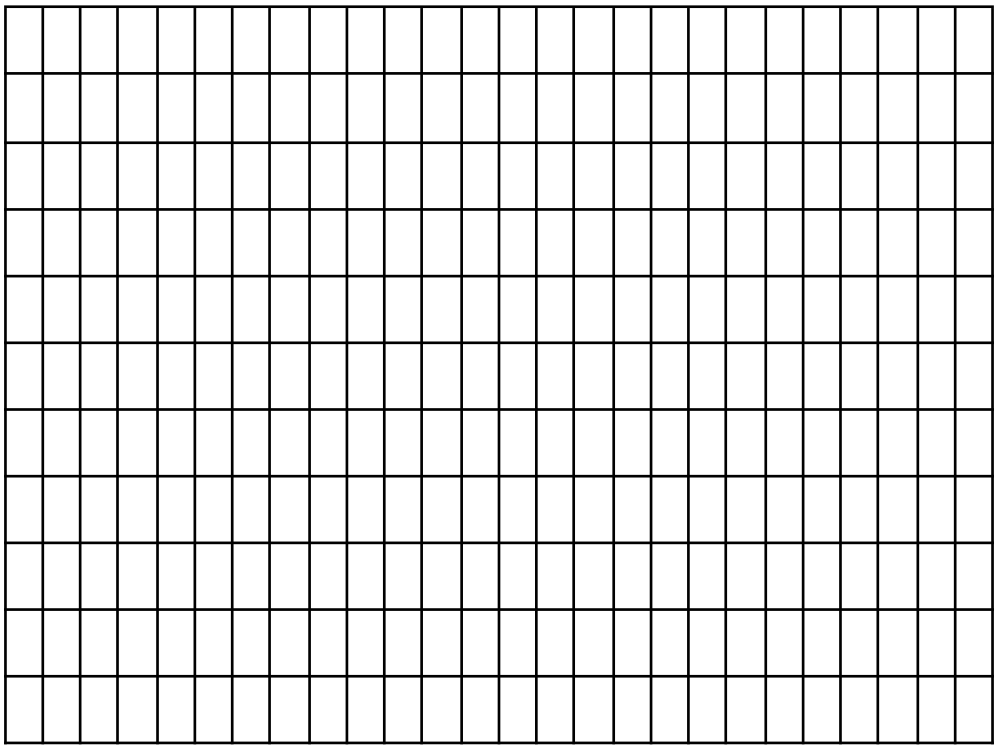
The student's results are in the table below:

Distance (m)	Fall time (s)
0.4	0.28
0.6	0.35
0.8	0.41
1	0.45
1.2	0.5
1.4	0.54
1.6	0.58

[WS] 5

(a) On the axes below, plot and draw a line of best fit for these data.





Marks

[WS] 1

[WS] 3

(b) Using your graph, estimate the height needed for the fall to take 0.48 seconds.

_____

(c) Is the hypothesis supported by the data?

Explain your answer with reference to the graph.

_____

_____ **[WS] 1**

_____

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_____

(d) Discuss ONE variable that would require controlling this experiment.

_____

_____

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_____

[END OF ASSESSMENT]

	North Sydney Boys High School *Science Faculty*	
MULTIPLE CHOICE ANSWER SHEET		

School Student Number: _____

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 ◯

School Student Number: _____

PERIODIC TABLE OF THE ELEMENTS

1 H 1.008 Hydrogen																	2 He 4.003 Helium
3 Li 6.941 Lithium	4 Be 9.012 Beryllium											5 B 10.81 Boron	6 C 12.01 Carbon	7 N 14.01 Nitrogen	8 O 16.00 Oxygen	9 F 19.00 Fluorine	10 Ne 20.18 Neon
11 Na 22.99 Sodium	12 Mg 24.31 Magnesium											13 Al 26.98 Aluminium	14 Si 28.09 Silicon	15 P 30.97 Phosphorus	16 S 32.07 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.95 Argon
19 K 39.10 Potassium	20 Ca 40.08 Calcium	21 Sc 44.96 Scandium	22 Ti 47.87 Titanium	23 V 50.94 Vanadium	24 Cr 52.00 Chromium	25 Mn 54.94 Manganese	26 Fe 55.85 Iron	27 Co 58.93 Cobalt	28 Ni 58.69 Nickel	29 Cu 63.55 Copper	30 Zn 65.38 Zinc	31 Ga 69.72 Gallium	32 Ge 72.64 Germanium	33 As 74.92 Arsenic	34 Se 78.96 Selenium	35 Br 79.90 Bromine	36 Kr 83.80 Krypton
37 Rb 85.47 Rubidium	38 Sr 87.61 Strontium	39 Y 88.91 Yttrium	40 Zr 91.22 Zirconium	41 Nb 92.91 Niobium	42 Mo 95.96 Molybdenum	43 Tc Technetium	44 Ru 101.1 Ruthenium	45 Rh 102.9 Rhodium	46 Pd 106.4 Palladium	47 Ag 107.9 Silver	48 Cd 112.4 Cadmium	49 In 114.8 Indium	50 Sn 118.7 Tin	51 Sb 121.8 Antimony	52 Te 127.6 Tellurium	53 I 126.9 Iodine	54 Xe 131.3 Xenon
55 Cs 132.9 Caesium	56 Ba 137.3 Barium	57–71 Lanthanoids	72 Hf 178.5 Hafnium	73 Ta 180.9 Tantalum	74 W 183.9 Tungsten	75 Re 186.2 Rhenium	76 Os 190.2 Osmium	77 Ir 192.2 Iridium	78 Pt 195.1 Platinum	79 Au 197.0 Gold	80 Hg 200.6 Mercury	81 Tl 204.4 Thallium	82 Pb 207.2 Lead	83 Bi 209.0 Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89–103 Actinoids	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson

KEY

Atomic Number	79
Symbol	Au
Standard Atomic Weight	197.0
Name	Gold

Lanthanoids

57 La 138.9 Lanthanum	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm Promethium	62 Sm 150.4 Samarium	63 Eu 152.0 Europium	64 Gd 157.3 Gadolinium	65 Tb 158.9 Terbium	66 Dy 162.5 Dysprosium	67 Ho 164.9 Holmium	68 Er 167.3 Erbium	69 Tm 168.9 Thulium	70 Yb 173.1 Ytterbium	71 Lu 175.0 Lutetium

Actinoids

89 Ac Actinium	90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium

Standard atomic weights are abridged to four significant figures.

Elements with no reported values in the table have no stable nuclides.

Information on elements with atomic numbers 113 and above is sourced from the International Union of Pure and Applied Chemistry Periodic Table of the Elements (November 2016 version).

The International Union of Pure and Applied Chemistry Periodic Table of the Elements (February 2010 version) is the principal source of all other data. Some data may have been modified.

North Sydney Boys High School
Science Faculty
Year 10 Science 2022
Assessment 3

General Instructions:

Reading time – 5 minutes
Working time – 1 hours and 10 minutes

- Write using black or blue pen
- Draw diagrams using pencil
- NESA approved calculators may be used
- This paper has three parts
- Write your student number at the top right corner of every page

Assessment Weightage

30% total weightage

- 25% Knowledge and Understanding (K&U)
- 5% Working Scientifically (WS)

Total Marks - 50

Part A: Knowledge & Understanding Multiple Choice

- 15 questions
- 15 marks

Part B: Working Scientifically Multiple Choice

- 5 questions
- 5 marks

Part C: K&U/ WS Written Response

- 6 questions
- 27 marks KU
- 3 marks WS

KU – Part A Q1 – Q15	**/15**
WS - Part B Q16 – Q20	**/5**
KU – Part C Q1-Q6 (except Qn 1c & 6c)	**/27**
WS - Part C Qn 1a & 6c	**/3**
Total	**/50**

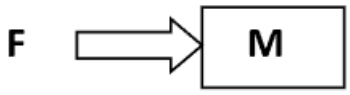
This paper MUST NOT BE REMOVED from the examination room

Student Number: _____

Part A [15 marks] **Answers are highlighted in Yellow**

Knowledge & Understanding

Q1 A force F is acting on a block of mass M, causing it to accelerate. **[1 mark]**



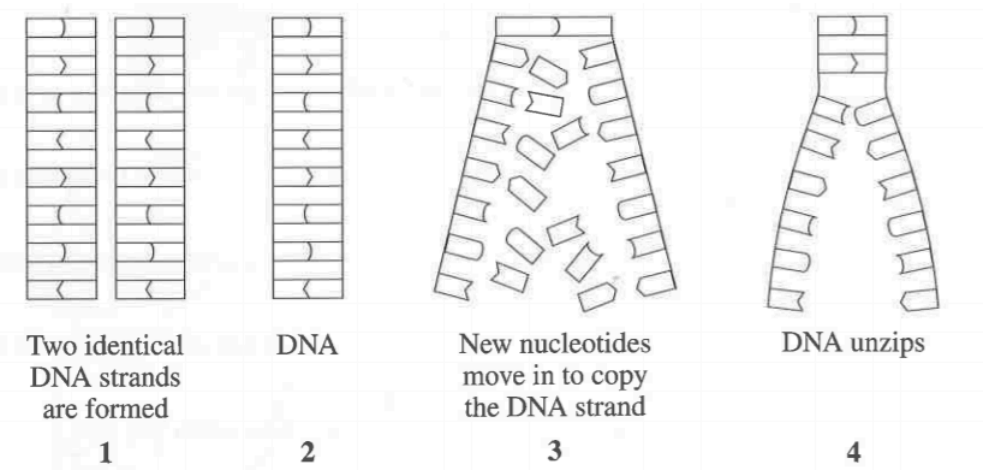
If the force stayed the same and the mass of the block was halved, its acceleration would:

A. Double
B. Stay the same
C. Halve
D. Decrease to zero

Q2 For a chemical reaction to occur, the atoms or ions or molecules must collide with sufficient energy for that reaction to occur. Select the one factor below that **DOES NOT** increase the rate of collision. **[1 mark]**

A. Add more solute (reactants) into a fixed volume of water
B. Breakdown the reactants from large pieces into smaller particles
C. Increase the volume of solution used
D. Use a Bunsen burner to heat up the reactants

Q3 The diagram represents a model of DNA replication. The steps are **NOT** in the correct order. Choose an answer that depicts the correct sequential order. **[1 mark]**



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

The following information is relevant for Questions 4 – 5.

Q4. A motorcycle that has a mass of 200 kg accelerates from 0 to 30 m/s in 3 seconds. The acceleration of the motorcycle is constant throughout the 3 seconds. **[1 mark]**

The net thrust force generated by the motorcycle during the first 3 seconds is
A. 10 N
B. 600 N
C. 2,000 N
D. 6,000 N

Q5. In reality, the thrust force generated would likely be more. **[1 mark]**

Which one of the following statements gives the best justification for this?
A. There are friction forces acting in the opposing direction
B. The inertia of the motorcycle resists the motion of the motorcycle
C. This is a consequence of Newton's Third Law
D. The motorcycle engine needs cleaning

Q6. When a piece of cobalt metal is added to a solution of lead (II) nitrate, a dark coloured precipitate is produced, and the solution changes colour. This reaction is represented by the chemical equation below. **[1 mark]**

$$Co_{(s)} + Pb(NO_3)_{2\,(aq)} \rightarrow Co(NO_3)_{2\,(aq)} + Pb_{(s)}$$

What is the type of reaction demonstrated in the equation above?
A. Combustion
B. Displacement
C. Decomposition
D. Acid-base neutralisation

Q7 Element X, which is in group 2 of the periodic table, reacts with Element Y, which is in group 16.
What is the formula of the compound produced? **[1 mark]**

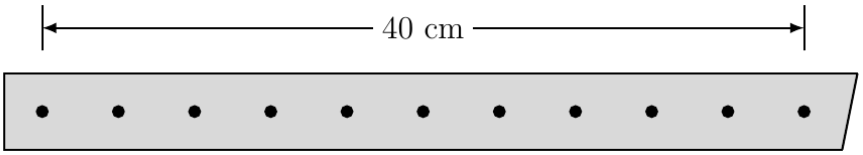
A. X_2Y_3
B. X_2Y
C. XY_3
D. XY

Q8 When a multicellular organism grows, its cells do not just get bigger and bigger. What happens to the cells so that the organism can grow?

A. The cells begin to shrink.
B. The DNA in the cells mutates.
C. The cells divide to form new cells.
D. The cells undergo natural selection.

Q9 In a science experiment, a ticker-timer is used to investigate the movement of a trolley. **[1 mark]**

Every second, the ticker-timer puts 40 dots on a tape (or 1 dot per 0.025 sec).



The speed at which the trolley was moving was
A. 1 cm/s
B. 10 cm/s
C. 60 m/s
D. 160 cm/s

Q10 Which of the following do not divide by mitosis?

A. Skin Cells
B. Liver Cells
C. Muscle Cells
D. Sperm Cells

Q11 A commercial drain cleaner contains hydrochloric acid. When a few drops of silver nitrate are added to a sample of the drain cleaner, a white precipitate is formed. What is the formula of the precipitate? **[1 mark]**

A. HCl
B. AgNO3
C. HNO3
D. AgCl

Q12 Choose the correct answer that lists the items from smallest to largest. **[1 mark]**

A. Chromosome, DNA, gene, chromosome, nucleus, cell, human body
B. DNA, gene, chromosome, nucleus, cell, human body
C. Gene, DNA, chromosome, nucleus, cell, human body,
D. DNA, chromosome, gene, nucleus, cell, human body

Q13 Dominic walks 3 m north, 3 m east and then 3 m south. **[1 mark]**
Which of the following correctly lists the total distance travelled and the total displacement?

	Total distance travelled	**Total displacement**
A.	3 m	9 m
B.	3 m	3 m
C.	9 m	9 m
D.	9 m	3 m

Q14 In a variety of garden peas, the allele for tall plants (T) is dominant over the allele for short plants (t). A cross between a tall plant and a short plant resulted in 50% of the offspring being short. **[1 mark]**

What were the genotypes of the parents?

A. TT and Tt
B. Tt and Tt
C. Tt and tt
D. TT and tt

Q15 On the weekend, Thomas was riding his bike to the local shops when a dog ran out in front of him. He slammed on his brakes and flew over the handlebars. Which of Newton's Laws is applicable when Thomas braked his bike immediately?
[1 mark]

A. Newton's First law
B. Newton's Second law
C. Newton's Third law
D. None of them

Part B [5 marks]

Working Scientifically

Q16 What is the most appropriate piece of equipment to accurately measure 50 mL of water? **[1 mark]**

A. 100 mL Measuring Cylinder
B. 250 mL Measuring cylinder
C. 100 mL Beaker
D. 250 mL Beaker

Q17 What should scientists do if new evidence is discovered, or an observation is made that contradicts a theory that was previously believed and 'proven' to be correct? **[1 mark]**

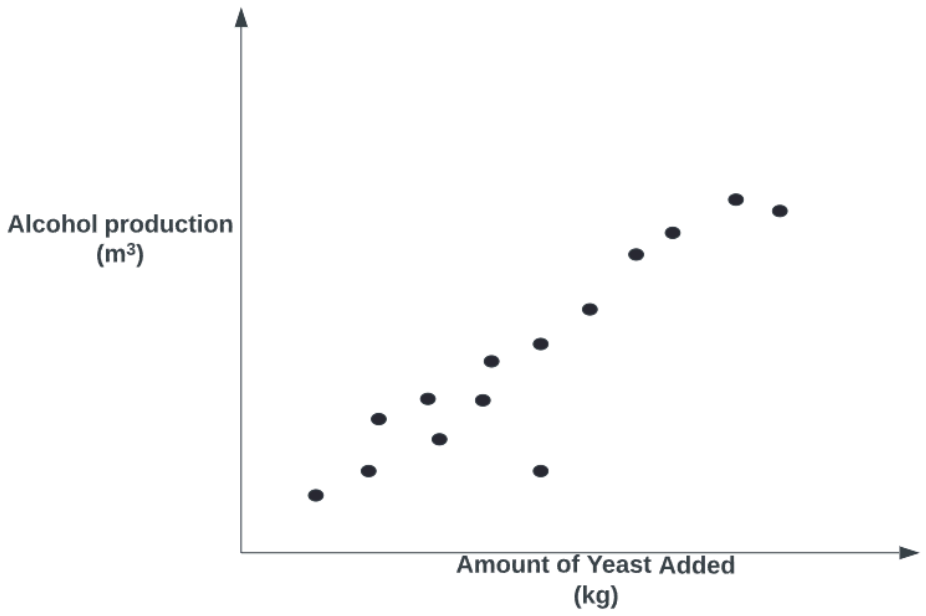
A. Re-check the evidence or observations, and if it is correct, modify the theory.
B. Reject any new evidence or observations, and keep accepting the previous theory.
C. Accept the new evidence or observations, and develop a new theory for it.
D. Accept the new evidence or observations and modify the theory.

Q18 The scale consistently measures the mass of objects to be 200 g less than their actual mass. **[1 mark]**

The scale is best described as

A. Precise and accurate
B. Precise, but not accurate
C. not precise, but accurate
D. not precise, nor accurate

Q19 Fourteen sugar fermentation experiments were performed to study the effect of a specific type of yeast provided on alcohol production. The graph below shows the relationship between the two variables: yeast amount added and alcohol production volume. **[1 mark]**



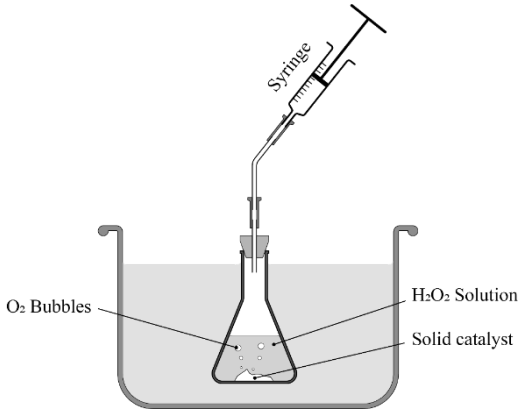
Which one of the following statements best describes the relationship between the two variables?

A. The amount of yeast added has no effect on the alcohol volume produced
B. The alcohol volume increases with a decreasing amount of added yeast
C. The alcohol production volume increases in a linear trend as more amount of yeast is added
D. There is an exponential increase of alcohol production volume as more yeast is being added

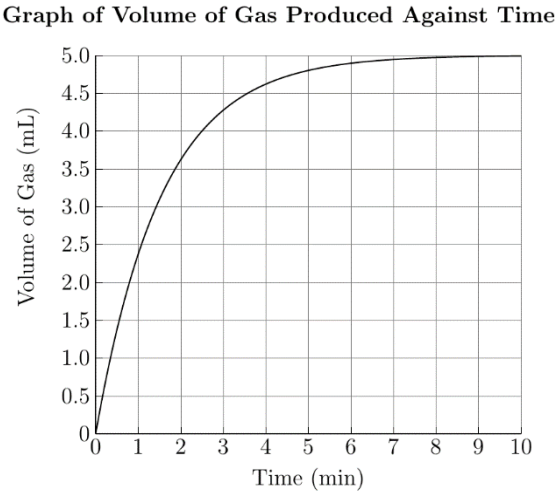
Q20 Hydrogen peroxide (H_2O_2) decomposes into water and oxygen gas as shown in the equation below. **[1 mark]**

$$2H_2O_{2\,(aq)} \rightarrow 2H_2O_{(l)} + O_{2\,(g)}$$

30 mL of hydrogen peroxide is placed in a conical flask along with an appropriate catalyst. The conical flask is then placed in a water bath at 30°C. The flask is sealed, and all the gas produced is collected in a syringe as shown in the diagram below.



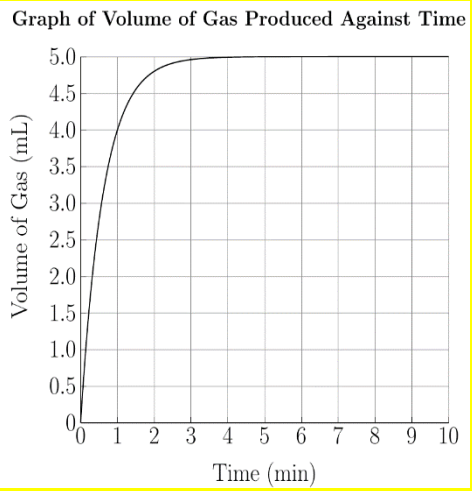
A graph of the volume of gas collected against time is shown below.



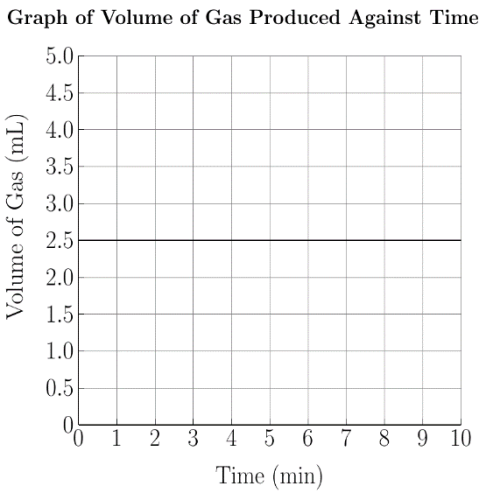
The experiment is repeated, but the flask is placed in a water bath at 60°C. Which of the following best represents the graph of the volume of gas against time that would be obtained?

Student Number: _____

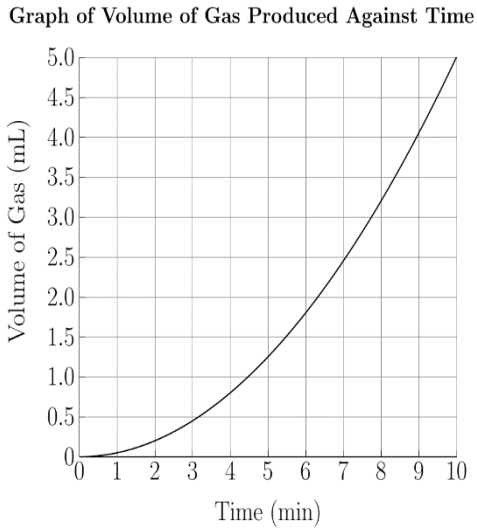
A.



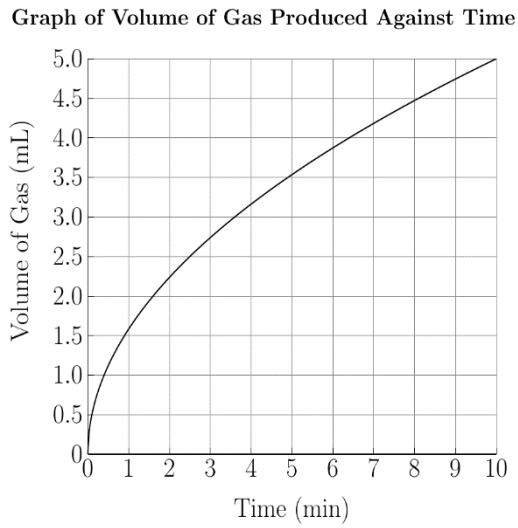
B.



C.

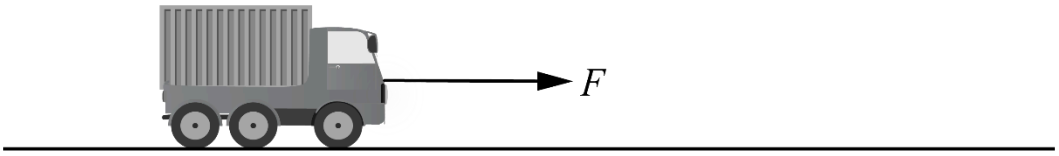


D.



Part C (30 marks) **(Note of Markers: Sample Answers are in BLUE)**
(Red font are comments to provide guidance on awarding marks)

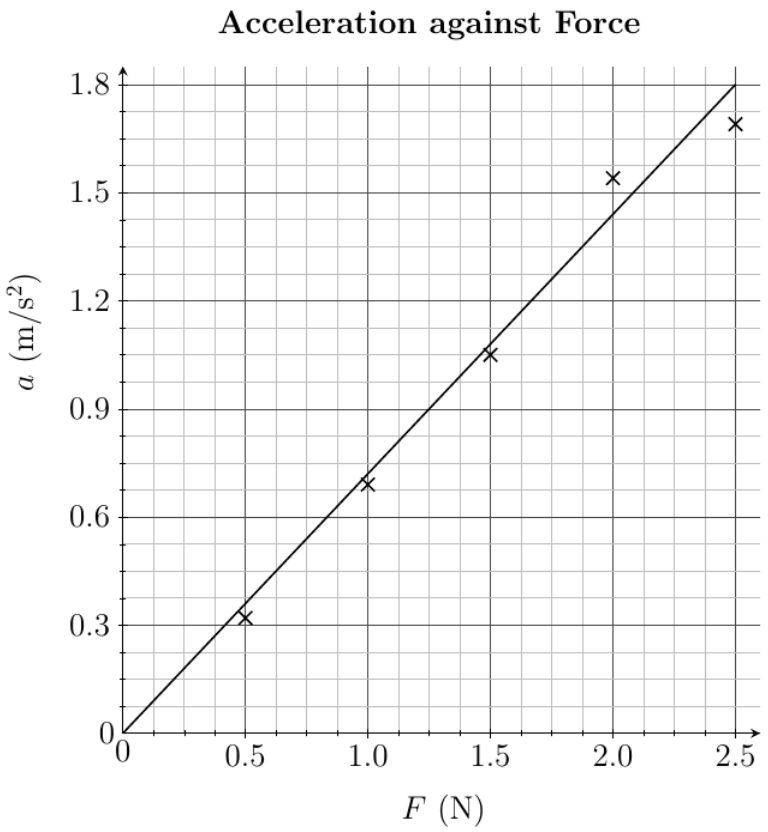
Qn1 [6 marks]
A science class was studying the acceleration of a toy truck that was pulled along a smooth track with a variable force, *F*. The set-up of this experiment is shown below.



The results obtained are shown in the table.

***F* (N)**	***a* (m/s^2)**
0.5	0.32
1.0	0.69
1.5	1.05
2.0	1.54
2.5	1.69

The graph below was plotted using the results.



(a) What is the independent variable in this experiment? **[1 mark][KU]**

Pulling force applied to the truck, F.

(b) It is given that ***F = ma***, where *m* is the mass of the toy truck. **[3 mark]**

Using the graph, determine the mass of the truck.

Two points that lie on the line are (0, 0) and (2.5, 1.8).

Gradient = Rise/Run = (1.8 – 0) / (2.5 – 0) = 0.72

Accept a gradient between 0.6 and 0.9.

Therefore, m = F/a = 1/0.72 = 1.39 kg.

Comments:

- 1 mark: rise/run using reciprocal
- 1 mark: used points from the graph
- 1 mark: correct number with unit

(c) State two things that can be done to improve the *reliability* of this experiment. **[2 marks]**

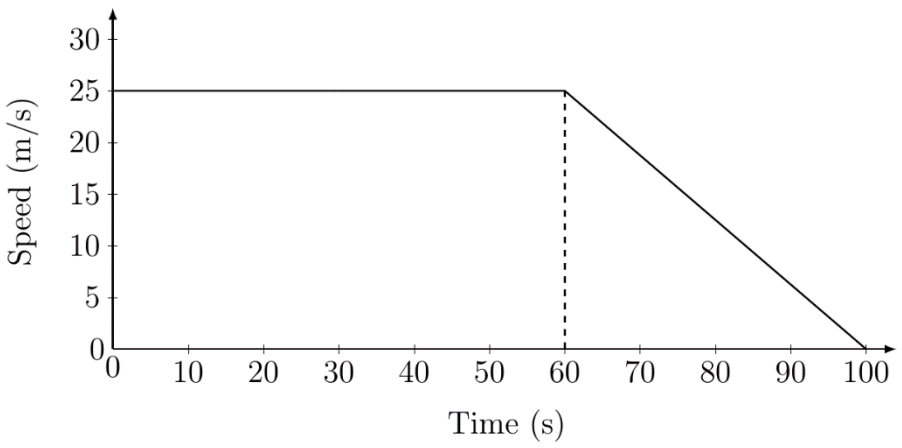
1) Perform more trials/ observations for each variable force e.g. 3 trials on 0.5N.
2) Use more accurate equipment to measure the variables.
3) Fix control variables (e.g., surface of the track, mass of the truck)

Comments:

- Give 1 mark for each valid answer.

Qn2 [4 marks]

The following speed-time graph shows part of a cyclist's journey.



(a) Calculate the average speed of the cyclist in the first 100 seconds. **[2 marks]**

The distance travelled by the cyclist in the first 60 seconds is
60 × 25 = 1,500 m.
The distance travelled by the cyclist in the last 40 seconds is
1/2 × 40 × 25 = 500 m. Comment: *- Give 1 mark for the correct working.*

Therefore, the average speed of the cyclist is
(1500 + 500)/100 = 20 m/s.
Comment: *- Give 1 mark for correctly calculating the average speed.*

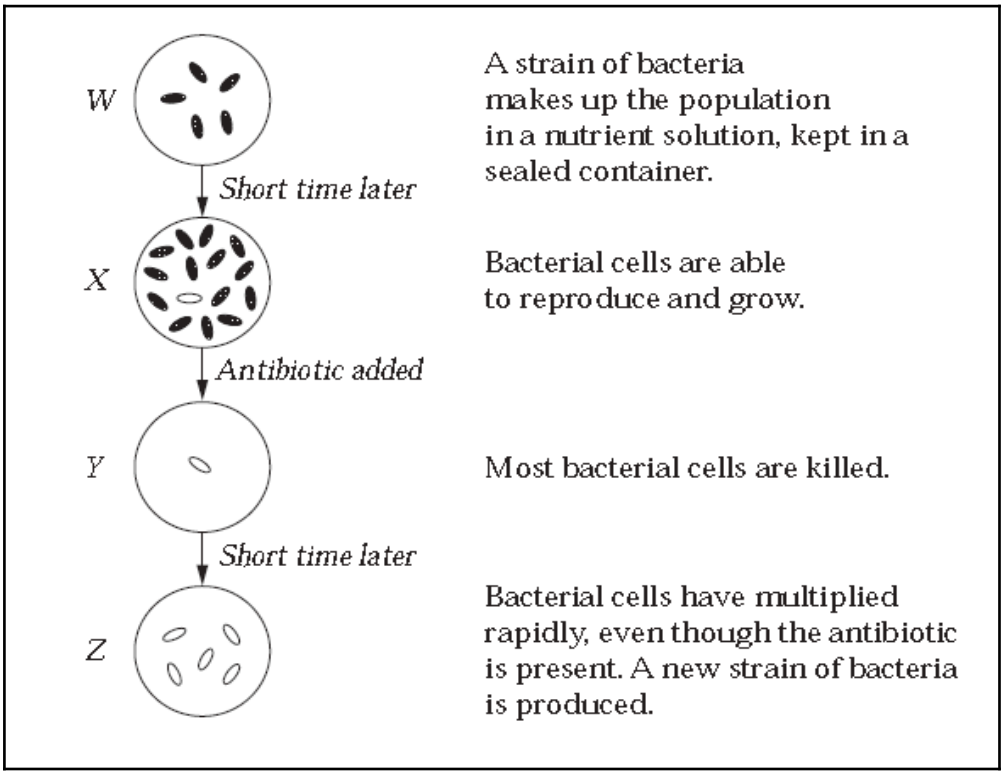
(b) Find the acceleration of the cyclist in the last 40 seconds. **[2 marks]**

a = –25/40 = –0.625 m/s^2.

Comments
- Give 1 mark for dividing 25 by 40.
- Give 1 mark for the correct acceleration with the negative symbol.

Qn3 [5 marks]

The diagram shows natural selection in a bacterial population.



(a) Using the information in the diagram, explain how the process of natural selection has occurred. **[3 marks]**

3 marks	Uses the diagram to explain natural selection, including that a mutation has occurred at X leading to an antibiotic resistant strain allowing it to reproduce and survive. Must refer to the diagram in answer.
2 marks	Uses the diagram to explain natural selection, including that a mutation has occurred at X leading to an antibiotic resistant strain allowing it to reproduce and survive. Does **not** refer to diagrams OR refers to diagrams with brief descriptions of natural selection.
1 mark	May describe natural selection OR describes what is happening in the diagram.

b) DNA mutations can occur when an organism reproduces. Explain why such mutations may be an advantage for its survival. **[2 marks]**

2 marks	Describes why mutations are advantageous as they create variation in a species. The favourable characteristics are then passed on to future generations. OR describes why mutations are advantageous as they create variation in a species and provides an example e.g peppered moth
1 mark	Missing one of the above.

Qn4 [5 marks]
Observe the following segment of DNA below.

Template strand: **AAGTCTGCGAAATTGCACGTA**
Coding strand: **TTCTGACGCTTTAACGUGCAT**

(a) Assuming that the template strand is correct, **circle** the two mistakes **in the coding strand !!!!!** shown and identify what the correct base should be. **[2 marks]**

Mistake 1: A

Mistake 2: T

(b) During transcription, the template strand is copied into mRNA. What would the mRNA strand for the above segment of DNA be? **[1 mark]**

UUCAGACGCUUUAACGUGCAU

(c) Mutations often occur in DNA, and a point insertion or deletion can cause what is known as a frameshift mutation.

Explain what a frameshift mutation is and the effect it may have on a protein. **[2 marks]**

A frameshift mutation is a type of mutation that affects every codon following the point of mutation. This results in a completely different amino acid code and causes significant changes to a protein's structure, which can render the protein dysfunctional.

Comments:
- 1 mark for explaining what a frameshift mutation is.
- 1 mark for identifying that it can change the amino acid sequence of the protein and affect its structure.

Qn5 [3 marks]

In an investigation, 10 ml of sodium chloride solution was mixed with 10 ml silver nitrate solution. The result was the formation of an insoluble white solid of silver chloride.

(Remember: all nitrates are soluble)

(a) Identify the type of chemical reaction that has occurred? **[1 mark]**

Precipitation reaction

(b) Write a balanced chemical equation for this reaction (include their respective state symbols). **[2 marks]**

AgNO3(aq) + NaCl(aq) = AgCl(s) + NaNO(aq)

Comments:
2 marks: Correct chemical formula, balanced and with states
1 mark: Missing 1-2 of the above

Qn6 [7 marks]
Acid rain can corrode structures made of limestone and marble, both of which contain high proportions of calcium carbonate ($CaCO_3$). Vanessa is designing an experiment in order to model the corrosion of limestone by acid rain. She prepares four different beakers A, B, C, and D, each with 5 g of calcium carbonate chips inside.

Vanessa adds a different solution to each beaker. Each solution contains a different ratio of nitric acid (HNO_3) to water as shown in the table below.

Set-Up	**Solution added to each set-up**	
	Volume of Water (mL)	**Volume of Nitric Acid (mL)**
A	0	40
B	10	30
C	20	20
D	30	10

As soon as she pours the solution into the respective beaker, she starts the timer and measures the time taken for all the calcium carbonate to dissolve. Vanessa's measurements are recorded in the table below.

Set-Up	Time Taken for all $CaCO_3$ to dissolve (s)
A	8
B	25
C	48
D	87

(a) Write a word equation for the reaction between nitric acid and calcium carbonate. **[1 mark]**

Nitric Acid + Calcium Carbonate → Calcium Nitrate + Carbon Dioxide + Water

(b) Referring to the kinetic model of matter, explain why increasing the concentration of nitric acid reduces the time taken for the limestone to dissolve. **[3 mark]**

Increasing the concentration increases the number of particles per unit volume, so the frequency of collisions between reactant particles increases. Hence, the rate at which the calcium carbonate is consumed increases (or the rate at which soluble calcium nitrate is produced increases) and so the calcium carbonate dissolves more quickly.

(c) Describe two variables that must be kept constant in order to ensure that a fair test is carried out. **[2 marks][KU]**

Comment: Give 1 mark each for each reasonable answer. Two possible answers include:

1: Temperature of the solution/set-up/reaction container

2: Surface area of the calcium carbonate chips

(d) Apart from the corrosion of structures, describe one negative impact of acid rain on the surrounding environment. **[1 mark]**

Comment: *Give 1 mark for each reasonable answer. An acceptable answer is given below.*

Acid rain can reduce the pH of aquatic environments, which may not be suitable for some marine organisms, leading to the loss of aquatic life.

Qn7 [10 marks]

A student performed an investigation to determine the relationship between the height an object is dropped from and the time it takes to fall.

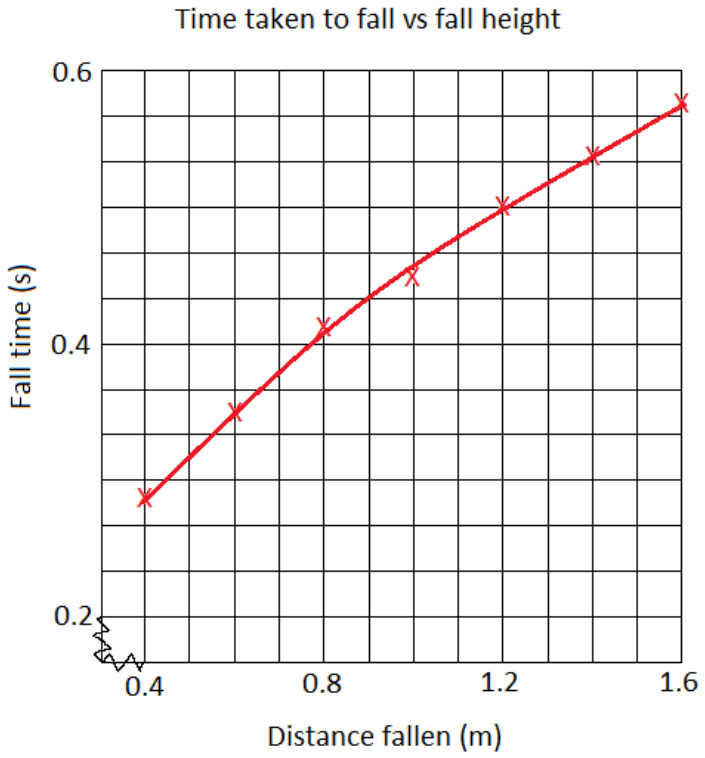
His hypothesis was that doubling the height would double the time it takes to fall.

The student recorded the time taken to fall by dropping a rock various distances as measured by a tape measure and using a stopwatch to time the fall duration.

The student's results are in the table below:

Distance (m)	Fall time (s)
0.4	0.28
0.6	0.35
0.8	0.41
1	0.45
1.2	0.5
1.4	0.54
1.6	0.58

(a) On the axes below, plot and draw a line of best fit for these data. **[5][WS]**



Marking Criteria	Marks
• Line of best fit (curve) graph with appropriate title, axes labelled, units correct, appropriate scale and correct plot.	5
• All of the above with one omission. (note, can be straight line of best fit at this mark level and lower)	4
• All of the above with two omissions.	3
• All of the above with three omissions.	2
• Some reasonable attempt at a graph made.	1

(b) Using your graph, estimate the height needed for the fall to take 0.48 seconds. **[1][WS]**
From the graph, the height would need to be 1.15 metres to take 0.48 seconds to fall.

_____

.

Marking Criteria	Marks
• Correct value for interpolation with reference to graph, with correct unit and reasonable variation allowance.	1

(c) Is the hypothesis supported by the data?
Explain your answer with reference to the graph. **[3][WS]**

The hypothesis that as the height doubles, the time taken to fall doubles is NOT supported by the results of the experiment. As the height increases, the time taken to fall does increase, but it does so at a decreasing rate, and certainly not doubling as the height doubles. Therefore the results do not support the hypothesis.

Marking Criteria	Marks
• Correct response to hypothesis, with conclusion fully supported with reference to the graph.	3
• Correct response to hypothesis, with conclusion partly defended.	2
• Some relevant correct statement(s) made, or correct response to hypothesis.	1

_____

(d) Discuss ONE variable that would require controlling this experiment. **[1][WS]**
The same type of object should be dropped every time

_____

Marking Criteria	Marks
• One variable that would require controlling stated.	**1**

Qn8 [10 marks]

A student carried out some experiments to place four metals, **V**, **W**, **Y** and **Z** in order of reactivity.
Table A shows the results.

Key ✅ shows a reaction happened
❌ shows no reaction happened
➖ shows the experiment was not performed

Table A

	metal **V**	metal **W**	metal **Y**	metal **Z**
Solution of **V** nitrate	➖	❌	❌	❌
Solution of **W** nitrate	✅	➖	✅	✅
Solution of **Y** nitrate	✅	❌	➖	✅
Solution of **Z** nitrate	✅	❌	❌	➖

(a) Place the metals in order of reactivity, starting with the most reactive. **[2][KU]**
(most reactive) V,Z, Y and W
Award 1 mark for at least 2 metals in correct order

_____

(b) Metal Z reacts with nitric acid. What would you see when metal Z reacts with nitric acid? Explain your reasoning. **[2][KU]**
Effervescence/ Bubbling of gas seen

_____
Z will displace/ produce hydrogen from the acid.

_____

_____

(c) Metal V reacts with HCl. What gas is produced from this reaction? And what test can be performed to identify the test. **[2][KU]**
Hydrogen gas produced. Place a **burning splint near the top/ mouth of the test tube** and a **pop sound** can be heard.

_____

_____

_____

(d) Metal V which is present in the form of carbonate chips, and 5g of this carbonate is added to 60mL of 2.0 mol/L of HCl. The graph in **Figure B** shows CO2 is being produced over a period of time.

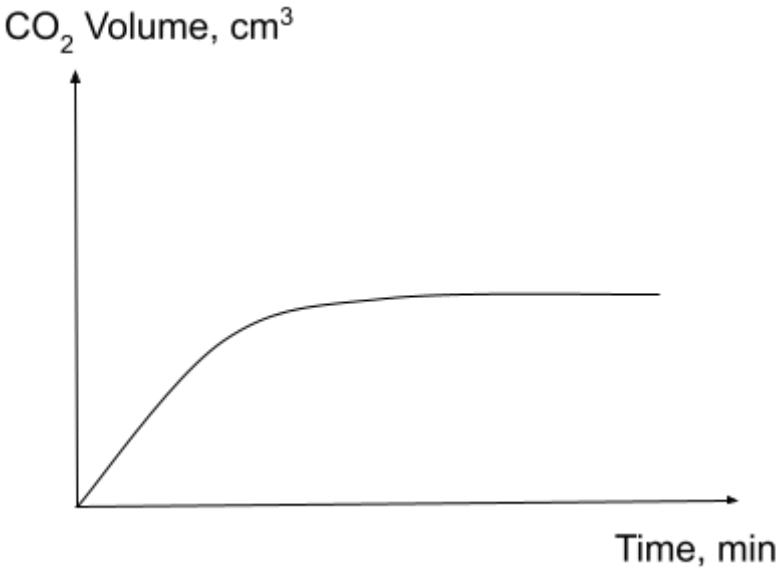


Figure B

The experiment above,

(i) is repeated using the 60.0 cm3 of 1.0 mol/L hydrochloric acid. Add to Figure B the graph that you would expect. Label this graph A. **[2][KU]**
Graph A - Gentler gradient, end slightly later, volume of gas will be halved (less).

(ii) is repeated using the same mass of **powdered** metal **V** carbonate. Add to Figure B the graph that you would expect. Label this graph B. **[2][KU]**
Graph B - Steeper Gradient, same volume of gas obtained, end slightly earlier.

[END OF ASSESSMENT]