



OFFICE OF TASMANIAN  
ASSESSMENT, STANDARDS  
& CERTIFICATION

Tasmanian Certificate of Education  
External Assessment 2017

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# PHYSICAL SCIENCES

## (PSC315114)

### PART 1

Time: 45 minutes

Pages:	16
Questions:	5
Attachments:	Information Sheet

#### Candidate Instructions

1. You **MUST** make sure that your responses to the questions in this examination paper will show your achievement in the criteria being assessed.
2. Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.
3. You should make sure you answer all parts within each question so that the criterion can be assessed.
4. This examination is 3 hours in length. It is recommended that you spend approximately 45 minutes in total answering the questions in this booklet.
5. The 2017 External Examination Information Sheet for Physical Sciences can be used throughout the examination.
6. All written responses must be in English.

On the basis of your performance in this examination, the examiners will provide results on each of the following criteria taken from the course statement:

**Criterion 5** Demonstrate knowledge and understanding of principles of motion and force.

Criterion 5 Total:	/40
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## Additional Instructions for Candidates

Show all working in your answers to numerical questions. Some credit will be given for unsimplified answers. Credit cannot be given for an incorrect answer unless it is accompanied by details of the working. Appropriate units must be included.

**Note:**

When candidates are asked to 'show that':

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Spare diagrams have been provided at the end of the booklet. If you use a spare diagram, please annotate that you have done so on the question that you are answering.

**Question 1**

(a) A 25.0 m long swimming pool faces north-south.

(i) A person swims northwards and stops after travelling 17.0 m. This took 28.0 seconds.

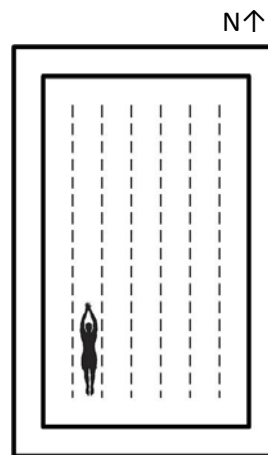
Calculate the average speed for the journey in  $\text{m s}^{-1}$  **and**  $\text{km h}^{-1}$ . (2 marks)

Speed in  $\text{m s}^{-1}$  .....

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Speed in  $\text{km h}^{-1}$  .....

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(ii) On another occasion, the person swims northwards the full length of the pool and returns half way back before stopping. This took 47.0 seconds.

Calculate the average velocity of the swimmer. (1 mark)

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(b) Another swimmer completes an open water race. The competitor swims 3.55 km directly south, then turns east and swims a further 1.71 km. This takes exactly 60.0 minutes.

(i) Sketch a vector diagram to represent the displacement of the swimmer. (1 mark)

**Question 1 continues.**

**Question 1 (continued)**

**For  
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(ii) Calculate the displacement of the swimmer. (2 marks)

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(iii) Calculate the average velocity of the swimmer. (1 mark)

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**Question 2**

The motion of a tennis ball, initially suspended from the ceiling of a building, is illustrated below.

Diagram (i) - The tennis ball is suspended from the ceiling by a short string.

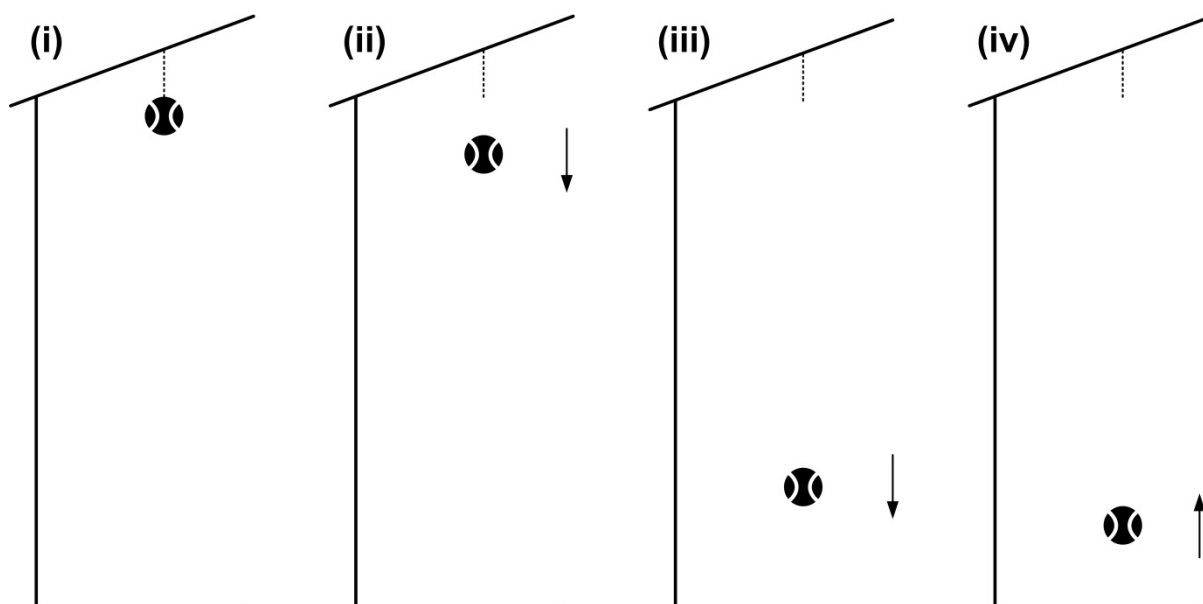
Diagram (ii) - The string is cut and the ball begins to fall.

Diagram (iii) - The ball continues to accelerate as it nears the floor.

Diagram (iv) - The tennis ball is moving upwards after bouncing on the floor.

The arrows indicate the direction of ball movement.

(a) On **each diagram** sketch the force vectors, if any, acting on the ball. (4 marks)



Ignore air resistance when completing the following calculations.

(b) If the ball is released from a height of 15.5 m, show that the speed of the ball on impact with the floor is approximately  $17 \text{ m s}^{-1}$ . (1 mark)

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**Question 2 continues.**

**Question 2 (continued)**

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- (c) Show that it takes the ball approximately 1.8 seconds to hit the floor. (1 mark)

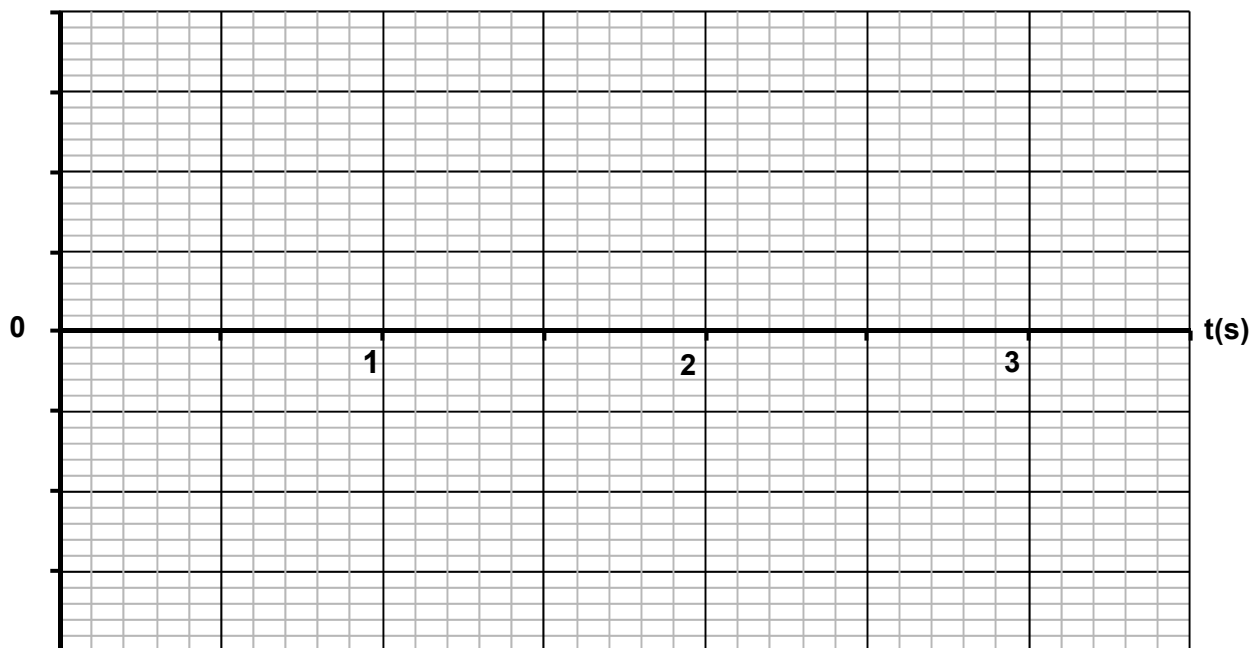
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When the ball hits the floor it bounces. It leaves the floor with a velocity of  $12.3 \text{ m s}^{-1}$  upwards and takes 1.25 seconds to reach its maximum height.

- (d) Calculate the maximum height reached by the ball. (2 marks)

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- (e) In the grid below, plot a velocity versus time graph of the motion of the ball. Include labels and relevant numerical values on the graph. (3 marks)



**Question 3**

A pizza delivery drone carrying three pizzas in a large padded box is taking off **vertically**. The combined mass of the drone and the padded box of pizzas is 5.00 kg.



- (a) Determine the weight of the drone and its load. (1 mark)

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- (b) Determine the force generated by the drone’s propellers to give a vertical acceleration of  $0.750 \text{ m s}^{-2}$ . (2 marks)

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After 3.00 seconds the pizza box accidentally detaches.

- (c) Show that the height of the drone at this time is approximately 3.4 m. (1 mark)

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- (d) Calculate the maximum height reached by the pizza box. (3 marks)

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**Question 3 continues.**



**Question 3 (continued)**

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- (e) It is anticipated that a pizza will occasionally detach during vertical take-off and so a thick foam mat was placed on the ground below the drone. Use **ONE** of Newtons Laws to explain the purpose of the mat. (2 marks)

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- (f) When 8 pizzas are in the box, the drone can only just get off the ground, accelerating very slowly. Explain this slow acceleration. (1 mark)

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- (g) In one unfortunate incident the Yum Yum drone lost control and rose up to nearly 100 m high before releasing the pizza. Onlookers commented that the pizza box reached terminal velocity during its fall. In terms of forces outline what is meant by terminal velocity. (2 marks)

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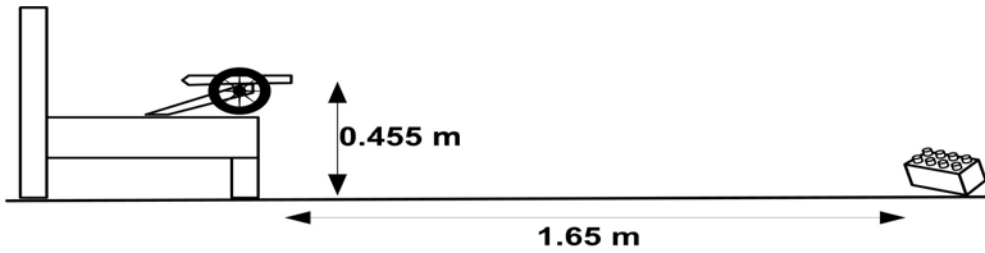
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**Question 4**

A child sets up a toy cannon on the end of a bench so that a projectile can be shot horizontally from a height of 0.455 m at a lego block 1.65 m away.



The toy cannon can shoot a projectile at a speed of  $4.90 \text{ m s}^{-1}$ .

- (a) Show that the projectile will hit the ground in front of the block. (3 marks)

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- (b) Determine the height the cannon will need to be in order for the projectile to hit the block. (2 marks)

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- (c) The child notices that the cannon moves backwards when the projectile is shot. Explain this phenomenon. (2 marks)

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**Question 5**

**For  
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An ice skater of mass 52.8 kg is carrying a 2.10 kg parcel. She is moving to northwards at a constant velocity of  $0.435 \text{ m s}^{-1}$ . In an attempt to stop herself on this frictionless surface she throws the parcel north with a velocity of  $5.16 \text{ m s}^{-1}$ .

By providing relevant calculations show that this will not be sufficient to stop her northerly motion. (3 marks)

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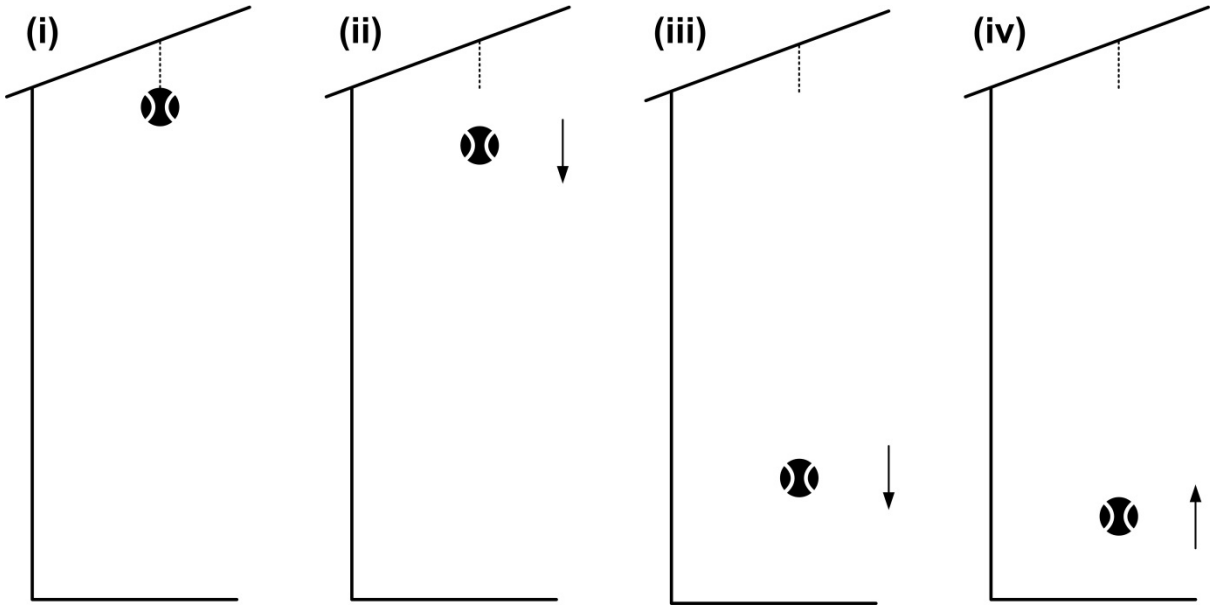
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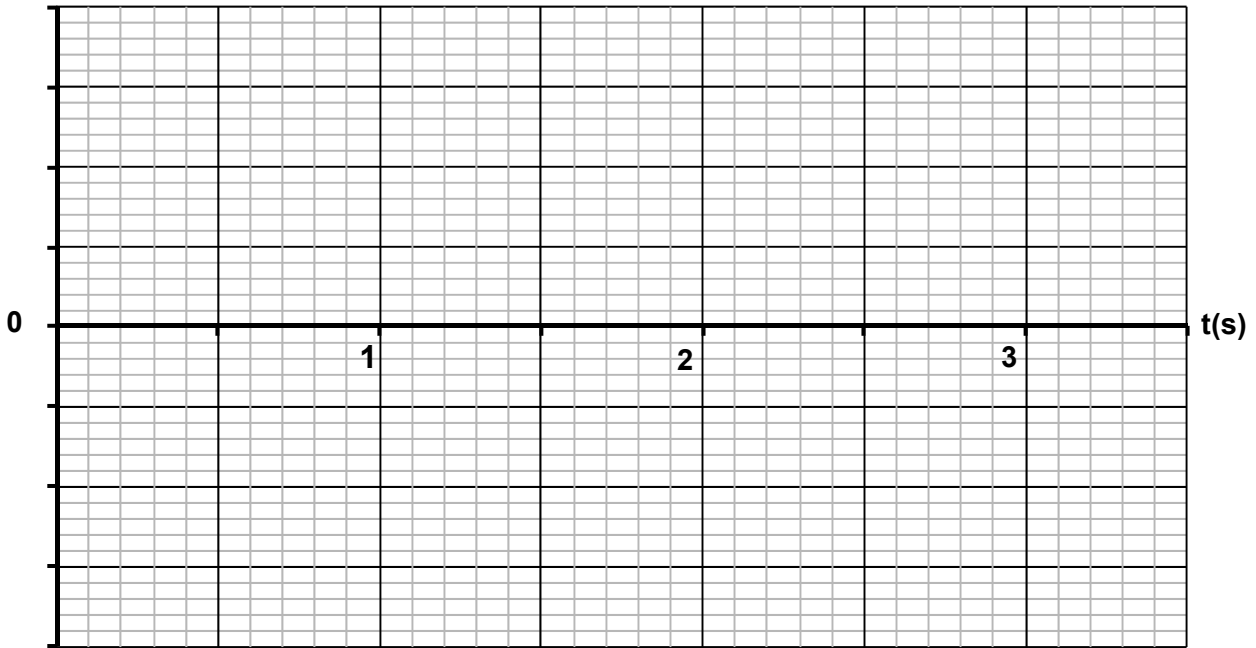
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**SPARE DIAGRAM**

Question 2 (a)



Question 2 (e)



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# PHYSICAL SCIENCES

## (PSC315114)

### PART 2

Time: 45 minutes

Pages:	16
Questions:	6
Attachments:	Information Sheet

#### Candidate Instructions

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On the basis of your performance in this examination, the examiners will provide results on each of the following criteria taken from the course statement:

**Criterion 6** Demonstrate knowledge and understanding of principles of sources and properties of energy.

Criterion 6 Total:	/40
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## Additional Instructions for Candidates

Show all working in your answers to numerical questions. Some credit will be given for unsimplified answers. Credit cannot be given for an incorrect answer unless it is accompanied by details of the working. Appropriate units must be included.

**Note:**

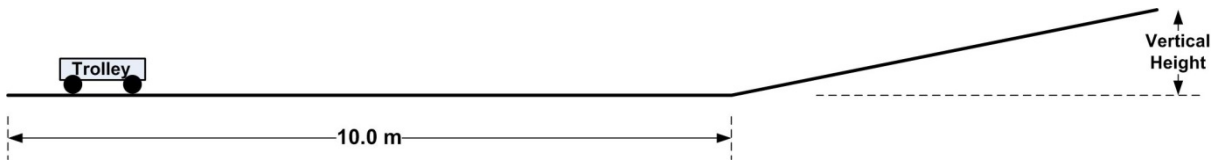
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**Question 6**

A 1.35 kg frictionless trolley is travelling at a constant speed of  $1.96 \text{ m s}^{-1}$  along a 10.0 m section of floor.



- (a) Calculate the kinetic energy of the trolley. (1 mark)

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- (b) At the end of the 10.0 m is an upwards slope. Calculate the vertical height up the slope the trolley can reach. (1 mark)

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- (c) A frictionless trolley with a smaller mass is also travelling along the same floor with the same velocity. Will this trolley be able to reach the same height as the first trolley? Justify your answer. (2 marks)

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- (d) In reality, the 1.35 kg trolley is travelling on a floor that is not frictionless and its forward motion is restricted by a force of 0.065 N opposite to its motion. By first calculating the energy loss due to friction, calculate the kinetic energy of the trolley just before reaching the upwards slope. (2 marks)

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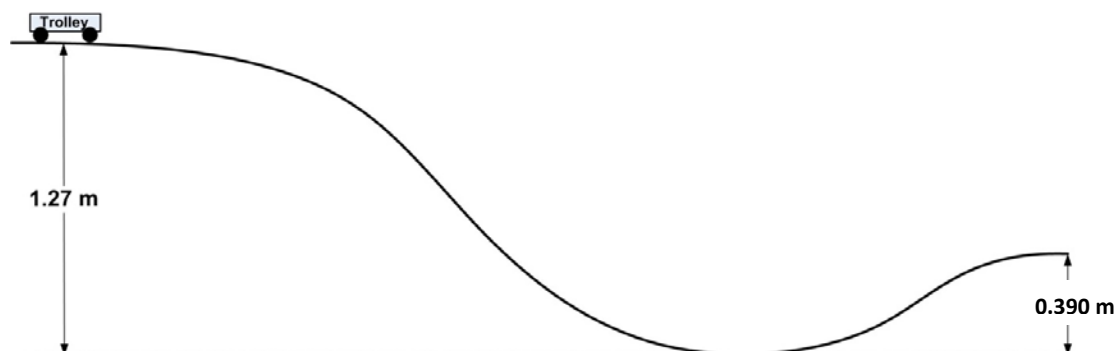
**Question 6 continues.**

**Question 6 (continued)**

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- (e) The same trolley, of mass 1.35 kg, is now placed on a sloping frictionless track as indicated below. It starts with the same initial speed ( $1.96 \text{ m s}^{-1}$ ), but the track starts 1.27 m above the floor and ends 0.390 m above the floor. Calculate the speed of the trolley at the end of the track.

(3 marks)



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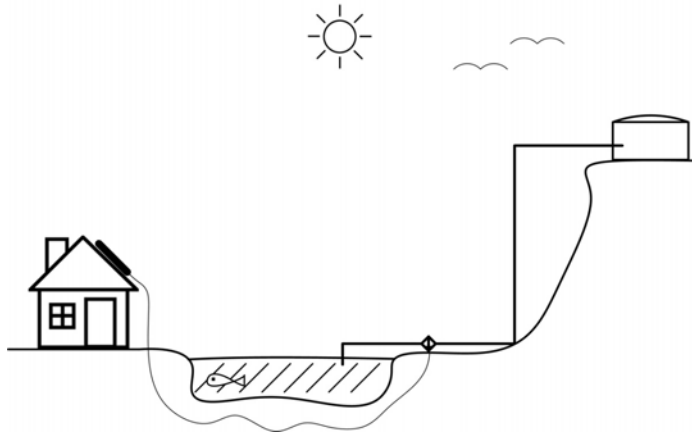
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**Question 7**

A solar panel was installed on top of a house in order to run a water pump that filled a water tank on top of a nearby hill from the dam near the house.



- (a) Outline the energy changes that are occurring when the tank is filling with water. (2 marks)

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- (b) If the water tank is exactly 58 m higher than the pump, show that the amount of energy gained by the  $5.40 \times 10^3$  kg of water is about 3 MJ. (1 mark)

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- (c) How much electrical energy will be needed to fill the water tank assuming the pumping process is 35% efficient? (1 mark)

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- (d) In kWh, how much electrical energy does this represent? (1 mark)

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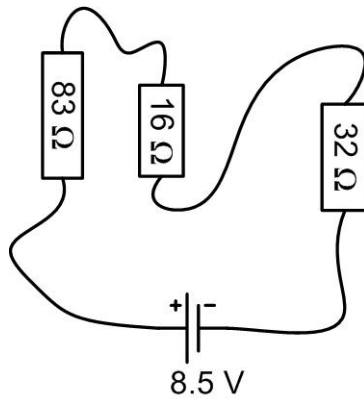
- (e) If the tank needs to be filled in 4 hours, what power must the water pump be rated above? (1 mark)

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**Question 8**

Three resistors are connected to a battery in a laboratory experiment. A student sketch of the situation is displayed below.



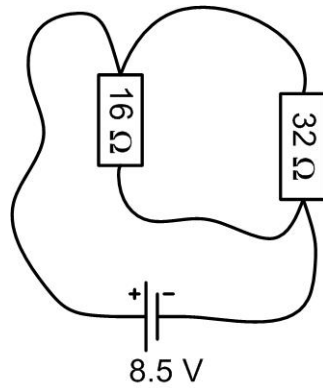
- (a) Calculate the total resistance of the circuit. (1 mark)

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- (b) Calculate the current flowing through the 16 Ω resistor. (1 mark)

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In a second circuit a resistor is removed and the wiring altered. Again a student sketch is displayed below.



- (c) Calculate the total resistance of the circuit. (1 mark)

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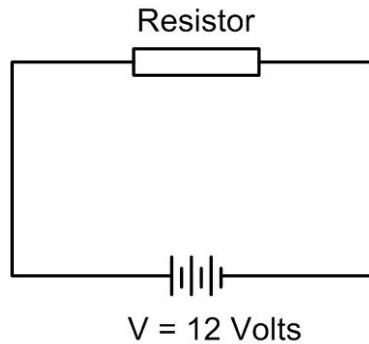
- (d) Calculate the current flowing through the 16 Ω resistor. (1 mark)

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**Question 9**

A circuit diagram of a resistor connected to a battery is sketched below.

- (a) In the circuit diagram below, place an ammeter to measure the current flow through the resistor and a voltmeter to measure the voltage across the resistor. (1 mark)



When the voltage is 12 V the ammeter indicates a current of 300 mA is flowing.

- (b) Calculate the amount of charge flowing through the resistor every second. (1 mark)

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- (c) How many electrons pass through the resistor every second? (1 mark)

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- (d) Calculate the power output of the resistor. (1 mark)

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**Question 9 continues.**



**Question 9 (continued)**

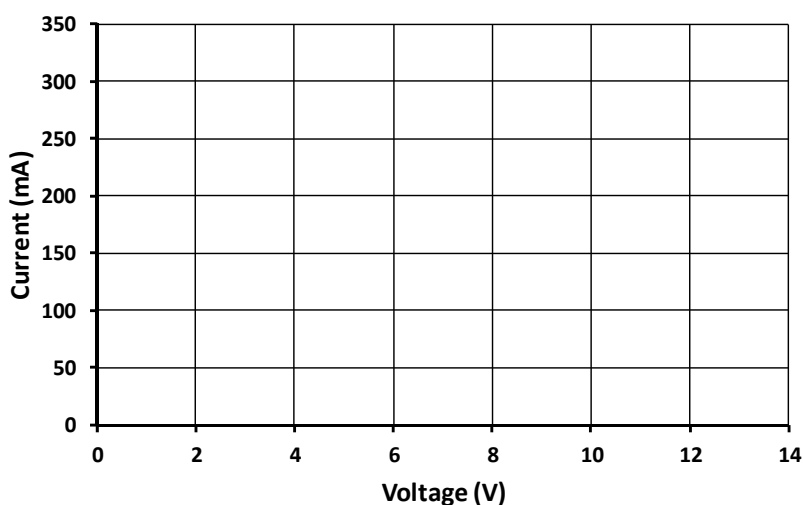
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The relationship between current and voltage of the resistor was investigated. When 12 V is applied the ammeter indicates a current of 300 mA is flowing.

- (e) On the grid below, sketch a line to show the relationship between current and voltage, assuming the resistor is acting as an ohmic device. Label this line as (e). (1 mark)

The resistor is replaced by a light bulb which also draws a current of 300 mA at 12 V.

- (f) On the same grid, sketch a second line indicating the light bulb acting as a non-ohmic device. Label this line as (f). (1 mark)



**Question 10**

Many elements have several naturally occurring isotopes, some of which are radioactive.

- (a) The most common isotope of the element carbon has six protons, six neutrons and six electrons in each atom. Write the symbol for another isotope of carbon and indicate the number of each subatomic particle present. (1 mark)

Symbol: .....

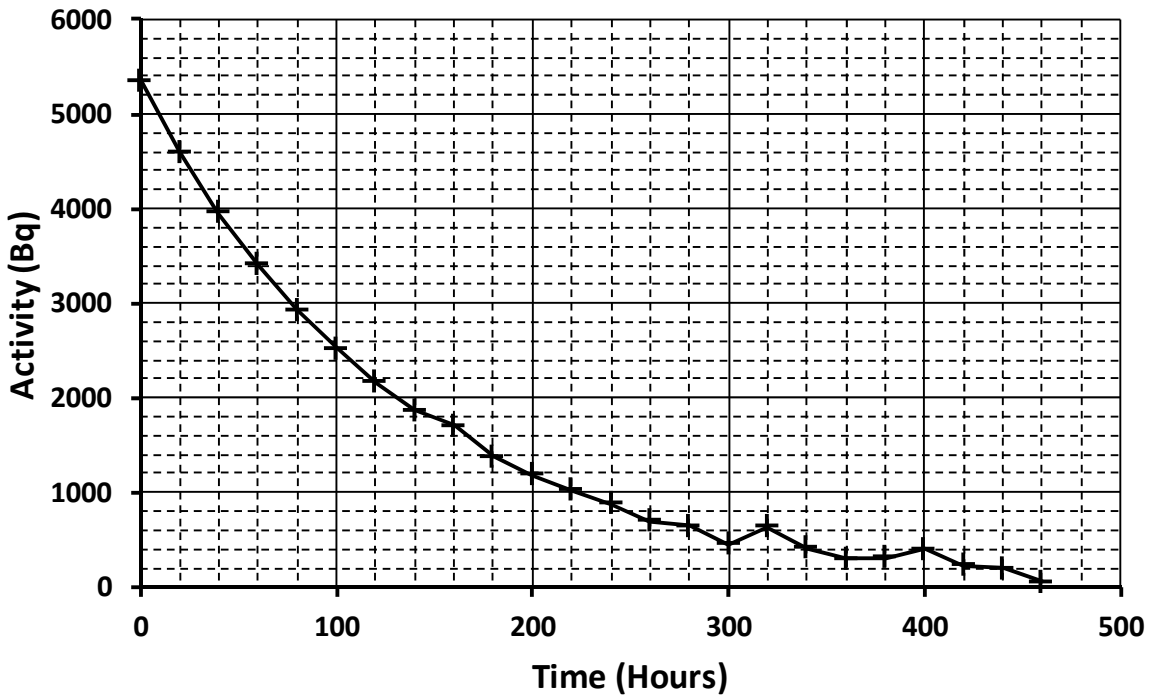
Subatomic particles: .....

A radioactive isotope of radon is radon-222 which emits an alpha particle.

- (b) Write the alpha decay equation for radon-222. (2 marks)

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The activity of a radon-222 sample was monitored over 460 hours. The following graph, corrected for background radiation, was obtained.



- (c) Use the graph to determine the half-life of radon-222. (1 mark)

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**Question 10 continues.**

**Question 10 (continued)**

- (d) The data points are joined to highlight that the graph above is not completely smooth and some variation is present, particularly after 300 hours. What caused this variation in activity? (1 mark)

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The graph has been corrected for background radiation.

- (e) What is background radiation? (1 mark)

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- (f) Identify the difference between background radiation and other types of radiation, for example, mobile phones and fluorescent lights. (1 mark)

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Since radon is a dense gas it can collect in the basement of poorly ventilated buildings. In the USA it is claimed that the decay of radon is the second largest cause of lung cancer behind smoking.

- (g) Outline how the alpha decay of radon-222 can cause lung cancer in humans. (3 marks)

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**Question 11**

**For  
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Nuclear reactors are present in many countries around the world. A fuel for nuclear reactors is uranium-235 and the reaction taking place is termed a fission reaction.

- (a) Write a nuclear equation for the fission of uranium-235 via bombardment with a neutron producing two different elements, one of which is barium-139, and three neutrons. (2 marks)

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A nuclear reaction can produce a chain reaction.

- (b) By including a diagram of uranium fission, explain what is meant by a nuclear chain reaction. (2 marks)

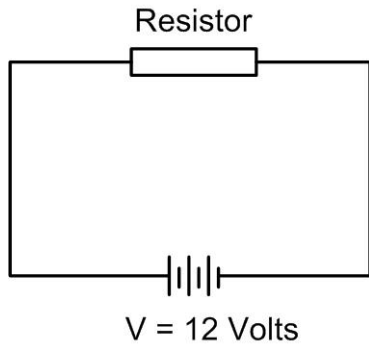
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- (c) Discuss the implication of having controlled or uncontrolled nuclear chain reactions. (1 mark)

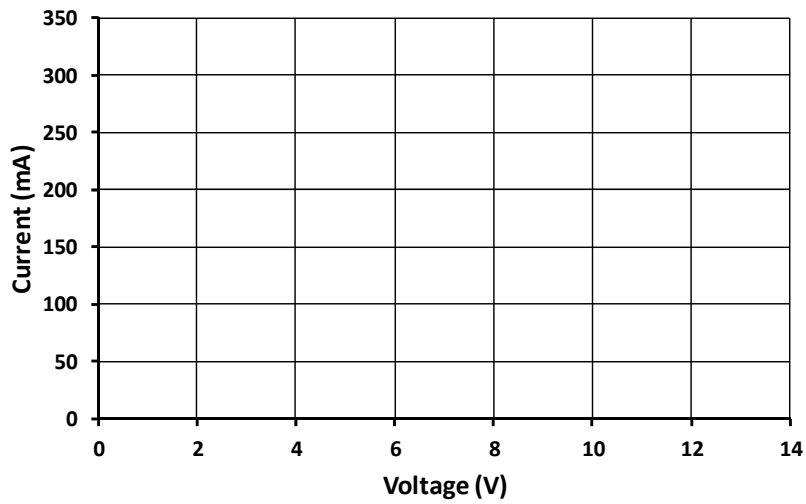
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SPARE DIAGRAMS

**Question 9 (a)**



**Question 9 (e) and (f)**



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# PHYSICAL SCIENCES

## (PSC315114)

### PART 3

Time: 45 minutes

Pages:	16
Questions:	7
Attachments:	Information Sheet

#### Candidate Instructions

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On the basis of your performance in this examination, the examiners will provide results on each of the following criteria taken from the course statement:

**Criterion 7** Demonstrate knowledge and understanding of the principles of chemical fundamentals: structures and properties.

Criterion 7 Total:	/40
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**Question 12**

Complete the first two columns in the table below by giving either a name or a chemical formula. In the third column, answer the question asked.

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The first row has been completed as an example.

(4 marks)

Systematic Name	Chemical Formula	
Dihydrogen oxide	H <sub>2</sub> O	Type of particles present in liquid? <i>Answer: molecules</i>
Tin		Name the particles present in the solid.
	SO <sub>3</sub>	Type of structure.
	CuCl <sub>2</sub>	State at room temperature.
Calcium permanganate		Symbol of ions present in aqueous solution.

**Question 13**

**For  
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(a) Draw an electron dot diagram of a dihydrogen sulfide,  $\text{H}_2\text{S}$ , molecule. (1 mark)

(b) In terms of structure, explain why dihydrogen sulfide,  $\text{H}_2\text{S}$ , is a gas at room temperature whereas sodium sulfide,  $\text{Na}_2\text{S}$ , is a solid. (3 marks)

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**Question 14**

There are two common isotopes of neon, namely  $^{20}\text{Ne}$  and  $^{22}\text{Ne}$ .

(a) When a sample of neon is analysed the isotopic composition is:

Isotope	Mass number	Percentage abundance
$^{20}\text{Ne}$	20	90.2
$^{22}\text{Ne}$	22	9.80

(i) Based on this information, calculate the relative atomic mass of the neon sample tested. (2 marks)

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(ii) The correctly calculated value of the relative atomic mass of the sample from part (i) varies from that given on page 6 of the 2017 External Examination Information Sheet. Give **ONE** reason why the values differ. (1 mark)

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(b) Neon is in group 18.

(i) Predict the chemical reactivity of neon. (1 mark)

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(ii) Provide a reason for your answer. (1 mark)

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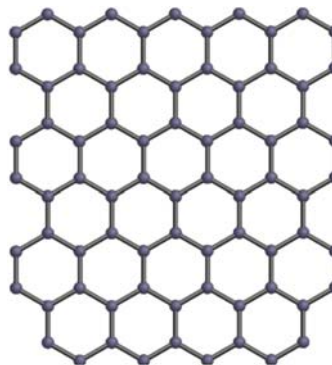
(c) Would the reactivity of the two isotopes be the same or different? (1 mark)

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**Question 15**

Graphene is an **allotrope** of carbon. It is a two-dimensional lattice of pure carbon where carbon atoms are bonded together in a hexagonal honeycomb lattice, as shown in the diagram.



**For  
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- (a) What is meant by the term **allotrope**? (1 mark)

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- (b) Predict if graphene will conduct electricity. Explain your answer. (2 marks)

Prediction: .....

Explanation: .....

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- (c) Predict if graphene has a high melting point. Explain your answer. (2 marks)

Prediction: .....

Explanation: .....

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**Question 16**

**For  
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Period 2 of the Periodic Table starts with the element lithium.

- (a) In terms of electron configuration, what does each of the elements in period 2 have in common? (1 mark)

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- (b) A compound formed from two of the elements in period 2 has the formula  $X_3Y_2$ . To what **groups** do X and Y belong? (1 mark)

Group number of X: .....

Group number of Y: .....

- (c) Excluding neon, which element in period 2 has the largest atomic radius? Explain your choice. (2 marks)

Element: .....

Explanation: .....

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- (d) Consider lithium fluoride and carbon tetrafluoride, two compounds formed between period 2 elements.

Explain why lithium will only form one type of bond when it forms compounds, yet fluorine will form more than one type of bond. (3 marks)

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**Question 16 continues.**



**Question 16 (continued)**

**For  
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Group 1 of the Periodic Table as shown in the 2017 External Examination Information Sheet includes hydrogen.

- (e) In terms of electron configuration, what does each of the elements in group 1 have in common? (1 mark)

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- (f) Give reason(s) why hydrogen **should not** be included in group 1. (2 marks)

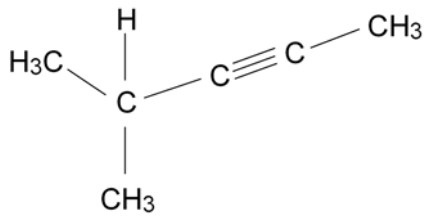
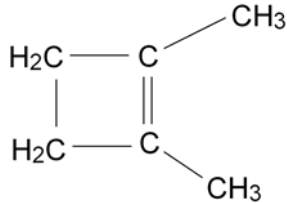
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**Question 17**

(a) Complete the following table.

(4 marks)

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Substance	Systematic Name	Structural Formula
X	2-chloro-2-methylpropane	
Y		
Z		

When answering the rest of the question it is sufficient to identify the relevant organic compound by the letters X, Y or Z, if appropriate, rather than by their systematic name.

(b) Which compounds, if any, are isomers? Justify your answer. (1 mark)

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**Question 17 continues.**

**Question 17 (continued)**

**For  
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Only**

- (c) Compound Z will undergo a reaction with hydrogen chloride gas,  $\text{HCl}_{(g)}$ . Draw the **structural formula** of the product. (1 mark)

Structure:

- (d) Which of the compounds will react with bromine at the slowest rate at room temperature? Explain your answer. (2 marks)

Compound: .....

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Explanation: .....

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**Question 18**

**For  
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A homologous series of hydrocarbons has the **empirical formula CH<sub>2</sub>**.

One member of the series has the formula C<sub>x</sub>H<sub>y</sub>.

When the hydrocarbon C<sub>x</sub>H<sub>y</sub> undergoes complete combustion 1 mole of C<sub>x</sub>H<sub>y</sub> produces 3 mole of carbon dioxide gas.

- (a) Determine the molecular formula of this hydrocarbon. (1 mark)

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- (b) Write a balanced chemical equation for the complete combustion of the hydrocarbon. (2 marks)

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Tasmanian Certificate of Education  
External Assessment 2017

PLACE YOUR CANDIDATE  
LABEL HERE

# PHYSICAL SCIENCES

## (PSC315114)

### PART 4

Time: 45 minutes

Pages:	12
Questions:	7
Attachments:	Information Sheet

#### Candidate Instructions

1. You **MUST** make sure that your responses to the questions in this examination paper will show your achievement in the criteria being assessed.
2. Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.
3. You should make sure you answer all parts within each question so that the criterion can be assessed.
4. This examination is 3 hours in length. It is recommended that you spend approximately 45 minutes in total answering the questions in this booklet.
5. The 2017 External Examination Information Sheet for Physical Sciences can be used throughout the examination.
6. All written responses must be in English.

On the basis of your performance in this examination, the examiners will provide results on each of the following criteria taken from the course statement:

**Criterion 8** Demonstrate knowledge and understanding of principles of chemical reactions and reacting quantities.

Criterion 8 Total:	/40
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## Additional Instructions for Candidates

Show all working in your answers to numerical questions. Some credit will be given for unsimplified answers. Credit cannot be given for an incorrect answer unless it is accompanied by details of the working. Appropriate units must be included.

**Note:**

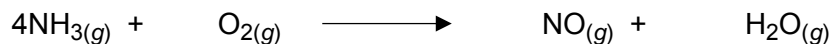
When candidates are asked to 'show that':

- a candidate should calculate their own answer to the appropriate number of significant figures and use this subsequently.
- a candidate who is unable to determine the required value should use the value given by the examiner in subsequent questions

**Question 19**

**For  
Marker  
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- (a) (i) The following chemical equation has been **partly** balanced. Complete the balancing of this equation. (1 mark)



- (ii) Give the chemical name of each of the **reactants**. (1 mark)

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- (b) Write a balanced chemical equation to represent the following reaction.

Zinc metal reacts with dilute sulfuric acid solution to give zinc sulfate solution and hydrogen gas. (2 marks)

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- (c) Lead(II) nitrate solution is added to sodium bromide solution.

- (i) Write a balanced net ionic equation to represent the chemical reaction occurring. (2 marks)

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- (ii) Identify the spectator ions present. (1 mark)

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**Question 20**

**For  
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Only**

1.00 g of phosphorus reacts with oxygen, forming 2.29 g of an oxide of phosphorus.

- (a) Calculate the mass of oxygen reacted. (1 mark)

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- (b) Determine the empirical formula of the oxide of phosphorus. (2 marks)

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- (c) If 0.20 mole of the oxide has a mass of 56.78 g, calculate the molar mass of the oxide. (1 mark)

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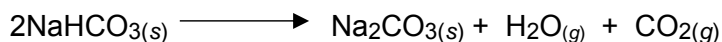
- (d) Hence determine the molecular formula of the oxide of phosphorus. (1 mark)

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### Question 21

Pure solid sodium hydrogen carbonate,  $\text{NaHCO}_{3(s)}$ , will undergo decomposition when placed in an evaporating basin and gently heated.

The balanced chemical equation representing the reaction is given below:



For  
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Use  
Only

A 3.25 g sample of sodium hydrogen carbonate was **completely** converted to the products shown.

- (a) Show that there is about  $4 \times 10^{-2}$  mole of sodium hydrogen carbonate,  $\text{NaHCO}_{3(s)}$ , in the 3.25 g sample. (2 marks)

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- (b) Calculate the mass of carbon dioxide,  $\text{CO}_2$ , produced by this reaction. (2 marks)  
( $M_r(\text{CO}_2) = 44.01$ .)

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- (c) Describe a simple test carried out in a school laboratory that will verify that carbon dioxide is a product. (1 mark)

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- (d) Suggest why the sodium carbonate produced is pure. (1 mark)

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**Question 22**

Dihydrogen sulfide, H<sub>2</sub>S, is a poisonous gas.

The recommended maximum exposure limit over a 10-minute period is **15 mg/m<sup>3</sup>**.

- (a) Calculate the number of dihydrogen sulfide molecules in 1 L of air at this level of exposure. (3 marks)

Useful information:      1000 L = 1 m<sup>3</sup>  
   M(H<sub>2</sub>S) = 34.08 g mol<sup>-1</sup>

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Dihydrogen sulfide, H<sub>2</sub>S, is **slightly soluble** in water, forming a weak acid.

- (b) Define the term **weak acid**.

As part of your answer write a balanced chemical equation to represent what happens when dihydrogen sulfide gas dissolves in water. The HS<sup>-</sup> ion is formed when the gas dissolves in water. (2 marks)

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- (c) Is it possible to make a concentrated aqueous solution of this slightly soluble dihydrogen sulfide?

Justify your answer, making reference to what is meant by the term concentrated in your answer. (2 marks)

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**Question 23**

**For  
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Only**

Outline **ONE** simple chemical test that can be carried out using test tubes to show a difference between samples of solid sodium chloride, NaCl, and solid sodium carbonate, Na<sub>2</sub>CO<sub>3</sub>.

As part of your answer:

- Name the chemical used in the test
  - Give the expected observation(s)
  - Write the balanced chemical equation to represent any reaction occurring.
- (4 marks)

Chemical used: .....

Observations: .....

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Chemical equation(s): .....

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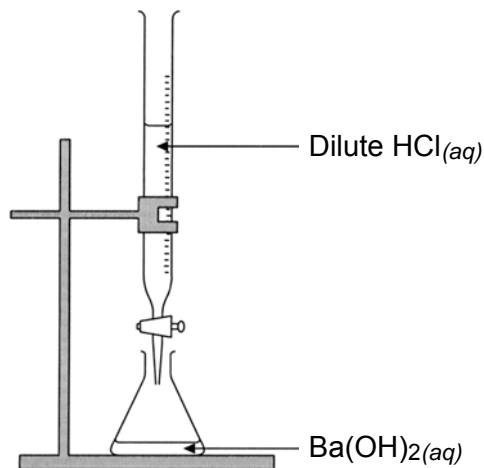
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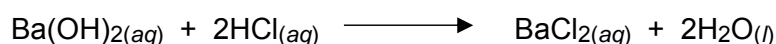


### Question 24

Titration techniques are used to determine the concentration of a sample of barium hydroxide solution using a solution of hydrochloric acid of known concentration.



The reaction occurring in the flask is given by the chemical equation:



- (a) Predict how the pH in the flask containing the barium hydroxide solution will change as the titration proceeds. At least one numerical value for the pH is expected in your answer. (1 mark)

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- (b) 23.7 mL of a solution of hydrochloric acid, of concentration  $0.120 \text{ mol L}^{-1}$ , was required to react completely with 25.0 mL of barium hydroxide solution.

Determine the concentration of the barium hydroxide solution. (3 marks)

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**Question 25**

**For  
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A calcium chloride solution,  $\text{CaCl}_{2(aq)}$ , of concentration  $5.70 \text{ mol L}^{-1}$  is prepared.  
( $M_r(\text{CaCl}_2) = 111.0$ ).

- (a) Calculate the mass of anhydrous calcium chloride,  $\text{CaCl}_2$ , which must be dissolved in 250 mL of solution to prepare the solution of this concentration. (2 marks)

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- (b) Determine the concentration of the chloride ion,  $\text{Cl}^-_{(aq)}$ , in this solution. (1 mark)

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- (c) The maximum amount of anhydrous calcium chloride that will dissolve in water at room temperature is 74.5 g/100 mL. This is called a saturated solution.

Is the prepared solution a saturated solution of calcium chloride? Justify your answer mathematically. (2 marks)

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- (d) After preparing the solution using the mass calculated in part (a), it was discovered that hydrated calcium chloride,  $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}_{(s)}$ , had been used instead of anhydrous calcium chloride.

Would the chloride concentration in the resulting solution be **more than, the same as, or less than** that calculated in part (b)? Justify your answer. (2 marks)

Prediction: .....

Justification: .....

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