

External Assessment 2024

PHYSICAL SCIENCES

PSC315118

Section **A**

Pages: 12

Questions: 4

Information Sheet: 1

Preparation time for this exam: 15 minutes

Suggested working time: 36 minutes

Instructions:

- Answer **all** questions and **all** items within each question.
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- The exam is **three (3) hours** in length. The suggested working time for this section is **approximately 36 minutes**.
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- The Physical Sciences Information Sheet can be used throughout the exam.
- All answers must be written in **English**.
- You **must** make sure your answers address the listed criterion.

Marker use

C4

/ 36

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Additional Instructions

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Section E	5	5	36 minutes	36 marks
Totals	25	25	180 minutes (3 hours)	180 marks

Criterion

You **must** make sure your answers address:

- Criterion 4 apply concepts and processes of atomic properties and nuclear reactions.

Question 1

Marker use

Most elements exist as a number of naturally occurring isotopes, for example ^{12}C and ^{13}C are two of carbon's isotopes.

- a) Draw a model of each of these isotopes. Show electrons in shells and indicate the number of protons and neutrons.

Model of ^{12}C	Model of ^{13}C
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- b) Identify a feature of your models which shows:

- i. the difference between the **two (2)** isotopes.

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- ii. **two (2)** similarities between the isotopes.

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- c) On an imaginary planet, chemists discover that carbon atoms consist of 35.5% ^{12}C and 20.0% ^{13}C . The remainder is ^{14}C . Calculate the relative atomic mass of carbon on this imaginary planet.

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Question 1 continues

Question 1 continued

Marker use

d) What feature of the nucleus of atoms found on this imaginary planet would tell the chemists that they had found carbon atoms, despite the different isotopic abundances?

/1

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e) Carbon-14 is radioactive and emits beta particles. Write a nuclear equation to show this.

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**Total
Q1**

/11

Question 2

Marker use

Sodium, magnesium, lithium and potassium are all extremely important metals both industrially, and in biological systems.

- a) Arrange the elements in order of **increasing atomic radius** (Hint: write the smallest one first and get larger).

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- b) Justify your answer to Part a) above.

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- c) Write the electron configuration of a magnesium atom.

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- d) Write the symbol and electron configuration of a **magnesium ion**.

/2

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- e) **Using the elements listed above**, identify **one (1)** other **ion** with the same electron configuration as the magnesium ion.

/1

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Total
Q2
/8

Question 3

Marker use

The production of elements beyond uranium in the Periodic Table was a major achievement in nuclear science.

- a) Americium-240 can be produced, along with another product, by bombarding plutonium-239 atoms with a neutron. Write a balanced nuclear equation for this reaction.

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- b) Bombarding plutonium-239 atoms with an alpha particle produces curium-242 along with another product. Write a balanced nuclear equation for this reaction.

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- c) The neutrons used to produce Am-240 can be relatively slow whereas the alpha particles used to produce Cm-242 must be relatively fast. Suggest reasons for this.

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- d) Identify **three (3)** safety precautions that people working with radioisotopes can take to minimise the potential for harm.

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Total
Q3
/9

Question 4

Radon-222 is a radioactive gas which decays by alpha emission. A graph of the activity of a sample of Rn-222 is shown below.

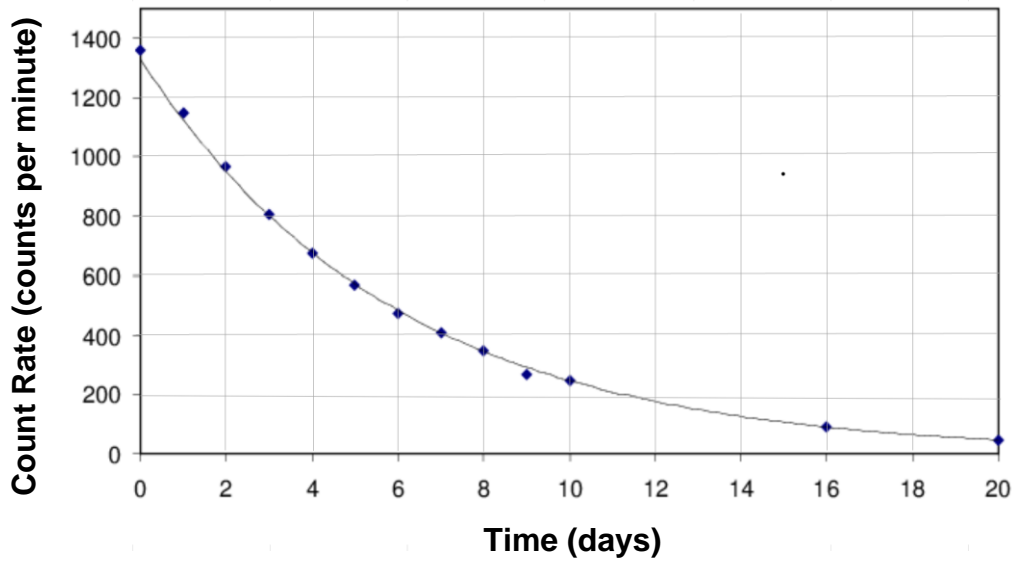


Figure 1: Graph showing activity of Rn-222.

Image Source: https://www.researchgate.net/figure/The-decay-curve-of-Rn-222-present-in-scintillator-oil_fig5_259609205

a) Estimate the half-life of Rn-222 from this graph. Show your working on the graph.

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b) Write the decay equation for Rn-222.

/1

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c) As stated above, radon-222 is a gas and emits alpha particles. Americium-241 also emits alpha particles. It is a solid with a half-life of 432 years.

/3

Why would exposure to Rn-222 be much more dangerous than exposure to the same mass of Am-241.

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Question 4 continues

Question 4 continued

Marker use

- d) How long will it take for a sample of americium-241 to decay to less than 12.5% of its original activity?

/2

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**Total
Q4
/8**

End of Section A
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External Assessment 2024

PHYSICAL SCIENCES

PSC315118

Section **B**

Pages: 16

Questions: 5

Information Sheet: 1

Suggested working time: 36 minutes

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Marker use

C5

/ 36

Additional Instructions

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Criterion

You **must** make sure your answers address:

- Criterion 5 apply concepts and processes of motion and force.

Question 5

Marker use

A yacht sails 1500 m west in 1200 s and then 2750 m north in 2300 s. At this time it reaches a mooring and stops there, tied up to the mooring.

a) Show that the average speed of the yacht was approximately 1 ms^{-1} .

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Figure 2: A moored yacht.

Image source: <https://twogetlost.com/mooring-ball>

b) Calculate the displacement of the yacht. Include a diagram in your answer.

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/3

c) A speedboat leaves from where the yacht started, 45 minutes (2 700 s) after the yacht leaves and travels directly to the mooring. Calculate the speedboat's velocity if it is to reach the mooring at the same time as the yacht.

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Total
Q5
/6

Question 6

Marker use

A diver steps off the side of a boat with an initial (vertical) velocity of 0.00 m s^{-1} . The diver and their equipment have a combined mass of 85.8 kg .



a) If the water is 1.55 m below the side of the boat, show that the magnitude of the diver's speed upon hitting the water is approximately 5.5 m s^{-1} .

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Figure 3: A person dressed in dive gear stepping off the boat into the water.
Image source: <https://www.searchscuba.com/blog/post/water-entry/>

b) When the diver hits the surface of the water their velocity slows to 0.50 m s^{-1} . Calculate the diver's change in momentum (impulse) when they hit the surface.

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/2

c) i. As the diver descends (moves downwards) they start to accelerate downwards again. Draw a labelled diagram to show **the forces** affecting the diver's motion as they descend.



Figure 4: Cartoon of a diver to be labelled.

/1

Question 6 continues

Question 6 continued

Marker use

- ii. As the diver descends their velocity increases from 0.50 m s^{-1} to 2.11 m s^{-1} in 3 s. Calculate the magnitude of the unbalanced force acting on the diver as they descend.

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- iii. Calculate the upwards force (the buoyant force) on the diver as they descend.

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Total
Q6
/7

Question 7

Marker use

A child throws a ball vertically upwards at 7.75 m s^{-1} , and the ball leaves the child's hand 1.25 m above the ground.

a) Calculate the maximum height above the ground reached by the ball.

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b) The child does not try to catch the ball as it falls. Show that the velocity of the ball as it hits the ground is approximately 9 m s^{-1} downwards.

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c) Calculate the total time it takes the ball to hit the ground after leaving the child's hand.

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Question 7 continues

Question 7 continued

Marker use

- d) The child does not try to catch the ball as it falls to the ground because they are afraid that it will hurt their hands if they catch it.

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State Newton's Second Law, and use this Law to explain **one (1)** thing the child could do or use to make contact with the falling ball less painful.

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Total
Q7
/9

Question 8

Marker use

Susan lives on the third floor of an apartment building that faces a forest. She has been learning to use a bow and arrow by shooting arrows horizontally from her balcony into the trees in the forest.



Her arrow leaves the bow with a horizontal velocity of 120.0 km h^{-1} forwards.

a) Show that the arrow leaves the bow at approximately 30 m s^{-1} forwards.

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Figure 5: A person holding a bow and arrow.

Image source: <https://www.alamy.com/stock-photo/woman-archer.html>

b) Instead of travelling until it hits the ground, the arrow sticks into a tree 15.5 m away from Susan. Show that it takes the arrow approximately 0.5 s to reach the tree.

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c) Calculate the vertical velocity with which the arrow hits the tree.

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d) Draw a vector diagram of the arrow's motion as it hits the tree and calculate its angle of impact with the tree.

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/1

/1

/3

Question 8 continues

Question 8 continued

Marker use

- e) If Susan lives 12.7 m above the ground, calculate the height above the ground at which the arrow hits the tree.

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**Total
Q8
/ 8**

Question 9

Marker use

The graph in Figure 6 shows the motion of a student doing a physics experiment.

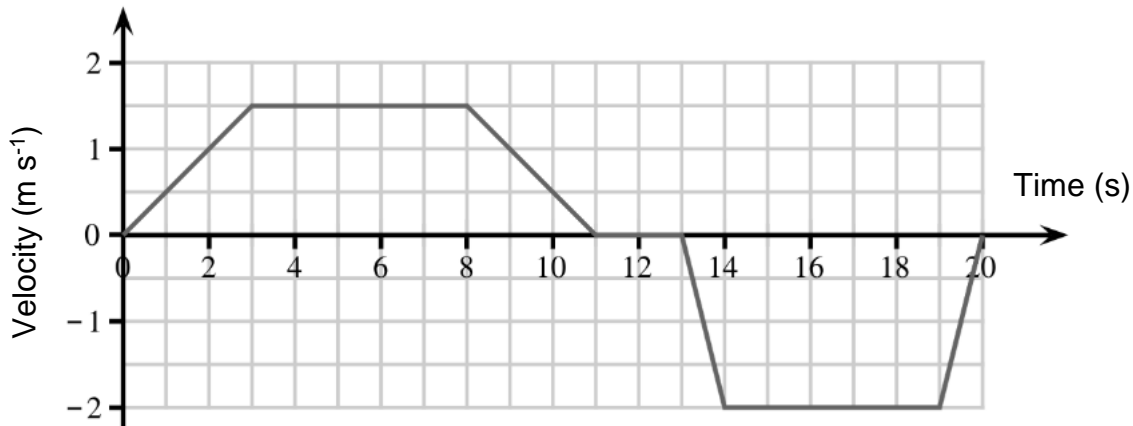


Figure 6: Graph showing motion during a physics experiment.

Image source: https://isaacphysics.org/questions/step_up_7_q5?stage=all

a) During which **period(s) of time** was the student:

i. stationary?

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/1

ii. moving backwards?

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/1

b) Use Figure 7 to draw an acceleration/time graph for this motion for the first 13 seconds, including an appropriate scale on the y-axis.

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/2

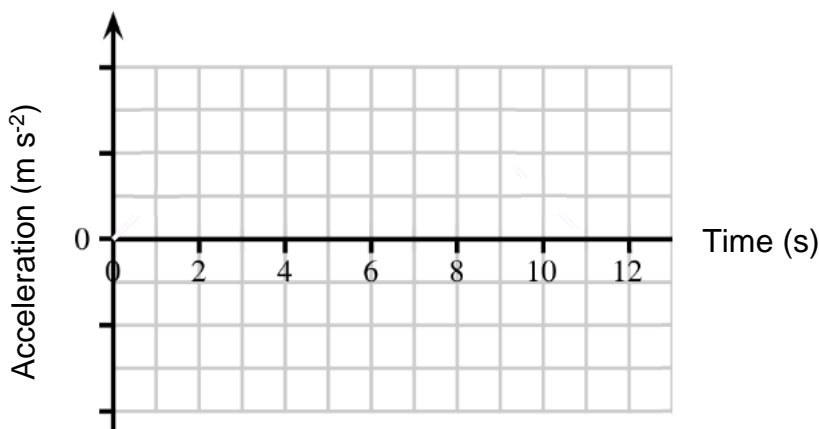


Figure 7: Graph showing motion during a physics experiment.

Image source: https://isaacphysics.org/questions/step_up_7_q5?stage=all

Spare diagram used (X)

Question 9 continues

Question 9 continued

Marker use

- c) Use the velocity-time graph to calculate the displacement of the student over the whole 20 seconds.

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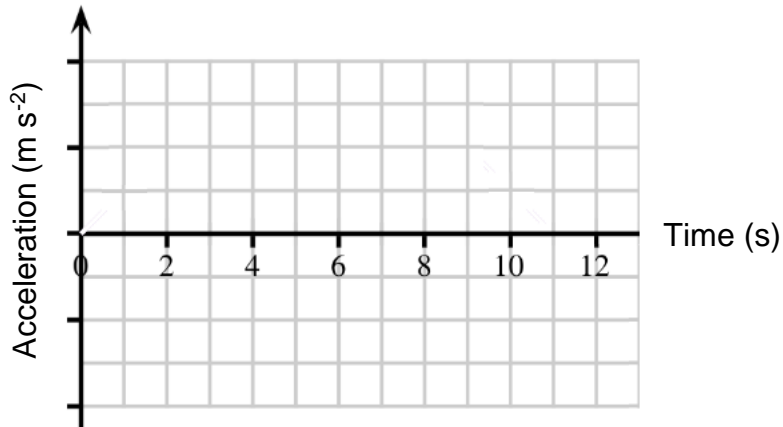
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**Total
Q9
/6**

Spare Diagram

Question 9 b)



End of Section B
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PHYSICAL SCIENCES

PSC315118

Section **C**

Pages: 16

Questions: 5

Information Sheet: 1

Suggested working time: 36 minutes

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Marker use

C6

/ 36

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Additional Instructions

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Criterion

You **must** make sure your answers address:

- Criterion 6 apply concepts and processes of conservation in physics.

Question 10

Marker use

When a person is ice skating, there is very little friction between their skates and the ice. In this question, assume that the force of friction can be ignored.



Figure 8: Photo of ice skates on ice.

Image source: <https://weatherology.com/trending/articles/Ice-Slippery-Subject.html>

A ball of mass 5.50 kg is thrown with a velocity of 10.5 m s⁻¹ North at a stationary child standing on ice and wearing ice skates, as shown above. The ice skater's mass is 35.6 kg.

a) Show that the momentum of the ball is approximately 60 kg m s⁻¹ North.

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The ice skater can react in one of two ways when the ball reaches them.

b) Calculate the velocity of the ice skater if:

/2

i. they catch the ball.

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Question 10 b) continues

Question 10 b) continued

Marker use

- ii. they allow the ball to collide with them but do not catch it. The ball rebounds with a velocity of 2.45 m s^{-1} South.

/2

**Total
Q10
/5**

Question 11

Marker use

A truck of mass 14,600 kg is travelling along the highway at 27.8 m s^{-1} (100 km h^{-1}) when the driver realises that his brakes have failed. Luckily, they are able to roll onto a safety-ramp, inclined at 15° relative to the road, as shown in Figure 9.

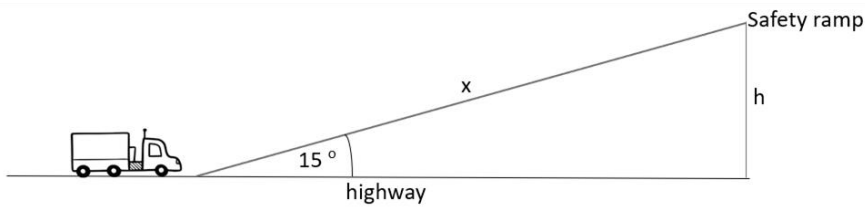


Figure 9: Diagram of truck driving along a highway, approaching a safety ramp.

- a) Show that the kinetic energy of the truck as it enters the safety ramp is approximately $6 \times 10^6 \text{ J}$.

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- b) Identify the energy change that occurs as the truck rolls up the ramp.

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- c) Assuming that friction can be ignored, calculate the truck's speed when it has achieved a vertical height of 10 m above the highway.

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- d) Assuming that friction can be ignored, calculate the height of the truck once it has stopped ("h" in Figure 9).

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Question 11 continues

Question 11 continued

Marker use

e) In fact, friction cannot be ignored, and the truck comes to a stop when it is only 25.5 m above the highway.

i. Calculate the work done by friction on the truck as it travels up the safety ramp.

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ii. Calculate the minimum ramp length required to stop the truck (25.5 m above the highway).

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iii. Calculate the magnitude of the frictional force on the truck as it travels up the ramp.

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**Total
Q11
/12**

Question 12

a) In order to investigate circuits, a student sets up a circuit containing:

- One light bulb.
- One switch.
- One 1.5 V cell.
- An ammeter to read the current through the bulb.
- A Voltmeter to read the voltage across the bulb.

/2

Using circuit notation and this equipment, draw a circuit that allows the current through the bulb, and the potential difference across the bulb to be measured.

b) Identify the energy changes occurring when the switch is closed.

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The student's teacher then provides the two circuits shown below. These circuits contain **12.0 V** batteries.

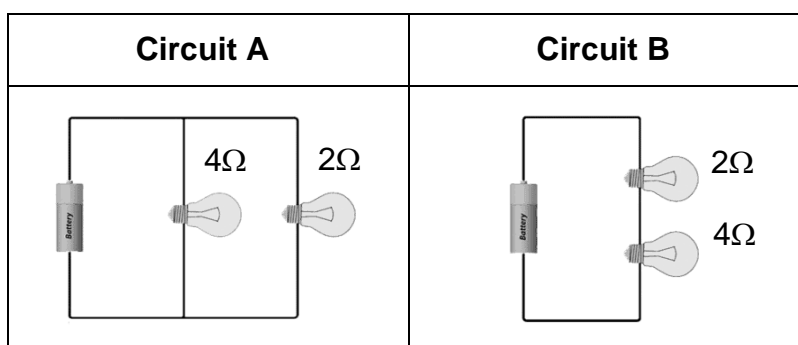


Figure 10: Diagram of two circuits.

Question 12 continues

Question 12 continued

Marker use

c) Calculate the **total resistance** in **Circuit A** (Figure 10).

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d) Calculate the **current** flowing across the **4Ω bulb** in **Circuit A** (Figure 10).

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e) Calculate the **voltage drop** across the **4Ω bulb** in **Circuit B** (Figure 10).

/3

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**Total
Q12
/8**

Question 13

Another circuit, Circuit C, is set up as shown, also with a power-pack set to 12.0 V, and a 9W globe.

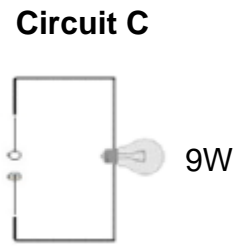


Figure 11: Diagram of circuit.

a) Calculate the **resistance** of the bulb in **Circuit C** (Figure 11).

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b) How much does it cost to use the light globe in **Circuit C** (Figure 11) **continuously for one week** if electricity is charged at 28c per kWh? Give your answer to the nearest cent.

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/1

The bulb in Circuit C (Figure 11) is replaced with an ohmic resistor.

c) Show that the resistor is ohmic by drawing a line on the graph paper below, starting your line with the point already plotted.

/1

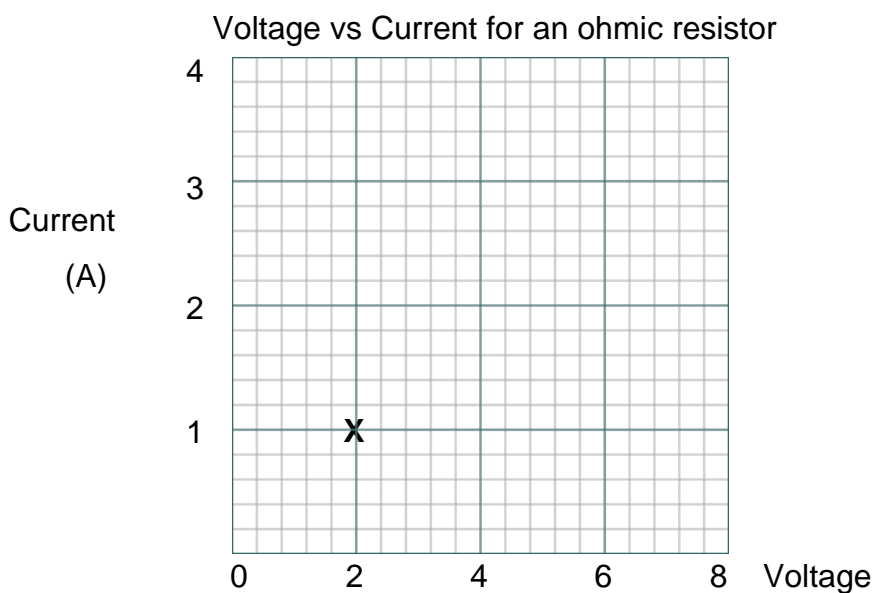


Figure 12: Graph for sketching your answer to 13 c).

Spare diagram used (X)

Question 13 continues

Question 13 continued

Marker use

d) Calculate the resistance of the resistor in Question 13 c).

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e) Is it valid to plot a point at (0,0) on Figure 12? Explain your answer.

/1

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**Total
Q13
/5**

Question 14

Marker use

Jason enjoys camping so he bought a camper van with a solar panel, as shown in Figure 13. Jason has also installed a battery to operate his fridge, and some other devices in the van.



Figure 13: Photo of camper van and solar panel.

Image source: <https://gabtravelling.com/solar-power-set-up-van/>

When the battery is fully charged it holds 220 “amp hours” of total charge. One “amp hour” is 1 ampere supplied for an hour.

- a) How many coulombs does 220 “amp hours” represent?

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/1

- b) Calculate the current that Jason’s 250 W solar panel is producing when operating at 12.5 V

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/1

- c) The fridge draws 6.0 amps and runs on 12 volts. Show that its resistance is 2 ohms.

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/1

- d) As stated above, Jason’s battery is rated at 12 V, and can deliver 220 A for 1 hour. Calculate the amount of stored energy it contains when fully charged, in kWh.

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/1

Question 14 continues

Question 14 continued

Marker use

e) In winter, Jason buys a 12 V heater with a resistance of 1.5Ω . He connects the heater to the battery in parallel with the fridge.

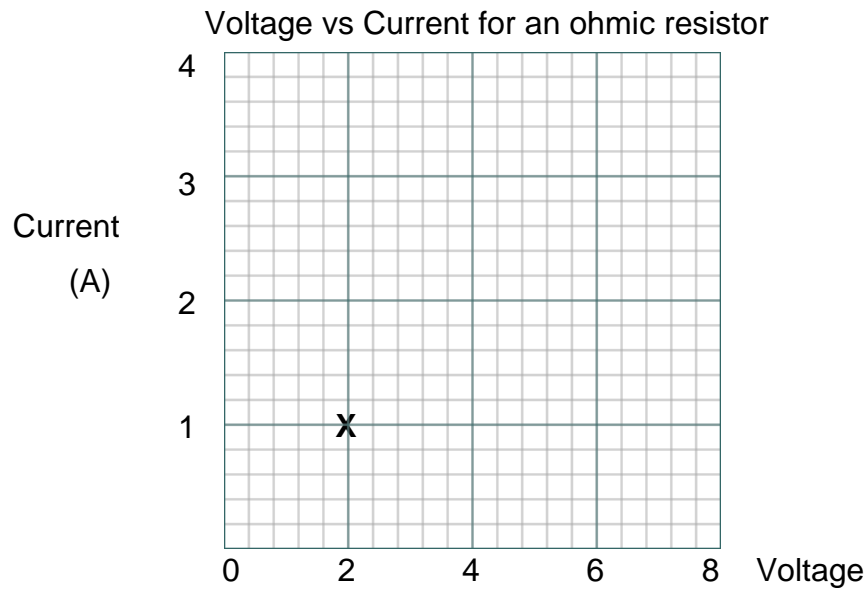
How will connecting these devices in parallel affect the time he can use them? Explain your answer.

/2

**Total
Q14
/6**

Spare Diagram

Question 13 c)



End of Section C
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PHYSICAL SCIENCES

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Section **D**

Pages: 12

Questions: 6

Information Sheet: 1

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Marker use	
C7	/ 36

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Criterion

You **must** make sure your answers address:

- Criterion 7 apply concepts and processes of chemical structures and properties.

Question 15

Marker use

Complete Table 1, giving the name or formula as required.

Name	Formula
Nitrogen gas	
	OCl_2
Copper(II) oxide	
	Fe_2S_3
Silver phosphate	
	ZnSO_4
Propyne	
	The straight-chain isomer of $\text{C}_{10}\text{H}_{22}$

Table 1

/4

Total
Q15

/4

Question 16

Marker use

The following elements, labelled A – F (**not** their real chemical symbols), have the electron configurations shown in the table below. When you answer the questions that follow, use the symbols A – F as shown in *Table 2*.

A	B	C	D	E	F
2	2,8,1	2,1	2,8,6	2,8,8	1

Table 2

a) Identify the element(s) in Period 3.

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/1

b) Identify the element(s) in Group 1.

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/1

c) Identify the noble gas(es).

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/1

d) Write the formula of the compound formed between elements C and D.

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/1

e) In the space below, draw the electron-dot (Lewis) diagram of the compound formed between elements D and F.

/1

f) Identify the charge on the ion formed by element D **and** write the electron configuration of its ion.

/1

Ion: Electron configuration:.....

**Total
Q16**

/6

Question 17

Marker use

Hydrocarbons can be used for a variety of purposes including as fuels, and as starting materials in chemical synthesis.

- a) Complete Table 3 to compare how a molecule of ethane and ethene **react with a molecule of Cl₂**.

	Ethane	Ethene
Name the reaction (if any).		
Name the product(s) formed.		
Draw the structure of the organic product(s).		

Table 3

- b) Using molecular formulas, write the equation for the complete combustion of **but-1-ene**.

.....

- c) Name a **saturated** isomer of **but-1-ene** and draw its structural formula.

Name

Structural formula:

/5

/2

/1

Question 17 continues

Question 17 continued

Marker use

- d) **Butane** and **calcium oxide** have the same molar mass. Butane has a low boiling point: -1°C , yet the boiling point of calcium oxide is 2850°C .

Account for this very large difference in boiling points.

/3

Total
Q17
/11

Question 18

Marker use

Sodium is a well-known example of a Group I element, and chlorine is a well-known example of a Group VII element.

a) Describe the structure of a sample of sodium metal.

/2

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b) When sodium and chlorine react together, a compound is formed that conducts electricity when it is molten and when it is aqueous.

/1

Identify the feature of the molten and aqueous compound that allows it to conduct electricity.

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c) The Group I and Group VII elements react readily together, but the two groups show the opposite trend in reactivity – Group I elements become more reactive moving down the group, whereas elements in Group VII become less reactive.

/4

Explain why these **two (2)** groups show the opposite trend in reactivity.

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**Total
Q18
/7**

Question 19

Marker use

A precipitation reaction occurs when calcium nitrate solution reacts with sodium carbonate solution. Write the following equations to represent this reaction.

a) Balanced chemical equation (“neutral species equation”), including states.

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b) Net ionic equation.

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c) Identify the spectator ions when calcium nitrate reacts with sodium carbonate.

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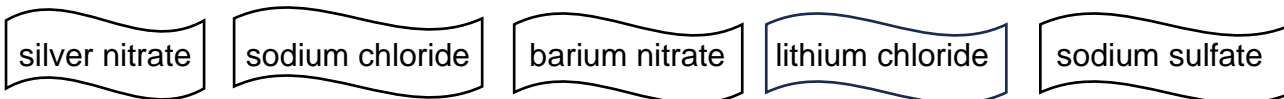
**Total
Q19
/4**

Question 20

Marker use

Labels have fallen off some chemical containers, and are laying on the floor. Therefore, the Laboratory Manager knows what the chemicals are, just not which is which.

The labels are:



The Laboratory Manager decides to do some reactions with the chemicals. She labels the reactions A – E and reacts them together in pairs. Her results are shown below:

	A	B	C	D	E
A	-	-	-	-	-
B	No reaction	-	-	-	-
C	No reaction	No reaction	-	-	-
D	No reaction	No reaction	White ppt	-	-
E	White ppt	White ppt	White ppt	No reaction	-

Table 4

a) Based on these results, identify chemicals C, D and E.

- i. C.....
- ii. D.....
- iii. E.....

/3

b) Sodium chloride and lithium chloride react the same way in precipitation reactions and hence these reactions are not suitable to distinguish between them.

/1

Identify the type of test that can distinguish between sodium chloride and lithium chloride.

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Total
Q20

/4

End of Section D
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External Assessment 2024

PHYSICAL SCIENCES

PSC315118

Section **E**

Pages: 12

Questions: 5

Information Sheet: 1

Suggested working time: 36 minutes

Instructions:

- Answer **all** questions and **all** items within each question.
- Write your answers in the spaces provided in this exam paper.
 - Show working in answers to numerical questions and use appropriate units. Marks may not be given to answers without working.
- The exam is **three (3) hours** in length. The suggested working time for this section is **approximately 36 minutes**.
- TASC approved scientific calculators can be used throughout the exam.
- The Physical Sciences Information Sheet can be used throughout the exam.
- All answers must be written in **English**.
- You **must** make sure your answers address the listed criterion.

Marker use	
C8	/ 36

Additional Instructions

- Note: When you are asked to “**show that**”:
 - You should calculate your own answer to the appropriate number of significant figures and then use this value to answer the following item(s) of the question.
 - If you are unable to determine the required value, you should use the value given in the following items of the question.

Guide to Exam Structure

	Questions available	Questions to answer	Suggested working time	Marks available
Section A	4	4	36 minutes	36 marks
Section B	5	5	36 minutes	36 marks
Section C	5	5	36 minutes	36 marks
Section D	6	6	36 minutes	36 marks
Section E	5	5	36 minutes	36 marks
Totals	25	25	180 minutes (3 hours)	180 marks

Criterion

You **must** make sure your answers address:

- Criterion 8 apply concepts and processes of chemical reactions and reacting quantities.

Question 21

Marker use

Sulfuric acid, H_2SO_4 , is the most widely produced industrial chemical in the world.

a) Show that the molar mass of H_2SO_4 is approximately 100 g mol^{-1} .

/1

.....

b) Show that there are approximately 0.05 mole of H_2SO_4 in 4.6 g.

/1

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.....

c) Calculate the number of hydrogen atoms in 4.6 g of H_2SO_4 .

/1

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d) Calculate the concentration (in mol L^{-1}) of sulfuric acid when 4.6 g are dissolved in 250 mL of water.

/1

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e) How would you expect the pH of the solution formed in Question d) to compare with the pH of nitric acid of the same concentration? Explain your answer.

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**Total
Q21**

/7

Question 22

Marker use

A geochemist working in a mine on Tasmania's west coast finds a mineral with the following percentage composition:

- Mg: 28.8 %
- C: 14.2 %
- O: 57.0 %.

a) Show that the empirical formula of this compound is MgCO_3 .

/2

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b) One of the ways that geochemists confirm the identity of a mineral is to test it using hydrochloric acid.

/2

Write a balanced chemical equation for the reaction of $\text{MgCO}_3(\text{s})$ with hydrochloric acid, including states.

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c) A solution of 0.1 mol L^{-1} hydrochloric acid initially has a $\text{pH} = 1$. Solid MgCO_3 is added to it until all of the acid has reacted. Outline how the pH of the solution changes as this occurs.

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d) Magnesium metal does not react with acid in the same way as magnesium carbonate.

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Write a balanced chemical equation to show the reaction of magnesium with hydrochloric acid.

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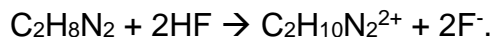
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Q22

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Question 23

Marker use

Ethylene diamine ($C_2H_8N_2$) reacts with hydrogen fluoride (HF) as shown:



a) Identify what is meant by a “Bronsted-Lowry” acid.

.....

/1

b) Identify the Bronsted-Lowry acid in the equation above.

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/1

c) In one experiment, 50.00 g of HF reacted completely with ethylene diamine.

i. Calculate the number of moles of HF that reacted.

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/1

ii. How many moles of $C_2H_{10}N_2^{2+}$ were produced in the reaction?

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/1

iii. What mass of $C_2H_{10}N_2^{2+}$ was produced in the reaction?

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/1

**Total
Q23**

/5

Question 24

Marker use

Citric acid is found in citrus fruits such as lemons. Its molecular formula and molar mass are shown below.



Citric acid
 $C_6H_8O_7$
Molar mass =
 192.1 g mol^{-1}

Figure 14: Pictures of citrus products, citric acid formula and molar mass.

- a) Citric acid is a weak acid. Explain what is meant by “weak acid”, and illustrate your answer with an equation using acetic (ethanoic) acid.

/2

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To analyse lemon juice for its citric acid content, a chemistry student carried out a titration of some diluted commercial lemon juice.

- Step 1. A 20.00 mL sample of commercial lemon juice was transferred to a 200.0 mL volumetric flask.
- Step 2. The volumetric flask was filled to the mark with distilled water and mixed by inversion.
- Step 3. 25.00 mL aliquots of the diluted lemon juice were transferred to conical flasks, and 2 drops of phenolphthalein indicator were added.
- Step 4. The diluted lemon juice samples were titrated with $0.1234 \text{ mol L}^{-1} \text{ NaOH (aq)}$.

The titration equation is $C_6H_8O_7(aq) + 3NaOH(aq) \rightarrow Na_3C_6H_5O_7 + 3H_2O(l)$ and the results of the analysis are shown in Table 5.

Question 24 continues

Question 24 continued

Marker use

Titration:	Rough	1	2	3
Concentration of NaOH (mol L)	0.1234	0.1234	0.1234	0.1234
Vol. diluted lemon juice used (mL)	25.00	25.00	25.00	25.00
Initial burette volume (mL)	0.00	15.75	30.25	0.20
Final burette volume (mL)	15.75	30.25	44.65	14.50
Titre (mL)	15.75	14.50	14.40	

Table 5

b) Calculate the missing value for the titre in Titration 3.

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/1

c) Show that the average titre is about 14 mL.

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/1

d) Calculate the average number of moles of NaOH used in the titration.

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e) Calculate the concentration of citric acid (in mol L⁻¹) in the diluted lemon juice.

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/2

Question 24 continues

Question 24 continued

Marker use

- f) The lemon juice used in the titration was obtained by diluting 20.00 mL of commercial lemon juice to 200.00 mL. Calculate the concentration of citric acid in **g L⁻¹** in the commercial (ie undiluted) lemon juice and give your answer to the correct number of significant figures.

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**Total
Q24
/9**

Question 25

Marker use

When sodium metal reacts with water, the products are sodium hydroxide and hydrogen gas. In a classroom demonstration, a teacher adds 6.5 g of sodium metal to 1.0 L of water.

a) Write a balanced chemical equation for this reaction.

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b) Calculate the mass of hydrogen gas produced in the reaction.

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c) Ignoring the water that reacts with the sodium, calculate the concentration of sodium hydroxide at the end of the reaction.

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Question 25 continues

Question 25 continued

Marker use

- d) A student challenges the teacher to justify ignoring the volume of water that reacts with the sodium when calculating the concentration of the sodium hydroxide at the end of the reaction.

/3

Use calculations to justify ignoring the volume of water that reacts when calculating the final sodium hydroxide concentration. (Note: the density of water is 1.0 g mL^{-1} .)

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**Total
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End of Section E

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