

PHYSICAL SCIENCES (PSC315118)

External Assessment Specifications inform the development of external assessments. The primary audience for this document is the course Setting Examiner and Exam Critics. It may also be of use to teachers and students.

These specifications must be read in conjunction with the current Course Document on the TASC website.

The external assessment for this course consists of a written exam.

WRITTEN EXAM STRUCTURE

The written exam is THREE hours.

Students will have an additional 15-minute preparation time during which students can take notes on the note paper provided and highlight any key words in the exam booklet during the allocated time. Students will not be permitted to start their exam until advised by the Exam Supervisor.

The written exam includes FIVE sections.

The criteria to be externally assessed are:

Criterion 4: apply concepts and processes of atomic properties and nuclear reactions

Criterion 5: apply concepts and processes of motion and force

Criterion 6: apply concepts and processes of conservation in physics

Criterion 7: apply concepts and processes of chemical structures and properties

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

SPECIFIC MATERIALS AND EQUIPMENT APPROVED FOR USE BY STUDENTS

- Current TASC PSC315118 Physical Sciences Information Sheet.

ASSESSMENT

All criteria are assessed numerically with marks out of 36.

A set of solutions or a marking tool will be developed by the Setting Examiner, provided to markers at the marking meeting that follows the external written exam; and will be available from TASC in the following year.

The external assessment must include questions that, separately or together, give opportunities to demonstrate the standards from rating C to rating A.

Final results will be awarded as a rating of A, B, C, t or z in the above criteria. These ratings are used in determining the final award according to the algorithm in the course document.

Numerical Mark Allocation

Exam papers are designed so that the number of marks allocated to a section, part or question corresponds to the recommended time allocation for it. This is so that a student knows when answering a 10 mark question that the question has been designed for students to spend approximately 10 minutes reading, thinking and then answering the question. Students may find that they spend less or more time on certain questions throughout the exam.

SECTION A

Structure

- This section will take students approximately 36 minutes to respond to and will be allocated 36 marks.
- This section will include between FOUR and SIX questions. All questions are compulsory.
- Questions will be mostly broken into items, which will be arranged in order of difficulty where possible.
- This section will address course content from properties of atoms and nuclear reactions.

Assessed Criteria

- Criterion 4 – apply concepts and processes of atomic properties and nuclear reactions (all Elements).

Nature of Questions

- See Appendix A

Nature of Responses

- Responses will be assessed numerically.

SECTION B

Structure

- This section will take students approximately 36 minutes to respond to and will be allocated 36 marks.
- This section will include between FOUR and SIX questions. All questions are compulsory.
- Questions will be mostly broken into items, which will be arranged in order of difficulty where possible.
- This section will address course content from motion and force.

Assessed Criteria

- Criterion 5 apply concepts and processes of motion and force (all Elements).

Nature of Questions

- See Appendix A

Nature of Responses

- Responses will be assessed numerically.

SECTION C

Structure

- This section will take students approximately 36 minutes to respond to and will be allocated 36 marks
- This section will include between FOUR and SIX questions. All questions are compulsory.
- Questions will be mostly broken into items, which will be arranged in order of difficulty where possible.
- This section will address course content from conservation in physics.

Assessed Criteria

- Criterion 6 apply concepts and processes of conservation in physics (all Elements).

Nature of Questions

- See Appendix A

Nature of Responses

- Responses will be assessed numerically.

SECTION D

Structure

- This section will take students approximately 36 minutes to respond to and will be allocated 36 marks.
- This section will include between FOUR and SIX questions. All questions are compulsory.
- Questions will be mostly broken into items, which will be arranged in order of difficulty where possible.
- This section will address course content from chemical structures and properties.

Assessed Criteria

- Criterion 7 apply concepts and processes of chemical structures and properties (all Elements).

Nature of Questions

- See Appendix A

Nature of Responses

- Responses will be assessed numerically.

SECTION E

Structure

- This section will take students approximately 36 minutes to respond to and will be allocated 36 marks.
- This section will include between FOUR and SIX questions. All questions are compulsory.
- Questions will be mostly broken into items, which will be arranged in order of difficulty where possible.
- This section will address course content from chemical reactions and reacting quantities.

Assessed Criteria

- Criterion 8 apply concepts and processes of chemical reactions and reacting quantities. (all Elements).

Nature of Questions

- See Appendix A

Nature of Responses

- Responses will be assessed numerically.

Appendix A - TYPES of Questions (All SECTIONS)

- Some extended questions should be non-routine contexts, not exceeding 6 to 8 marks within the section. The remainder should be in routine contexts.
- Some scenarios of questions are real-world scenarios.
- A balance of questions ranging from short to extended response format.
- Responses range from closed to open-ended.

Routine context:

These questions require skills or procedures expected to have been encountered by all students in Physical Sciences, Level 3 within familiar contexts.

(Reference: Physical Sciences 2014 Exam Paper, Part 3, Question 12)

Complete the following table. The first row has been completed as an example. (4 marks)

Name of compound	Chemical formula	Structure
calcium chloride	CaCl ₂	ionic
	NO ₂	
fluorine gas		
	K ₂ Cr ₂ O ₇	
iron(III) sulfide		

(Reference: Physical Sciences 2017 Exam Paper, Part 4, Question 25a)

A calcium chloride solution, CaCl_{2(aq)}, of concentration 5.70 mol L⁻¹ is prepared.
(M_r(CaCl₂) = 111.0).

- (a) Calculate the mass of anhydrous calcium chloride, CaCl₂, which must be dissolved in 250 mL of solution to prepare the solution of this concentration. (2 marks)

(Reference: Physical Sciences 2014 Exam Paper, Part 2, Question 10)

Uranium-235 is a radioactive isotope of uranium that decays by a series of emissions of alpha and beta particles that finally creates a stable isotope of lead (²⁰⁷Pb).

- (a) The first decay in the series is from uranium-235 to thorium-231 by the emission of an alpha particle.

Write the nuclear equation for this emission. (1 mark)

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- (b) The second decay in this process is the decay of thorium-231 to protactinium-231.

Write the nuclear equation for this emission. (1 mark)

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- (c) This decay process then continues.

How many alpha particles would be emitted in the whole decay process from ²³⁵₉₂U to the final stable isotope ²⁰⁷₈₂Pb? Explain your answer. (2 marks)

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Non-routine context:

These questions require procedures not previously encountered in expected prior learning activities. These require the combination, and sometimes the selection, of a set of skills in unfamiliar contexts. These questions should be designed to address an 'A' standard for the relevant criterion.

(Reference: Physical Sciences 2015 Exam Paper, Part 1 Question 5b)

In baseball, players are encouraged to 'follow through' when hitting a ball. This increases the time of contact between the bat and the ball compared with when the player does not follow through.

Use Physics principles to explain the advantage achieved by 'following through' assuming the forces are the same in both cases.

(3 marks)



(Reference: Physical Sciences 2015 Exam Paper, Part 4 Question 23)

A retired Chemistry teacher gave a pentillion (10^{18}) gold atoms to each of the Chemistry students they had taught over their career. The gold dust was weighed to the nearest μg and placed in envelopes.

(a) Calculate the mass of gold dust placed in each envelope measured in μg . (3 marks)

(b) The teacher was able to purchase gold dust from a jeweler at a cost of \$50.00 per gram.

Calculate the cost of the gold dust in each envelope to the nearest cent. (1 mark)

Real-world scenarios:

These questions relate principles and theories of Physical Sciences to physical phenomena in the real world. The nature of approximations of theory to reality is clearly stated.

(Reference: Physical Sciences 2014 Exam Paper, Part 1, Question 5)

In a tennis match, a player serves the ball by striking it with a racquet. The ball is struck when it is at the maximum height, where its instantaneous velocity is zero.

After it is struck the ball moves forward with a velocity of 51.0 m s^{-1} . The mass of the ball is 57.0 g .

(a) What is the momentum of the tennis ball: (2 marks)

(i) immediately before it is struck by the tennis racquet?

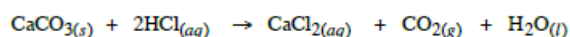
(b) The impact time of the racquet on the ball was $4.00 \times 10^{-3} \text{ s}$. What was the average force of the racquet on the ball? (1 mark)

(Reference: Physical Sciences 2015 Exam Paper, Part 4, Question 23)

Limestone is a rock that is composed mainly of calcium carbonate. A scientist wishes to determine the percentage by mass of calcium carbonate in a sample of limestone.

To do this a 0.280 g sample of the limestone is reacted with hydrochloric acid. This required 44.6 mL of 0.102 mol L^{-1} hydrochloric acid to react completely. Assume any impurities in the sample do not react with hydrochloric acid.

The chemical equation for the reaction is shown below.



(a) Calculate the number of moles of hydrochloric acid used in the reaction. (2 marks)

(b) How many moles of calcium carbonate are there in the rock sample? (1 mark)

(c) Calculate the percentage of calcium carbonate in the rock sample. (3 marks)

Short response format:

These questions are composed of a brief prompt that demands a response to some stimulus material that varies from a single response to a few written points. This format is particularly suited to questions that require a closed-ended response. This sort of question is suited to assessing the student's ability to:

- recall specific information and methods related to key content
- apply rehearsed methods to familiar situations
- demonstrate understanding of key concepts in previously unseen stimulus material.

(Reference: Physical Sciences 2016 Exam Paper, Part 1, Question 3)

Two builders working on the roof of a high-rise building were 200 m above the ground. One of the builders threw a bottle of water to their co-worker. The co-worker missed the bottle, which then went over the edge of the building, moving horizontally at 5.00 m s^{-1} .

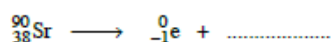
The bottle landed in the garden below 6.40 s later.

- (a) **How far from the base of the building did the bottle land?** (1 mark)
- (b) **Show that in the absence of friction the vertical velocity of the bottle was about 63 m s^{-1} down when it hit the ground.** (1 mark)

(Reference: Physical Sciences 2014 Exam Paper, Part 2, Question 6)

- (a) **Strontium-90 is a radioactive isotope that decays by the emission of beta particles.**

Complete the equation below to show the decay of strontium-90 and name the other product. (1 mark)



Name of other product:

(Reference: Physical Sciences 2014 Exam Paper, Part 3, Question 15)

- (b) **Fluorine (atomic number 9) and neon (atomic number 10) are in the same period of the Periodic Table. Fluorine is highly reactive whereas neon is unreactive.**
- (i) **Explain why these elements are both included in the same period.** (1 mark)
- (ii) **Explain the difference in reactivity in terms of their electronic structures.** (2 marks)

Extended response format:

These questions involve lengthy and/or multi stage responses of increasing complexity. Greater complexity may be due to one or more of, but not limited to, the following:

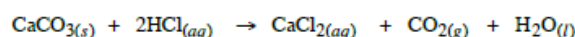
- a greater cognitive demand of physical sciences concepts
- the necessity to select appropriate information
- justification of a response via a logical line of reasoning.

(Reference: Physical Sciences 2015 Exam Paper, Part 4, Question 23)

Limestone is a rock that is composed mainly of calcium carbonate. A scientist wishes to determine the percentage by mass of calcium carbonate in a sample of limestone.

To do this a 0.280 g sample of the limestone is reacted with hydrochloric acid. This required 44.6 mL of 0.102 mol L^{-1} hydrochloric acid to react completely. Assume any impurities in the sample do not react with hydrochloric acid.

The chemical equation for the reaction is shown below.



- (a) **Calculate the number of moles of hydrochloric acid used in the reaction.** (2 marks)
- (b) **How many moles of calcium carbonate are there in the rock sample?** (1 mark)
- (c) **Calculate the percentage of calcium carbonate in the rock sample.** (3 marks)

(Reference: Physical Sciences 2015 Exam Paper, Part 1, Question 4)

The specifications for an aeroplane that uses Hobart airport are:

- Thrust (force) of each of the two engines is 120 kN
- Maximum take-off weight is 73.5 tonnes
- Maximum landing weight is 64.5 tonnes
- Take off speed is 79.6 m s^{-1}



- Identify the term that is incorrectly used in the specifications. Explain. (1 mark)
- Why is there a difference between the 'maximum take-off weight' and 'maximum landing weight'? (1 mark)
- Show that the acceleration of this fully loaded aeroplane as it takes off is approximately 3.3 m s^{-2} . Assume all the force from the engines is available. (2 marks)
- Calculate the minimum length of runway required for the aeroplane to take off. (2 marks)

Closed-ended response:

These are questions for which there is a single 'correct' or 'best' response.

Reference: Physical Sciences 2016 Exam Paper, Part 1, Question 6)

An 80.0 kg passenger entered a stationary lift.

- Calculate the weight of the passenger. (1 mark)
- Determine the normal force acting on the passenger (the force applied by the floor of the stationary lift on the passenger). (1 mark)

(Reference: Physical Sciences 2016 Exam Paper, Part 3, Question 18)

- What is meant by the term isomer? (1 mark)

(Reference: Physical Sciences 2016 Exam Paper, Part 3, Question 19)

LPG, liquid petroleum gas, consists of propane gas, $\text{C}_3\text{H}_8(\text{g})$.

- Write an equation for its complete combustion in oxygen gas. (1 mark)

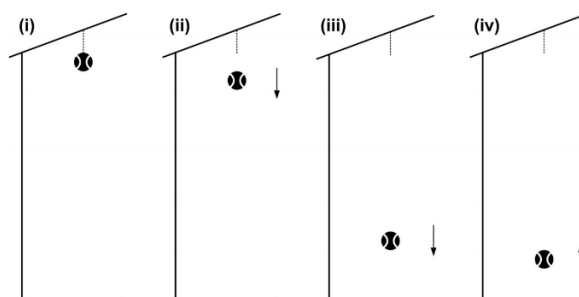
(Reference: Physical Sciences 2017 Exam Paper, Part 1, Question 2)

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.

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



Ignore air resistance when completing the following calculations.

- 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 m s^{-1} . (1 mark)
- Show that it takes the ball approximately 1.8 seconds to hit the floor. (1 mark)

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

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

Open-ended response:

These are questions for which there may be multiple correct responses OR in which the quality the argument and/or the expression is being assessed.

(Reference: Physical Sciences 2014 Exam Paper, Part 4, Question 24)

- (a) A student was given two unlabelled bottles, one containing a solution of silver nitrate and the other containing a zinc nitrate solution. The student was asked to undertake a simple test to distinguish between the two.
- (i) What test should the student undertake? Write a balanced equation to justify your choice. (2 marks)
- (ii) Write a net ionic equation for the case where a reaction occurs. (1 mark)
- (b) The student is then given two more unlabelled bottles, one containing a potassium sulfate solution and the other containing a potassium carbonate solution.
- What test should the student undertake in this case? Justify your choice with an ionic equation. (2 marks)

(Reference: Physical Sciences 2015 Exam Paper, Part 2, Question 8)

- (d) By comparing the properties of alpha particles and beta particles and neutrons, explain why neutrons are more effective in initiating a fission reaction than either alpha or beta particles. (3 marks)

(Reference: Physical Sciences 2016 Exam Paper, Part 2, Question 11)

Patients treated with radioisotopes are advised to avoid close contact with children or pregnant women for a 24-hour period.

- (iv) Explain the basis for this precaution. (2 marks)