PHYSICS (PHY415115)

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 FOUR sections.

The criteria to be externally assessed are:

Criterion 5: identify and apply principles of Newtonian mechanics including gravitational fields

Criterion 6: identify and apply principles of electricity and magnetism

Criterion 7: identify and apply general principles of wave motion

Criterion 8: identify and apply principles of the wave-particle nature of light, atomic and nuclear physics and models of the nucleus and nuclear processes.

SPECIFIC MATERIALS AND EQUIPMENT APPROVED FOR USE BY STUDENTS

- Current TASC PHY415115 Physics Information Sheet.
- A TASC approved calculator.

OFFICE OF TASMANIAN ASSESSMENT, STANDARDS & CERTIFICATION

ASSESSMENT

All criteria are assessed numerically with marks out of 45.

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 45 minutes to respond to and will be allocated 45 marks.
- This section will include between FIVE and SEVEN questions. All questions are compulsory.
- This section will address course content about Newtonian mechanics including gravitational fields.

Assessed Criteria

- Criterion 5 identify and apply principles of Newtonian mechanics including gravitational fields (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 45 minutes to respond to and will be allocated 45 marks.
- This section will include between FIVE and SEVEN questions. All questions are compulsory.
- This section will address course content principles and theories of electricity and magnetism.

Assessed Criteria

- Criterion 6 identify and apply principles of electricity and magnetism (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 45 minutes to respond to and will be allocated 45 marks.
- This section will include between FIVE and SEVEN questions. All questions are compulsory.
- This section will address course content about general principles of wave motion.

Assessed Criteria

- Criterion 7 identify and apply general principles of wave motion (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 45 minutes to respond to and will be allocated 45 marks.
- This section will include between FIVE and SEVEN questions. All questions are compulsory.
- This section will address course content about the particle nature of light, and atomic and nuclear physics.

Assessed Criteria

- Criterion 8 identify and apply principles of the wave-particle nature of light, atomic and nuclear physics and models of the nucleus and nuclear processes (all Elements).

Nature of Questions

- See Appendix A

Nature of Responses

- Responses will be assessed numerically.

Appendix A - TYPES of Questions (All SECTIONS)

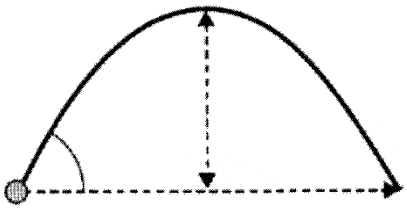
- Some extended questions should be non-routine contexts. The remainder should be in routine contexts.
- Some scenarios of questions are real-world scenarios.
- A balance of questions ranging from short to extended response format.
- Responses range from closed to open-ended.

Routine context:

These questions require skills or procedures expected to have been encountered by all students in Physics, and in familiar contexts.

(Reference: *Physics* Exam Paper 2013, Part 1, Question 2)

A cricketer hits a ball at an angle of 60˚ to the horizontal so that it rises to a vertical height of 15.0 m above the point from which it is hit. The landing point is at the same height as the starting point, as shown in the diagram. Ignore air resistance.



For an angle of 60° and a height of 15m,

(a) (i) Calculate the vertical component of the ball's initial velocity. (1 mark)

(ii) Hence determine the speed at which the ball leaves the cricketer's bat. (2 marks)

(b) Determine the time of flight of the ball. (2 marks)

(c) How far from the batsman does the ball land? (2 marks)

(d) The batsman later hits the same shot but the ball is caught by a fielder at a distance of 33.0 m from the batsman.

At what height above the ground is the ball caught? (3 marks)

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: *Physics* Exam Paper 2012, Part 1, Question 4)

A water-powered jet-pack worn by a 'flyer' has recently been developed. This jet-pack is driven by a motor and pump mounted in a small boat. A large flexible hose leads to the jet-pack worn by the flyer.

(a) In one particular unit, the pump delivers 49 litres of water per second to the jet-pack. The jet of water is supporting 120 kg of person and equipment in a fixed position. 1.0 L of water has a mass of 1.0 kg. Calculate the speed at which the water is being ejected from the jet nozzle. (3 marks)

(b) Assuming a long enough hose is available, state a factor that would limit the height to which this flyer can rise. Explain your reasoning. (2 marks)

(c) Suppose you had to redesign the system so that it would go to a greater maximum height.

You can

- change the speed of the water without changing the amount of water per second, or

- increase the amount of water per second without changing its speed. Which is the more efficient option? Justify your choice. (2 marks)

Real-world scenarios:

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

(Reference: *Physics* Exam Paper 2012, Part 3, Question 11).

1. A person throws a cricket ball vertically upwards. The graph shows velocity versus time for the motion of the ball from the time the person starts throwing the ball till the time at which the ball lands on the ground. For simplicity, this graph was drawn **assuming that the acceleration of gravity, g, has a value 10** ms^{-2}. (Reference: Exam Paper 2010, Part 1, Question 1).

Calculate the time taken for the proton to travel once around its path, **assuming a uniform field**.

Short response format:

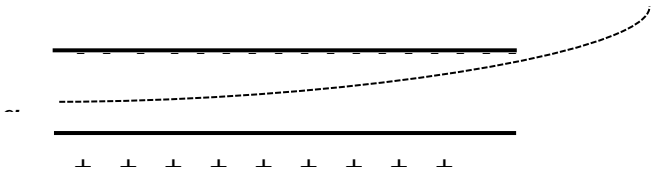
These questions are composed of a brief prompt that demands a response to some stimulus material that varies from a single response to a few written points. This sort of question is suited to assessing the student's ability to:

- 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: *Physics* Exam Paper 2012, Part 2, Question 8)

Ernest Rutherford identified and named α, β and γ particles. He determined their charges by passing the particles through an electric field.

An alpha particle (helium nucleus) travelling at $3.0 \times 10^{7}\ ms^{-1}$ is projected between two parallel plates. The plates have a potential difference of 150.0 kV, with the lower plate being positive; they are 1.5 cm apart and each is 5.0 cm long.



(a) On the diagram, draw the electric field lines in the space between the plates. (1 mark)

(b) Determine, and specify fully, the electric field strength between the plates. (2 marks)

(c) Determine the electric force on the alpha particle. (1 marks)

(d) Determine the acceleration of the alpha particle. (1 mark)

(e) Find the time taken for the alpha particle to traverse the region between plates. (1 mark)

(f) What will the vertical displacement of the alpha particle be as it leaves the plates? (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 physics concepts
- the necessity to select appropriate information
- justification of a response via a logical line of reasoning.

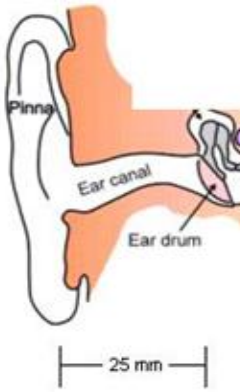
(Reference: *Physics* Exam Paper 2011, Part 3, Question 12)

The human ear canal (opposite) has similar properties to a closed organ pipe of length 25 mm shown in the simplified diagrams below.

(a) In the two simplified diagrams, show the resonance wave patterns for the fundamental and first overtone. (2 marks)

Fundamental

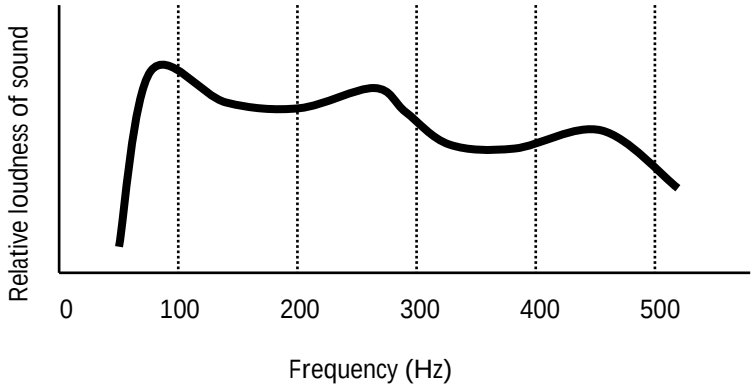
First overtone



(b) Show that the fundamental frequency is about 3 kHz. (2 marks)

(c) Human ears are particularly sensitive to sounds of frequency about 3 kHz and above about 10 kHz. Explain this using the principles of physics. (3 marks)

(d) The diagrams below show a stethoscope used by doctors to hear a patient's heartbeat and a typical frequency response of such a stethoscope.



A stethoscope is essentially a hollow tube with an open end connected to the vibrations within the body of the patient and a closed end in the doctor's ear.

Explain the three peaks in the graph, given that the total tube length of the stethoscope is about 0.9 m. (3 marks)

Closed-ended response:

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

(Reference: *Physics* Exam Paper 2012, Part 1, Question 5)

Stella and her crew, space-travellers from Earth, visit the planet Minerva in a distant planetary system. A year on Minerva is equal to 200 Earth-days. One day on Minerva is 12 Earth-hours.

Mass of Earth = 5.97×10^{24} kg
Radius of Earth = 6371 km

Radius of Earth's orbit = 1.50×10^{8} km

(a) The mother-ship of Stella's crew continually orbits Minerva every 100 minutes at an orbital radius of 4500 km.

Show that the mass of Minerva is about 1.5×10^{24} kg.

Open-ended response:

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

(Reference: *Physics* Exam Paper 2012, Part 4, Question 18)

In the medical physics unit of a hospital, cancer cells may be killed by using a beam of either high-energy X-rays or gamma rays. Both X-rays and gammas are ionising electromagnetic radiation; the X-rays can be produced by accelerating electrons in a Coolidge tube and the gammas obtained from a radioisotope such as Co-60. The rays are concentrated into a narrow beam focused on the target.

(a) In terms of safety, convenience and flexibility, give two reasons why the use of X-rays may be preferred to gammas. (Assume that X-rays and gammas have the same effect on cancer cells.)