Time allowed

• Perusal time: 10 minutes
• Working time: 2 hours

Examination materials provided

• Paper Two — Question book
• Paper Two — Resource book
• Paper Two — Response book

Equipment allowed

• QSA-approved equipment
• ruler graduated in millimetres
• non-programmable calculator
• graphing calculator

Paper Two is an open book examination. You may refer to any paper-based material that you have brought into the examination room.

Directions

You may write in this book during perusal time.

Paper Two has two parts:
• Part A
• Part B

Show all working.

Suggested time allocation

• Part A: 70 minutes
• Part B: 50 minutes

Assessment

Assessment standards are at the end of this book.

After the examination session

Take this book when you leave.
Planning space
Part A

Complex reasoning processes.
Part A has five questions of equal value. Attempt four questions only. Show all working.
Write your responses in the response book.
Suggested time allocation: 70 minutes.

Question 1
A rattlesnake can strike at a top speed of 30.0 km/h over a distance of 25.0 cm. This acceleration is reported to be 10 times that of a Ferrari.

What is the acceleration of a Ferrari in SI units?

Note: 1 mile = 1.60 km; 1 inch = 25.4 mm

Question 2
A 5.00 g bullet is fired at $4.00 \times 10^2$ m/s at Superman who is standing at rest on frictionless ice. Naturally, the bullet bounces harmlessly off Superman’s chest at the same speed and in the opposite direction.

If Superman weighs $1.00 \times 10^2$ kg, find his velocity after impact.

Question 3
Sound travels approximately 4.5 times faster in seawater than it does in air. Calculate any difference in the wavelength and frequency of a 1500 Hz soundwave that was generated in air and went underwater. Assume that, in this instance, sound travels at 340 m/s in air.

Justify your response.

Question 4
A string of fifty identical party lights is connected in series to a 240 V source.

Find the resistance and wattage of each lamp if a current of 0.100 A flows in the circuit.

What would be the disadvantage, if any, of connecting the 50 lamps in parallel using the same power source?

Question 5
An electrical contractor has been asked to place two 4.00 m wires 5.00 mm apart in a restricted ceiling space. Currents of 7.50 A and 5.00 A flow in opposite directions.

Calculate the forces between the wires. Does any action need to be taken to stop the wires moving when the currents are switched on? Explain your response.

End of Part A
Part B

Complex reasoning processes.
Part B has four questions of equal value. Attempt two questions only. Show all working.
Write your responses in the response book.
Suggested time allocation: 50 minutes.

Question 1
Would it be easier to push or pull a single-wheel roller up one step? The radius of the roller is just larger than the step.
List any assumptions made. Use vectors and a diagram to justify your response.

Question 2
A person looks up at an angle of 40° to the top of a 30 m high cliff where a regimental cannon is located.
A cannonball is fired at an angle of 20° above the horizontal and at a velocity of $8.00 \times 10^2$ m/s in the direction of the person.
Where would the person look to see the cannonball in flight after the sound of firing is heard?
(Assume that the cannonball can be seen easily and that the speed of sound in air is 335 m/s.)

Question 3
At what angle, $\theta$, would light have to enter the clear equilateral triangular prism ($n = 1.45$), if it were to take the pathway shown? An equilateral triangle has all sides and all angles equal.

Question 4
An X-ray of wavelength $3.00 \times 10^{-10}$ m strikes a shiny metal surface, producing a $2.00 \times 10^{-5}$ A current. The work function of the metal is $5.00 \times 10^{-16}$ J.
Find the kinetic energy of the ejected electrons.
If 1 in 1000 photons emits an electron, determine the number of photons striking the metal surface each second.

End of Part B

End of Paper Two
# Assessment standards from the Physics Senior External Syllabus 2000

## Paper Two

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Very High Achievement</th>
<th>High Achievement</th>
<th>Sound Achievement</th>
<th>Limited Achievement</th>
<th>Very Limited Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex reasoning processes</td>
<td>A high ability to use complex reasoning in challenging situations involving the candidate's understanding of subject matter and a high ability to use scientific processes at an advanced level.</td>
<td>Competence in using complex reasoning in challenging situations involving the candidate's understanding of subject matter and competence in using scientific processes at an advanced level.</td>
<td>Some success in using complex reasoning in challenging situations involving the candidate's understanding of subject matter and some success in using scientific processes at an advanced level.</td>
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