Time allowed

- Perusal time: **10 minutes**
- Working time: **2 hours 30 minutes**

Examination materials provided

- Paper One — Question book
- Paper One — Resource book
- Paper One — Multiple-choice response sheet
- Paper One — Response book

Equipment allowed

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

Directions

You may write in this book during perusal time.

Paper One has **two** parts:

- Part A — Multiple choice (15 questions)
- Part B — Short response (15 questions)

Attempt all questions.

Suggested time allocation

- Part A: 30 minutes
- Part B: 2 hours

Assessment

Assessment standards are at the end of this book.

After the examination session

Take this book when you leave.
Planning space
Part A — Multiple choice

Knowledge of subject matter: 15 marks.
Part A has 15 questions of equal value. Attempt all questions.
Each question contains four options. Select the option that you think is correct or is the best option. Respond on the multiple-choice response sheet.
Suggested time allocation: 30 minutes.

Question 1
How many significant figures are in the answer to the following calculation?

\[ \cos A = \frac{(a^2 - b^2 - c^2)}{2bc} \]

where \( a = 3.070, \ b = 5.20 \) and \( c = 0.082 \)

A One  
B Two  
C Three  
D Four

Question 2
The graph below shows the motion of a toy car over a 5.00 s time interval.

![Graph showing motion of a toy car](image)

The displacement of the toy car over the time interval was

A 20 m.  
B 40 m.  
C 60 m.  
D 80 m.
Question 3
What force would be needed to accelerate a 55 kg person on skates across ice at 1 g? (Assume no friction.)
A 55 N
B 450 N
C 540 N
D 600 N

Question 4
How long will it take an arrow to reach the highest point of its trajectory if it is fired at 98.0 m/s at an angle of 30.0° to the horizontal?
A 2.50 s
B 5.00 s
C 7.50 s
D 10.0 s

Question 5
The front of a modern car is designed to crumple during a collision. This is to minimise what effect?
A Force
B Energy
C Velocity
D Momentum

Question 6
A vehicle’s speedometer shows
A average speed.
B average velocity.
C instantaneous speed.
D instantaneous velocity.
Question 7
A cat falls off a ledge and reaches the ground in 1.50 s at what speed?

A  1.47 m/s  
B  1.50 m/s  
C  6.53 m/s  
D  14.7 m/s

Question 8
When a person walks directly towards a mirror at 2.30 m/s, the image and the person appear to approach each other at a speed of

A  0.00 m/s.  
B  1.15 m/s.  
C  2.30 m/s.  
D  4.60 m/s.

Question 9
If the speed of light in a diamond is 124000 km/s, what is its index of refraction?

A  \(4.13 \times 10^{-4}\)  
B  0.413  
C  2.42  
D  2419

Question 10
When two small electric charges are held at a fixed separation, they exert a force of attraction on each other of 50.0 N.

To obtain a force of 200 N, you could

A  double the distance of separation.  
B  double the size of both charges.  
C  halve both charges.  
D  double one charge.
Question 11
During a lie detector test a voltage of 6.0 V is applied across two fingers. When a certain question is asked, the resistance drops from 400000 \( \Omega \) to 200000 \( \Omega \).

What current flows when the resistance drops?

A 30 mA  
B 120 mA  
C 150 mA  
D 300 mA

Question 12
What would be the magnetic field strength 2.0 m from a cable carrying a 4.5 A current?

A \( 4.5 \times 10^{-7} \) T  
B \( 9.0 \times 10^{-7} \) T  
C \( 8.9 \times 10^{-8} \) T  
D \( 9.0 \times 10^{-8} \) T

Question 13
Determine the strength of the magnetic field within a 15.0 cm long solenoid which has 735 turns. The current flowing in the solenoid is 3.55 A.

A 0.0219 T  
B 219 m T  
C \( 3.28 \times 10^{-3} \) T  
D \( 2.19 \times 10^{-4} \) T

Question 14
Isotopes of an element contain

A the same number of protons and neutrons.  
B the same number of neutrons.  
C different numbers of protons.  
D the same number of protons.
Question 15

Which of the following symbols represents the element X, which contains 56 protons and 58 neutrons?

A  \[ \begin{array}{c} 114 \\ 56 \end{array} \] X

B  \[ \begin{array}{c} 56 \\ 114 \end{array} \] X

C  \[ \begin{array}{c} 56 \\ 58 \end{array} \] X

D  \[ \begin{array}{c} 56 \\ 56 \end{array} \] X

End of Part A
Question 1
Knowledge

a. State the number of significant figures in the following measurements.
   i. 25.9 km
   ii. 8.030 x 10³ g
   iii. 0.062 mm
   iv. 0.05130 L

b. Convert the following percentage errors into absolute errors.
   i. 10.35 ± 0.6 %
   ii. 247 ± 5.2 %

Question 2
Knowledge

A box rests on a plane which is at an angle of 15° to the horizontal. If the friction between the box and the plane has a maximum value of 10 N, what would be the maximum weight of the box before it slides down the plane? Use a diagram in your response.

Question 3
Scientific processes

Respond to Question 3 on page 25 of your response book.

The table below shows data associated with the sprinting speeds of various animals.

a. Complete the table in your response book using whatever calculations are necessary.

<table>
<thead>
<tr>
<th>Animal</th>
<th>Distance</th>
<th>Time</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheetah</td>
<td>75 m</td>
<td>3.0 s</td>
<td>?</td>
</tr>
<tr>
<td>Greyhound</td>
<td>160 m</td>
<td>10.0 s</td>
<td>?</td>
</tr>
<tr>
<td>Gazelle</td>
<td>1.0 km</td>
<td>?</td>
<td>100 km/hr</td>
</tr>
<tr>
<td>Turtle</td>
<td>?</td>
<td>3.0 s</td>
<td>1.0 cm/s</td>
</tr>
</tbody>
</table>

b. Create a table that ranks the animals from fastest to slowest, giving speed in m/s.
Question 4  Scientific processes

Respond to Question 4 on page 26 of your response book.

The tables below show data associated with a rocket-propelled sled of mass 25.0 kg

a. Complete the tables in your response book using whatever calculations are necessary.

Zero resistance

<table>
<thead>
<tr>
<th>Force</th>
<th>Acceleration</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 N</td>
<td></td>
</tr>
<tr>
<td>200 N</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 m/s²</td>
</tr>
</tbody>
</table>

Sled experiences constant 50 N resistance

<table>
<thead>
<tr>
<th>Force</th>
<th>Acceleration</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 N</td>
<td>0 m/s²</td>
</tr>
<tr>
<td>100 N</td>
<td></td>
</tr>
<tr>
<td>200 N</td>
<td></td>
</tr>
</tbody>
</table>

(2.5 marks)

b. On the graph paper provided in the response book, draw graphs of force versus acceleration on the one set of axes.

(2.5 marks)

Question 5  Knowledge

a. How does impulse differ from a force?

(1 mark)

b. What is the impulse that stops a 50.0 kg carton, sliding at 4.0 m/s, when it encounters a rough surface?

(2 marks)
Question 6  Scientific processes

Respond to Question 6 on page 27 of your response book.

The following data was collected during an experiment using springs.

<table>
<thead>
<tr>
<th>Applied force (N)</th>
<th>0</th>
<th>10.0</th>
<th>20.0</th>
<th>30.0</th>
<th>40.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension (cm)</td>
<td>0</td>
<td>5.0</td>
<td>10.0</td>
<td>15.0</td>
<td>20.0</td>
</tr>
</tbody>
</table>

a. Draw a graph of force versus extension.  
   (3 marks)

b. Find the spring constant in N/m.  
   (1 mark)

c. What is the stored elastic potential energy of the spring when it has been stretched by 17.0 cm?  
   (1 mark)

Question 7  Knowledge

a. A 50 kg weight is lifted a vertical distance of 2.0 m. A 25 kg weight is then lifted a vertical distance of 4.0 m. How much energy was required to lift each weight?  
   (2 marks)

b. If both weights are lifted their respective distances in the same time, how does the power required for each compare?  
   (1 mark)

Question 8  Scientific processes

The diagram below is of a transverse wave moving along a rope from left to right.

![Wave Diagram]

a. Which points are moving:
   i. upwards  
   ii. downwards  
   iii. forwards  
   (3 marks)

b. Which points have maximum kinetic energy?  
   (1 mark)

c. Which points are momentarily at rest?  
   (1 mark)
Question 9  Knowledge

a. Red light has a longer wavelength than violet light. Which light colour has the higher frequency? Justify your response.  

(2 marks)

b. A fishing trawler skipper notices wave crests passing the anchor rope every 1.50 s. She estimates that the wave crests are 12.0 m apart. What is the speed of these waves?  

(2 marks)

Question 10  Knowledge

A two-point source interference experiment used to determine the wavelength of a monochromatic light source has a screen placed exactly 3.00 m away. If the slits have a 0.0500 mm separation, and the dark fringes on the screen have a uniform 3.30 cm separation, what is the wavelength of the light source?  

(2 marks)

Question 11  Knowledge

A water droplet carrying a charge of 8.00 x 10^-15 C moves from one point to another within a thundercloud. If the potential difference between the two points is 6.00 x 10^3 V, what work is done on the water droplet?  

(2 marks)

Question 12  Knowledge

The heater in a waterbed has a 36 Ω resistance. What will be its power rating (kW) if it uses a 240 V source?  

(3 marks)

Question 13  Knowledge

A communications truck in the Libyan desert travels east at a horizontal speed of 25.0 m/s. In this region, the horizontal component of the Earth’s magnetic field is 4.50 x 10^-5 T. If the truck has a 1.40 m long aerial, what will be the induced emf (mV) in the aerial?  

(2 marks)
Question 14  Scientific processes

Respond to Question 14 on page 28 of your response book.

Radioactive dating uses the ratio of radioactive C-14 which decays over time to C-12 which does not decay.

a. If the half-life of C-14 is 5700 years, draw a graph of the ratio of C-14 isotopes dating back about 12000 years.  

(3 marks)

b. The Shroud of Turin was thought to have been a burial cloth associated with the death of Jesus Christ 2000 years ago. Modern techniques have estimated that the Shroud is approximately 600 years old. Show on your graph where the Shroud has been scientifically dated as well as where it was thought to have been dated. 

(2 marks)

Question 15  Knowledge

When an alpha particle strikes U-238, there is a possibility that Pu-239 is formed.

This can only occur if three identical particles are emitted. Write a balanced nuclear equation and name these emitted particles.

(3 marks)

End of Part B

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

#### Paper One

<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>Knowledge of subject matter</td>
<td>A very high ability to recall and apply knowledge in simple situations.</td>
<td>A high ability to recall and apply knowledge in simple situations.</td>
<td>A satisfactory ability to recall and apply knowledge in simple situations.</td>
<td>A limited ability to recall and apply knowledge in simple situations.</td>
<td>A very limited ability to recall and apply knowledge in simple situations.</td>
</tr>
<tr>
<td>Scientific processes</td>
<td>A very high ability to succeed in simple scientific process tasks — collecting and organising data, processing information, making simple judgments, communicating information in various contexts, devising and designing simple/single step investigations.</td>
<td>A high ability to succeed in simple scientific process tasks — collecting and organising data, processing information, making simple judgments, communicating information in various contexts, devising and designing simple/single step investigations.</td>
<td>A satisfactory ability to succeed in simple scientific process tasks — collecting and organising data, processing information, making simple judgments, communicating information in various contexts, devising and designing simple/single step investigations.</td>
<td>A limited ability to succeed in simple scientific process tasks.</td>
<td>A very limited ability to succeed in simple scientific process tasks.</td>
</tr>
</tbody>
</table>