1 In which situation is energy NOT transferred by waves?
   (A) An earthquake tremor is felt.
   (B) Warmth is felt when standing in sunshine.
   (C) A lightning bolt strikes a tree.
   (D) A walkie talkie is used for two people to talk to each other.

2 The wavelength and amplitude of the wave shown on the axes below are:

   NOT TO SCALE

   ![Wave diagram]

   (A) 6.0cm and 6.0cm respectively
   (B) 2.0cm and 3.0cm respectively
   (C) 4.0cm and 3.0cm respectively
   (D) 4.5cm and 6.0cm respectively
3 Two waves, A and B travelling in the same medium are represented below.

When viewed on the screen of a CRO, which of the momentary resultant waves below is possible as waves A and B interact?

(A)     (B)  

(C)     (D)

4 Which of the following alternatives describes one necessary condition for total internal reflection to occur?

(A) The light is travelling slower in the medium it is in than it would in the medium it is trying to enter.

(B) The light will slow down upon attempting to enter the next medium.

(C) The medium which the light is attempting to enter must have a higher refractive index than the medium it is in.

(D) There must be an air gap between the two mediums involved.
A length of resistance wire has a potential difference applied across its ends. Which graph of current versus length shown below most closely resembles the graph obtained as the diameter of the resistance wire is varied?

(A) \[ \text{I vs. diameter} \]

(B) \[ \text{I vs. diameter} \]

(C) \[ \text{I vs. diameter} \]

(D) \[ \text{I vs. diameter} \]

Two bar magnets are approaching each other, as shown in the diagram below.

Which statement correctly describes the magnetic field due to the magnets at a point mid-way between the two north poles as the distance between the bar magnets decreases?

(A) It gradually increases.

(B) It remains unchanged at zero.

(C) It gradually decreases.

(D) It approaches zero.
7 Of the circuits shown, which would have the most power being delivered by the battery?

(A) \[12V \quad 4\ \Omega \quad 4\ \Omega\]

(B) \[10V \quad 4\ \Omega \quad 3\ \Omega\]

(C) \[8V \quad 6\ \Omega \quad 2\ \Omega\]

(D) \[6V \quad 2\ \Omega \quad 2\ \Omega\]

8 An electricity bill states that a house has been using an average of 25 kW h of electricity per day. What average use per day will the next bill show if the people in the house take steps to reduce their electricity use by:

- using 5 lights of 100W each for one hour less each day; and
- use the air-conditioner of 2000W for two hours less per day?

(A) 22.5 kW h

(B) 20.5 kW h

(C) 18 kW h

(D) 16 kW h
9  For which journey is the average velocity the greatest?

(A) A jet plane flies from Sydney to Brisbane (800 km one way) and returns to Sydney in 3 hours.

(B) A runner wins a 42 km marathon race, starting and finishing in the same stadium, in 2 hours and 14 minutes.

(C) The Earth makes one complete revolution around the Sun in one year.

(D) A sailing boat sails from Sydney to Hobart (1200 km) in 8 days and 3 hours.

10 Two identical steel balls are moving as shown.

\[
\begin{align*}
&\text{2.0 m/s}^{-1} & \quad \text{2.0 m/s}^{-1} \\
\end{align*}
\]

The balls collide elastically. Which is the only possible outcome after the collision?

(A) \[\begin{align*}
&0 \text{ m/s}^{-1} & \quad 0 \text{ m/s}^{-1} \\
\end{align*}\]

(B) \[\begin{align*}
&2.0 \text{ m/s}^{-1} & \quad 2.0 \text{ m/s}^{-1} \\
\end{align*}\]

(C) \[\begin{align*}
&0 \text{ m/s}^{-1} & \quad 4 \text{ m/s}^{-1} \\
\end{align*}\]

(D) \[\begin{align*}
&2.0 \text{ m/s}^{-1} & \quad 2.0 \text{ m/s}^{-1} \\
\end{align*}\]

11 A 1000 kg car is moving at 25 m/s\(^{-1}\) when a net force of 200 N acts to slow the car. This force acts while the car moves through a distance of 300 m. The new speed of the car is:

(A) 17.5 m/s\(^{-1}\)

(B) 19.0 m/s\(^{-1}\)

(C) 22.5 m/s\(^{-1}\)

(D) 23.0 m/s\(^{-1}\)
The penetrating power versus charge for several forms of radiation, X, Y and Z, is plotted on the axes as shown.

The position on these axes of a newly discovered particle comprised of 4 protons and 2 neutrons would be closest to:

(A) A
(B) B
(C) C
(D) D

“Stars owe their existence to gravity.” This statement was made because:

(A) gravity causes the pressure necessary in the core of stars.
(B) gravity prevents the formation of heavy elements anywhere else except in stars.
(C) without gravity, the Big Bang could not have happened.
(D) gravity causes the creation of black holes.

A suitable hypothesis in a first hand investigation is necessary as:

(A) it allows us to tell if the results are valid.
(B) it focuses the investigation by making a tentative statement which can be tested.
(C) a wrong hypothesis means the investigation was wrong.
(D) it states what the aim of the investigation really is.
Four dart players threw four darts each at the dart board. They were aiming for the bull’s eye in the centre.

Which player was least accurate?

(A)     (B)

(C)     (D)
Part B – 60 marks
Attempt Questions 16-32
Allow about 1 hour and 30 minutes for this part.

Answer the questions in the spaces provided.
Show all relevant working in questions involving calculations.

Question 16 (7 marks)

To demonstrate the relationship between current, voltage and power for a model electric heating coil you performed an investigation requiring certain apparatus.

(a) Use a labelled diagram to describe the apparatus used.  

(b) Outline what measurements were recorded (actual results are not required).  

(c) Recall the relationship that was found in the investigation.

Question 16 continues on page 11.
Question 16, continued

(d) Describe two ways in which the validity of this investigation may be improved.

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Question 17 (3 marks)

Compare and contrast the motion of the medium as mechanical transverse waves and longitudinal waves pass through it.

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Question 18 (3 marks)

The solar wind has been known to cause damage to satellites in orbit around the Earth.

Explain how the solar wind might do this.

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Marks

2

3

3
**Question 19 (2 marks)**

The early Pioneer spacecraft are now over $2.0 \times 10^{13}$ m away from Earth, sending information back to Earth using a 4.0 watt radio transmitter.

How many times stronger is the signal from a mobile phone when it is transmitting 4.0 watts from a distance of 2.0 km away?

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**Question 20 (2 marks)**

One application of reflection is in parabolic satellite dishes, used to gather the radio signal from a satellite to reflect it onto the receiving antenna which is placed at the focus of the dish.

Use a diagram to show at least four “rays” of radio waves being focussed onto the receiver of such a parabolic satellite dish.
Question 21 (4 marks)

7.30 x 10\(^{19}\) electrons flow past a point in a conductor in the time of 4.00 s.

(a) What current, expressed as amperes, does this charge flow represent?

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(b) The resistance of the conductor through which this charge is flowing is known to be 4.50 \(\Omega\). What must the potential difference be across the ends of the conductor?

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Question 22 (4 marks)

A circuit diagram is drawn as shown:

![Circuit Diagram]

(a) Explain what happens when the circuit shown above is connected, including the readings on the meters.

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Question 22 continues on page 14.
Question 22 (continued)

(b) Re-arrange the above circuit diagram so that when it is connected, the voltage across the resistance and the current through it will be shown on the meters correctly. Sketch this new circuit diagram below.

Question 23 (4 marks)

Discuss the relative dangers of an electric shock from a 240 V AC mains supply (as used in Australia) and a 110 V DC supply (as was used by Edison from the 1870s) on the muscles of the body.
Question 24 (3 marks)

When an electromagnet is constructed, placing an iron nail into the coils improves the strength of the magnetic field produced.

Using a diagram to show the shape and direction of the magnetic field with magnetic lines of force, explain why the iron nail has this effect.

Question 25 (2 marks)

“A car travelled from city P to city Q with an average speed of 80 km h\(^{-1}\). The car’s average velocity for the same trip was 60 km h\(^{-1}\) north.”

For the above statement, explain how the difference between the car’s average speed and its average velocity could occur. A diagram may also be used.
Question 26 (4 marks)

A truck travelling to the east at 20 m s\(^{-1}\) approaches a roundabout at the same time as a car travelling to the north at 30 m s\(^{-1}\), as shown in the diagram.

(a) To an observer in the truck, the car’s speed relative to the truck is greater than 30 m s\(^{-1}\). By finding the car’s velocity relative to the truck, show why this is so.

(b) In terms of kinetic energy, explain why a head-on crash on a fast highway between two cars has consequences more severe than a similar crash on a slower local suburban road.
Question 27 (5 marks)

A newspaper reported that a car was accidentally driven off a multi-storey car park, landing nose-down on the concrete footpath below “with a force equal to a crash into a wall at 90 km h⁻¹”. Assume the mass of the car to be 1.00 x 10³ kg.

(a) Find the kinetic energy of the car just before crashing into the footpath.

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(b) Assuming that the car drove off the car park horizontally at a very slow speed, find the height of the car park above the footpath below.

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Marks

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Question 28 (3 marks)

Delivery vans owned by Australia Post have a thick wire mesh protection screen installed behind the driver’s seat. By referring to the concepts of inertia and Newton’s Laws of Motion, explain the reasons why this protection is now added to all similar commercial delivery vans.

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Marks

Question 29 (4 marks)

(a) Outline two major differences between the models of the Universe in the time of Aristotle and the time of Newton.

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(b) Account for the changes made to the model of the Universe by astronomers in the 1600s in terms of the advances in technology.

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Question 30 (5 marks)

Outline the processes that are believed to have occurred from the beginning of the Universe until the formation of the first galaxies.

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Question 31 (2 marks)

An investigation was performed to gather information in order to calculate the refractive index of perspex.

Identify any two steps in the method of this investigation that should be taken to ensure that the result is reliable and for each step, discuss how it may increase the reliability.

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Question 32 (3 marks)

The intensity of the radiation emitted versus the wavelength of the radiation for two stars is plotted on the same set of axes, as shown.

(a) Compare the surface temperatures and colours of star A with those of star B.

(b) If the two stars are the same size, state with reasons what can be said about the brightness of star A compared to the brightness of star B?