NAME: Mr. EMEKY

TEACHER: SOLUTIONS

2004

PRELIMINARY COURSE
FINAL EXAMINATION

NOTE. Question 18 is worth 4 Marks NOT 5.

PHYSICS

2 UNIT

General Instructions

- Assessment Task No. 4
- Weighting – 40%
- Reading time – 5 minutes
- Working time – 2 hours
- Physics Formulae & Data Sheets are attached to the back of this paper.
- The Multiple Choice Answer Sheet is attached to the back of this paper. Carefully tear it off ready for use and write your name on it.

This examination has TWO parts.

Part A **Multiple Choice**

Total marks **(16)**
- Attempt ALL Questions
- Mark your answers on the Multiple Choice Answer Sheet provided.
- Allow about 30 minutes for this part.

Part B **Extended Answer Questions**

Total marks (50)
- Attempt ALL Questions
- Write your answers in the spaces provided in this Exam Paper.
- Allow about 1 hour and 30 minutes for this part.

ANSWERS

Name: R. EMERY TEACHER: _____

Part A – Answer Sheet

1	(A)	○	(B)	○	(C)	●	(D)	○
2	(A)	○	(B)	●	(C)	○	(D)	○
3	(A)	●	(B)	○	(C)	○	(D)	○
4	(A)	○	(B)	○	(C)	○	(D)	●
5	(A)	○	(B)	○	(C)	○	(D)	●
6	(A)	●	(B)	○	(C)	○	(D)	○
7	(A)	●	(B)	○	(C)	○	(D)	○
8	(A)	○	(B)	●	(C)	○	(D)	○
9	(A)	○	(B)	○	(C)	●	(D)	○
10	(A)	○	(B)	○	(C)	○	(D)	●
11	(A)	○	(B)	●	(C)	○	(D)	○
12	(A)	●	(B)	○	(C)	○	(D)	○
13	(A)	○	(B)	●	(C)	○	(D)	○
14	(A)	○	(B)	○	(C)	○	(D)	●
15	(A)	○	(B)	●	(C)	○	(D)	○
16	(A)	○	(B)	○	(C)	●	(D)	○

YR. 11 Final EXAM SOLUTIONS

PRELIM. COURSE 2004

MULTIPLE CHOICE QUESTIONS
Total Marks (16)
Attempt questions 1 – 16
Allow about 30 minutes for this part

Answer the questions on the Multiple Choice Answer Sheet provided.

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1. A popular Sydney radio station has a transmitting frequency of 96.1 MHz. What is the wavelength of this wave in metres?

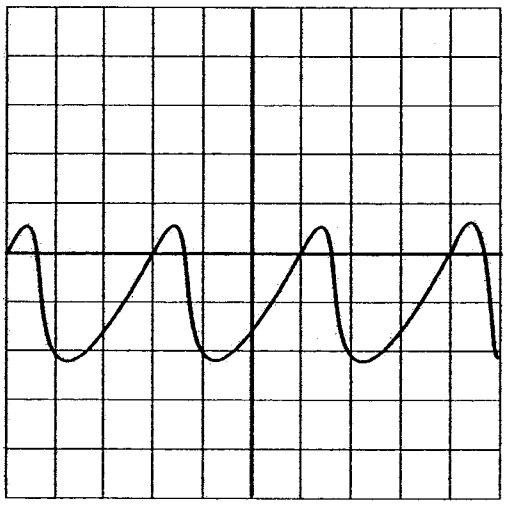
(A) 3.2×10^{7}
(B) 3.1×10^{6}
(C) 3.1
(D) 0.32

$v = f\lambda$, $f = \frac{v}{\lambda}$ $\lambda = \frac{v}{f} = \frac{3\times10^{8}}{96.1\times10^{6}}$

2. An electromagnetic wave may undergo total internal reflection when

(A) The wave travels from a medium where its velocity is relatively high to a medium where its velocity is relatively low.
(B) The wave travels from a medium where its velocity is relatively low to a medium where its velocity is relatively high.
(C) The angle of incidence is larger than the angle of refraction.
(D) The angle of incidence is smaller than the critical angle.

3 The following diagram illustrates a sound wave appearing on the screen of an oscilloscope.



The speed of the wave is 343 m/s. Each horizontal grid division on the screen is worth 5×10^{-3} seconds. Determine the wavelength of the wave.

(A) 5.1 m
(B) 15 m
(C) 69 m
(D) 1700 m

$v = f\lambda$ $\lambda = \frac{v}{f}$ $f = \frac{1}{T}$ $T = 3$ divs $= 15\times10^{-3}$ s

$= \frac{343}{66.6}$ $= 66.6$ Hz

$= 5.145$ m

4. Which of the following stars would have the lowest surface temperature?

(A) blue giant

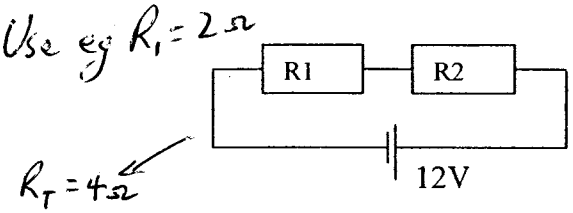
(B) yellow main sequence

(C) white dwarf

(D) red giant

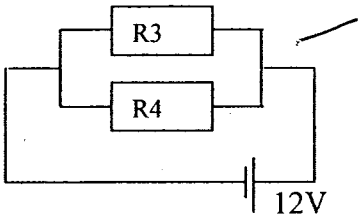
5. The diagrams show two different circuits. All resistors are identical.

Use eg $R_1 = 2\Omega$



$R_T = 4\Omega$

$I_T = 3A$



$R_T = 1\Omega$

$I_T = 12A$

I in each resister = 6A

Which statement about the currents flowing in the resistors is correct?

(A) The current in all resistors is the same.

(B) The currents in R1 and R2 are one quarter the currents in R3 and R4.

(C) The currents in R1 and R2 are twice the currents in R3 and R4.

(D) The currents in R1 and R2 are half the currents in R3 and R4.

6. Which statement about electrical power is correct?

(A) Power is a measure of the rate at which electrical energy is changed into other forms of energy.

(B) Power measures how much electrical energy is used by an appliance each time it is used.

(C) Power is a measure of the amount of energy a power supply can supply to an electrical circuit.

(D) The power of an energy source is determined by its voltage.

7. What property of a fuse wire makes it useful as a safety device in the home?

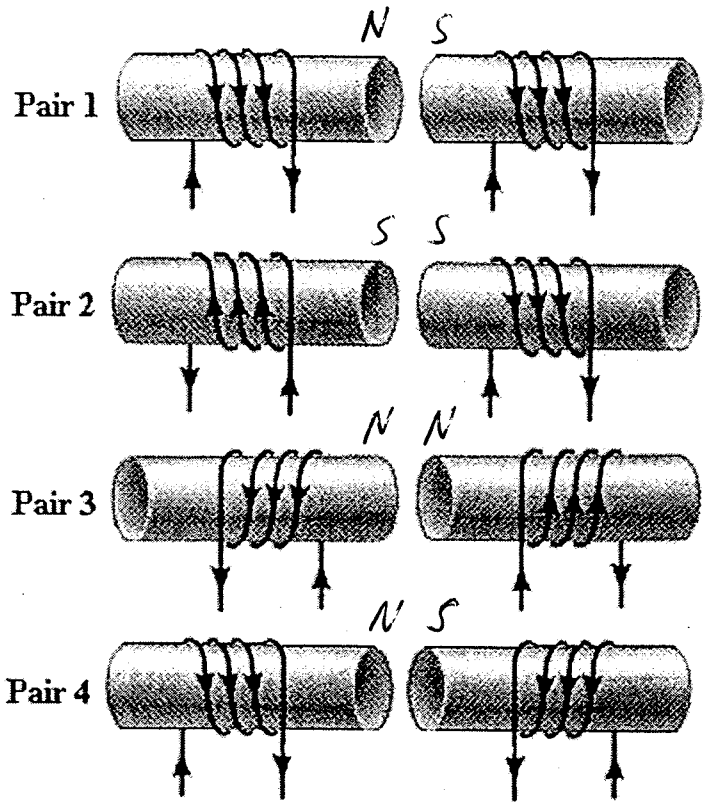
(A) It has a relatively low melting point.

(B) It can be readily replaced.

(C) It has a lower resistance than the wires used in the rest of the circuit.

(D) It has a large cross-sectional area.

8. Jenny was given four pairs of coiled wires. Each coil was linked to its own DC source.



Use RH Grip Rule

Which two pairs of coils did Jenny correctly predict would attract each other?

(A) Pairs 2 and 3
(B) Pairs 1 and 4
(C) Pairs 3 and 4
(D) Pairs 1 and 2

9. A car of mass 3600 kg is travelling in a circular path of radius 10m at a speed of 30km h^{-1}. What is the sideways force needed to keep the car moving in the circular path?

$8.3 ms^{-1}$

$F = \frac{mv^2}{r} = \frac{3600 \times 8.3^2}{10}$

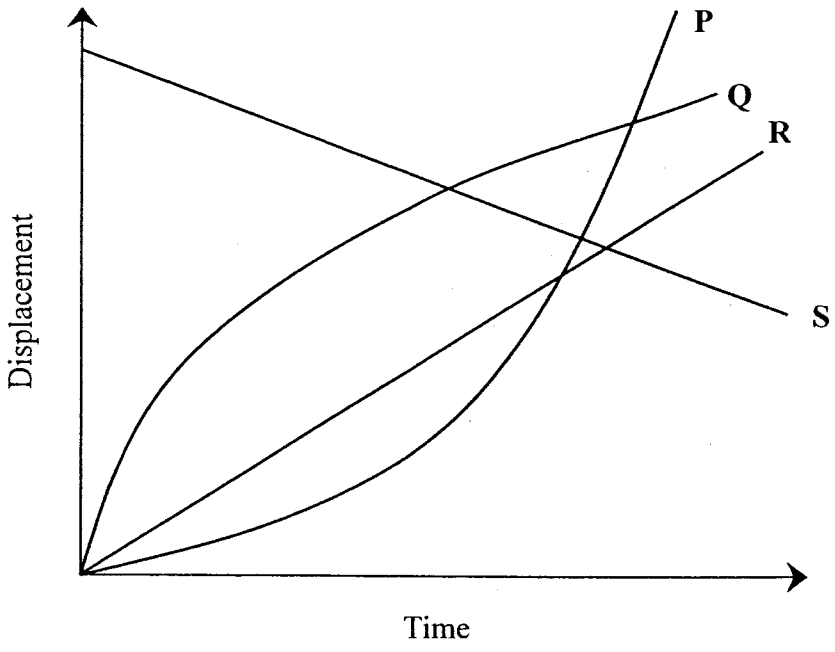
$\doteq 24800\ N$

(A) 0 N
(B) 10800 N
(C) 25000 N
(D) 324000 N

10. A safety device is utilised in a circuit in a house. When a dangerous amount of current flows, the generated magnetic field from an electromagnet in the circuits, is large enough to attract a switch, which breaks the circuit. This safety device is called

(A) a fuse
(B) double insulation
(C) earthing
(D) a circuit breaker

11. The displacement vs time graph below shows graphs of four different motions.



Which graph shows the motion of an object that has decreasing velocity?

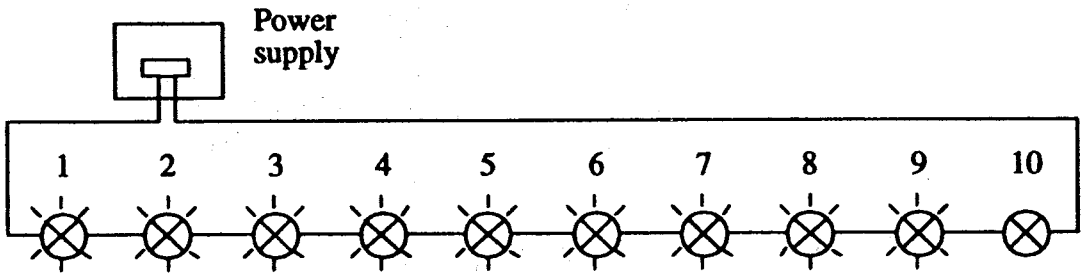
(A) Graph P
(B) Graph Q
(C) Graph R
(D) Graph S

12. The inertia of a vehicle is its
(A) tendency to remain at uniform velocity or in rest position.
(B) mass multiplied by its velocity
(C) change in momentum
(D) mass

13. Which statement correctly compares the terms *luminosity* and *brightness*?

(A) Brightness and luminosity both refer to the energy radiated by a glowing object.
(B) Luminosity is the energy radiated per second while brightness is the energy per square metre received per second.
(C) Brightness is the energy radiated per second while luminosity is the energy per square metre received per second.
(D) Luminosity is the power of a star and brightness is the energy radiated by a glowing object.

14. **A set of Christmas tree lights contains ten lamps connected *in series* as shown in the diagram.**



When the lamps are plugged in and switched on, it is found that lamps 1 to 9 glow brightly but lamp 10 does not.

Which of the following statements best explains why lamp 10 is not glowing brightly?

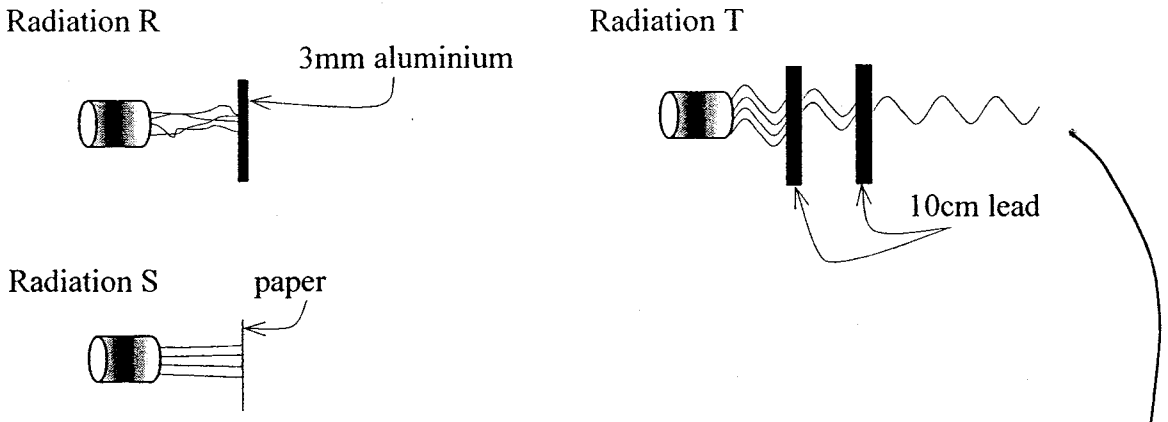
(A) The filament of lamp 10 is broken.

(B) There is a break in the wire leading to lamp 10.

(C) The lamps 1 to 9 are blocking the current from lamp 10.

(D) The resistance of lamp 10 is too low.

15. The diagram shows the results of testing the penetrating ability of different kinds of radiation, labelled R, S and T.



Which alternative correctly names the radiation types?

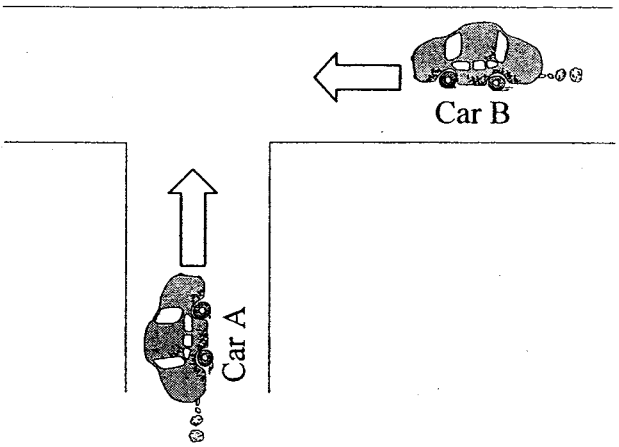
	Radiation R	Radiation S	Radiation T
(A)	beta	gamma	alpha
(B)	beta	alpha	gamma
(C)	gamma	beta	alpha
(D)	gamma	alpha	beta

16. **The velocity of object A relative to object B is defined as the velocity of A minus the velocity of B, or mathematically:**

$$\vec{v}_{AB} = \vec{v}_A - \vec{v}_B$$

Use this definition to answer the following question.

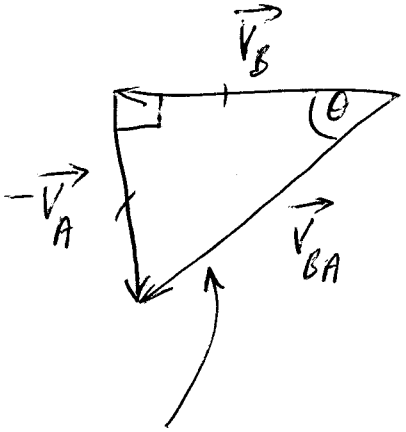
Two vehicles, each travelling at 60km h^{-1}, approach an intersection.
Car A approaches from the south and car B from the east.



What is the velocity of car B relative to car A?

(A) 60 km h^{-1} SW
(B) 60 km h^{-1} NE
(C) 85 km h^{-1} SW
(D) 85 km h^{-1} NE

$\vec{V}_{BA} = \vec{V}_B - \vec{V}_A$



Hypotenuse MUST be bigger than 60 km h^{-1}

EXTENDED ANSWER QUESTIONS
Total Marks (50)
Attempt questions 17 – 28
Allow about 1 hour and 30 minutes for this part

Answer the questions in the space provided on this paper.

Question 17 (2 marks) **Marks 2**

The electromagnetic radiation that reaches the outer atmosphere of the Earth is approximately 1400 Wm^{-2}. If the distance from the Sun to the Earth is 1.4×10^{11} m and the distance from the Sun to Uranus is 2.8×10^{12} m, determine the intensity of the electromagnetic radiation reaching Uranus.

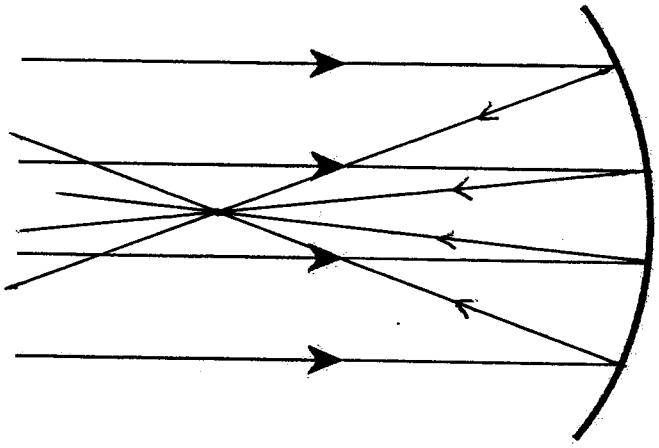
$\frac{I_U}{I_E} = \frac{d_{SE}^2}{d_{SU}^2}$ $\therefore I_U = \frac{I_E \cdot d_{SE}^2}{d_{SU}^2}$

$= \frac{1400 \times (1.4 \times 10^{11})^2}{(2.8 \times 10^{12})^2}$

$= 3.5\ W/m^{-2}$

Question 18 (4 marks) ← Yes 4 Marks NOT 5. **Marks**

4 rays of light are incident upon a mirrored surface.



Rays come to a focus as shown. Arrows on all rays.

(a) Identify the shape of the surface. **1**

Concave

(b) On the diagram, construct the rays as they reflect off the surface. ~~2~~ 1

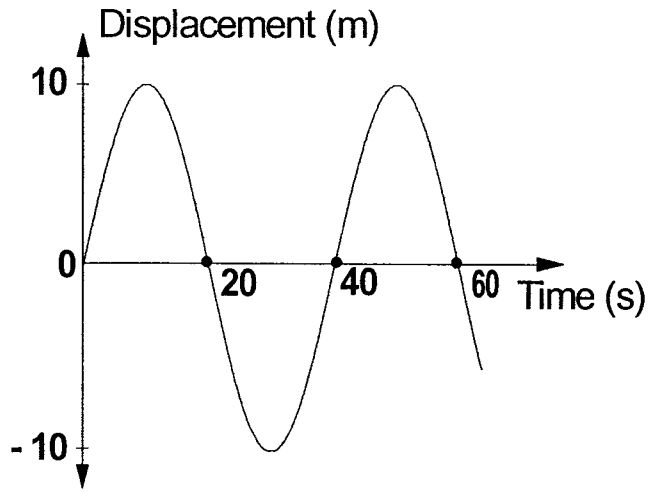
(c) Describe an application for the surface. 2

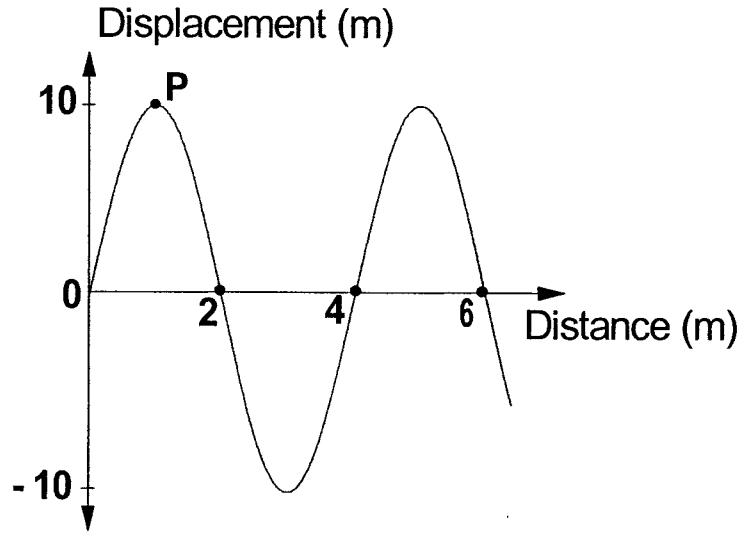
eg Car headlights use concave (parabolic) reflectors. Globe is placed at the focus. Light rays from globe strike mirror and are reflected as parallel rays of light.

NOTE: Lots of applications – reflecting + radio telescopes, satellite dishes, solar furnaces etc.

QUESTION 19 (4 Marks) **Marks**

The graphs below describe the same transverse wave.





For this transverse wave determine the:

(a) Wavelength: 4m (from 2nd graph) **1**

(b) Amplitude: 10m (from either graph) **1**

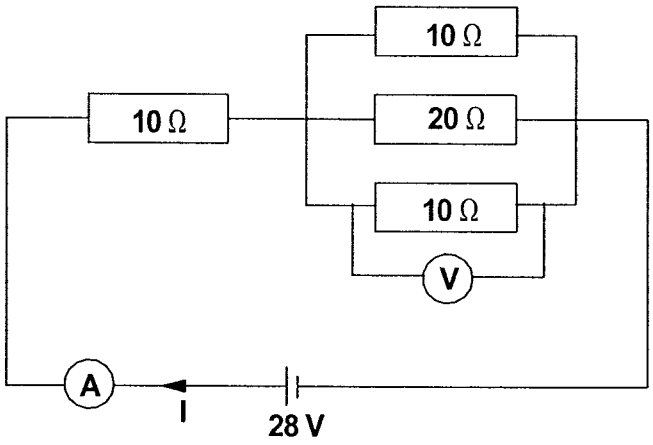
(c) Frequency: $f = \frac{1}{\text{period}} = \frac{1}{40}$ Hz = 0.025 Hz (from graph 1) **1**

(d) Vertical displacement of point P, 20s later than the time shown above.

−10m **1**

QUESTION 20 (5 Marks)

This question refers to the following electric circuit.



In the above circuit the reading on the voltmeter is 8V. Determine:

(a) The potential difference across the 20Ω resistor.

8 V

1

(b) The current in the 20Ω resistor.

$I = \frac{V}{R} = \frac{8}{20} = 0.4\,A$

1

(c) The total resistance of the circuit.

$R_T = 10 + \left(\frac{1}{10} + \frac{1}{20} + \frac{1}{10}\right)^{-1}$

$= 10 + 4$

$= 14\,\Omega$

1

(d) The reading on the ammeter.

$I_T = \frac{V_T}{R_T} = \frac{28}{14} = 2\,A$

1

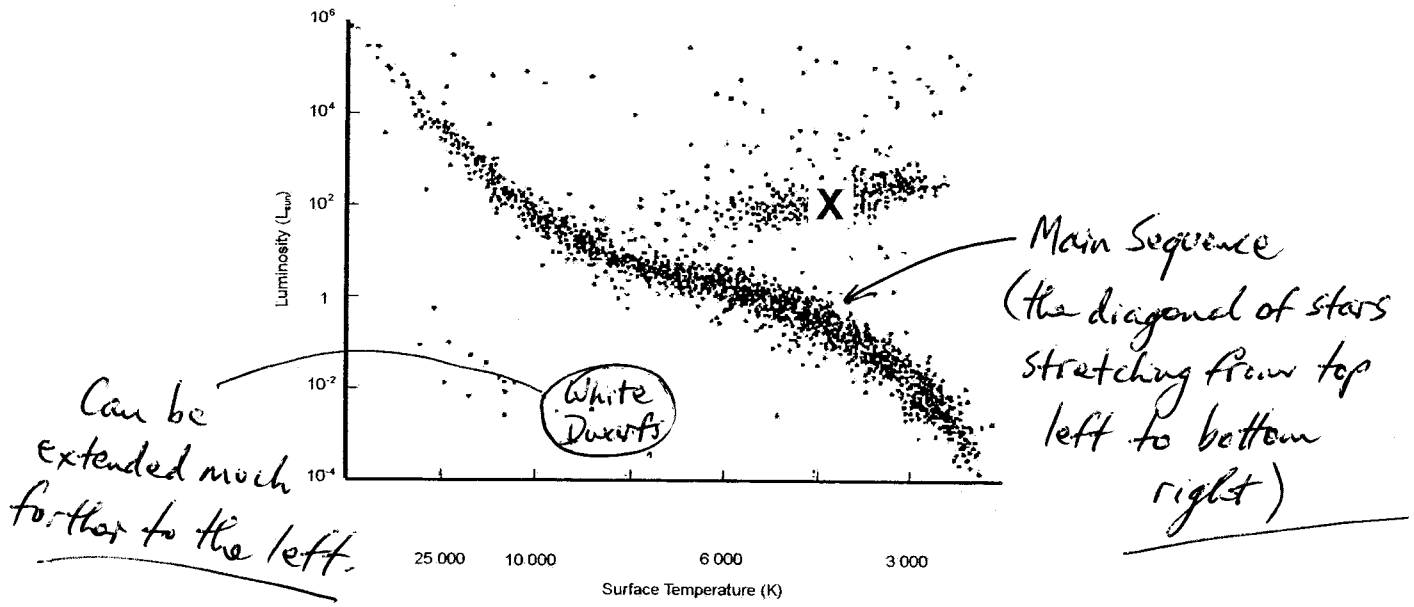
(e) The power dissipated by the whole circuit.

$P = VI = 28 \times 2 = 56\,W$

1

QUESTION 21 (4 Marks)

This question refers to the Hertzsprung-Russell diagram below.



(a) **Identify the main source of emission of radiation from stars of the type located at position X.**

Fusion of helium (or helium burning) **1**

(b) **On the HR diagram clearly label the Main Sequence and the position of White Dwarf stars.** **1**

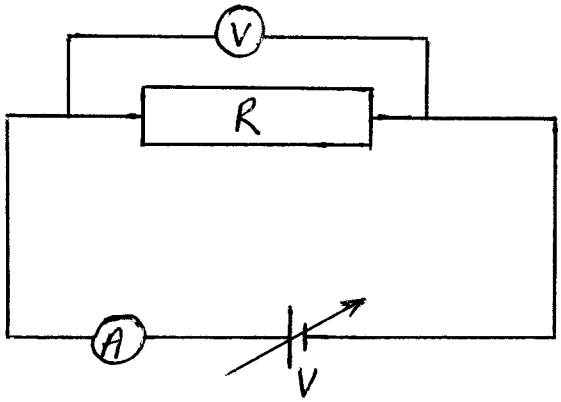
(c) **Our own Main Sequence star, the Sun, emits both particles and radiation in the direction of the Earth. A continuous stream of particles passes the Earth at speeds up to 700 km/s. Identify the particulate nature of this solar wind.**

protons + electrons **2**

(If they replace either of the above with "atomic nuclei" or "neutrinos" — that is OK.)

QUESTION 22 (5 Marks)

Describe an experimental method that could be used to determine whether a particular resistor, R, obeys Ohm's Law. As part of the method, draw a diagram of the circuit you would use.



5

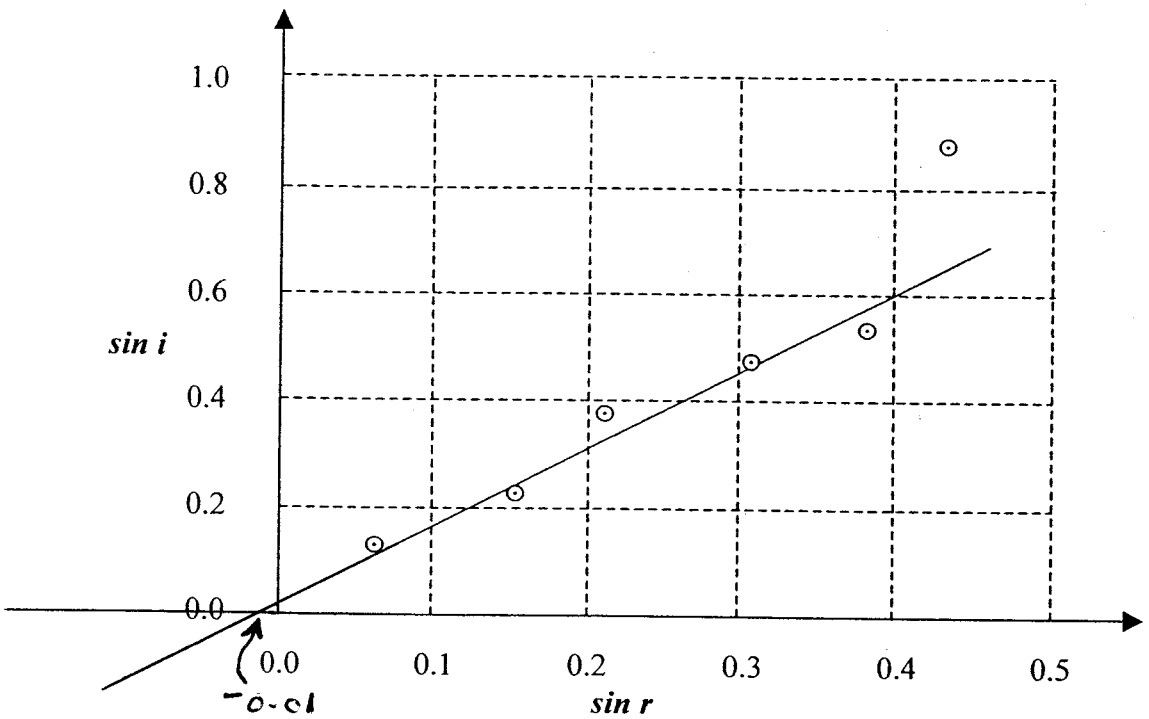
Set up circuit as shown with voltmeter in parallel with R and ammeter in series with R. Set variable voltage source on lowest setting and record potential difference across and current through R. Repeat experiment many times by increasing voltage applied across the circuit.

Plot potential difference V's current values for R on a graph. Draw the curve (line) of best fit. Examine curve of best fit. A straight line would indicate that R is an ohmic resistor. A non-linear curve would indicate that R was non-ohmic.

(*) FOR 5 Marks would expect ⇒ correct positions of (V) + (A)
vary circuit voltage, measure V and I for R
repeat expt many times
graph V vs I (or I vs V)
correct interpretation of results
(eg straight line → R = ohmic)

Question 23 (6 marks)

A student performed an experiment to measure the way a beam of light was bent upon entering a transparent prism. The following graph was produced from the measurements.



(a) What relationship does the data suggest? Use this relationship to find the refractive index of the transparent material. **2**

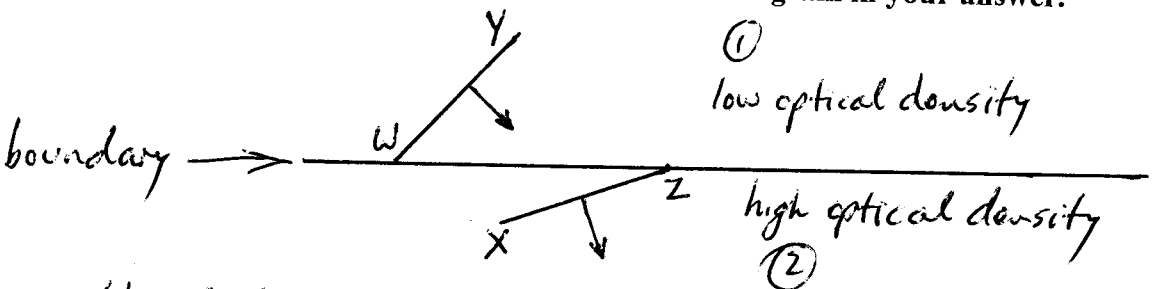
$\sin i \propto \sin r$; $RI = \frac{\sin i}{\sin r}$ = slope of graph = $\frac{0.6 - 0}{0.4 - (-0.01)}$

$= 1.5$

(b) Given that the refractive index of the transparent material is constant, assess the reliability of the above results. **2**

Data points are mostly close to line of best fit indicating high reliability. One outlier point is present – the result of an unreliable measurement.

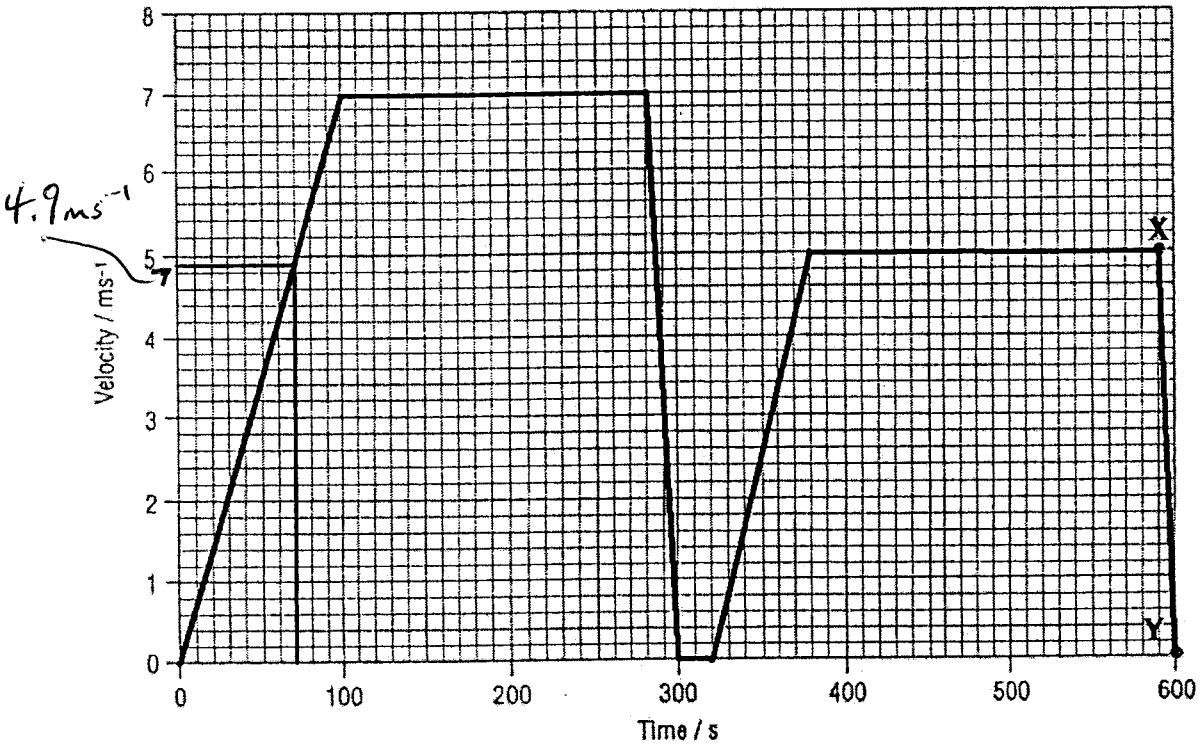
(c) Refraction is caused by the change in velocity of a wave as it crosses the boundary between two different media. Outline how the change in velocity of a wavefront causes the wavefront to bend. Use a diagram in your answer. **2**



Wavefront WY strikes boundary and moves into a medium in which velocity is reduced. From W, wavefront travels to X in same time as Y takes to reach boundary. Since WX < YZ, clearly WY cannot be parallel to XZ – the change in velocity has caused the wavefront WY to bend.

Question 24 (4 marks) **Marks**

Peter cycles to school from home. The graph represents his journey.



(a) What is Peter's velocity after 70 seconds? **1**

4.9 ms⁻¹

(b) **After how many seconds did Peter stop for the first time?** **1**

300 s

(c) Calculate Peter's acceleration at the end of his journey (between points X and Y). **1**

$a = (v-u)/t = (0-5)/10 = -0.5\ ms^{-2}$

(d) If Peter and his bike have a combined mass of 60 kg, calculate the resultant force acting on Peter and his bike as he reduces his velocity at the end of his journey (between points X and Y). **1**

$F = ma = 60 \times -0.5$

$= -30\ N$

or 30N in opposite direction to original motion.

Students must answer this verb to get full marks!

QUESTION 25 (4 Marks)

Assess the effects of sunspot activity on Earth's power grid and satellite communications.

4

Assessment

Link between sunspots + effects on Earth

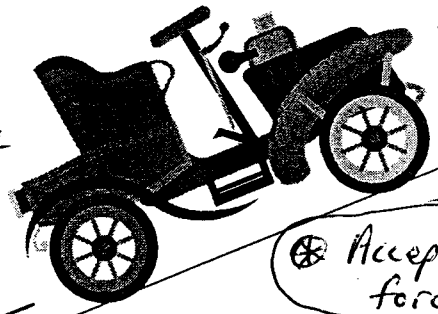
Effect on power grid

Effect on satellites

Sunspot activity can and does produce extremely severe effects on Earth's power grid and satellite communications. Especially when sunspot cycle is at a maximum, flares and prominences hurl huge quantities of high energy radiation + charged particles towards Earth, causing magnetic storms. These storms produce power surges in electrical power lines that can burn out the lines, producing massive blackouts. The storms disrupt radio communications including satellite communications. Satellites can also be damaged or destroyed by the overloading of their electrical circuits as a result of huge variations in the magnetic field in which they are moving.

Question 26 (4 marks) **Marks**

The diagram shows a car moving uphill at constant velocity.



Force of engine up hill

3 forces for 3 marks

Component of weight of car acting downhill

* Accept vertical weight force

Force of friction opposing motion up hill (includes air resistance)

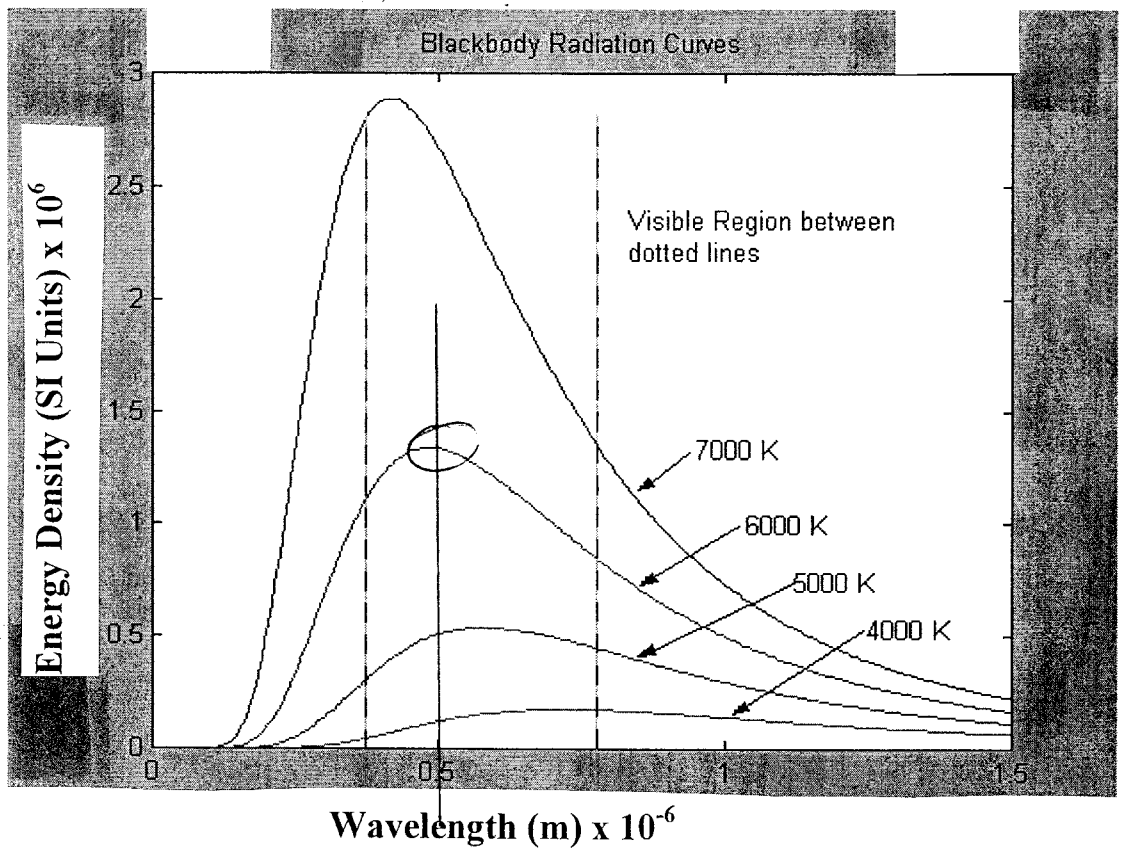
(a) On the diagram, use labelled arrows to show all the forces acting on the car that determine the velocity of the car. **3**

(b) Write a statement to describe the net force on the car. **1**

The net force on the car is zero.

QUESTION 27 (2 Marks)

The graphs below show the amount of radiation (energy density) emitted from a body at various temperatures as a function of wavelength.



(a) At what wavelength (approximately) does the body emit the most radiation, when the body is at a temperature of 6000 K?

0.5×10^{-6} m (or 5×10^{-7} m) **1**

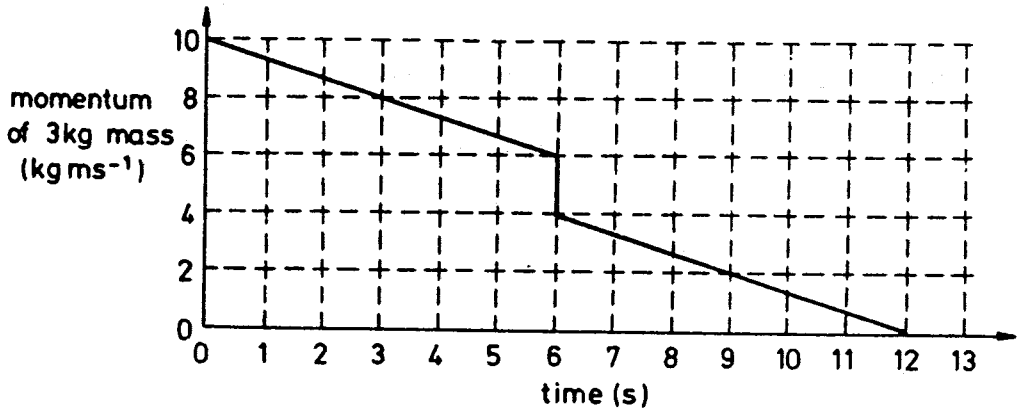
(b) The graphs show a trend between the temperature of the body and the dominant wavelength of radiation emitted from the body. Identify this trend.

The higher the temperature, the lower the wavelength of maximum emission **1**

(or equivalent statement)

QUESTION 28 (6 Marks) **Marks**

The graph below shows the time variation of momentum for a 3 kg mass moving in a straight line and subjected to a constant retarding force. During this time the object undergoes a collision.



(a) Find the speed of the mass at time t = 3s.

At $t = 3s$, $p = 8\,Ns$ and so $v = p/m = 8/3\ ms^{-1}$ 1

$= 2.67\ ms^{-1}$

(b) Determine the magnitude of the retarding force acting on the 3 kg mass at time t = 3s.

$F = \frac{\Delta p}{t}$ = slope of graph = $\frac{10-6}{6-0} = 0.67\,N$ 2

(c) At t = 6s, the 3 kg mass collides head on with a stationary 1 kg mass. The two masses move off in the same straight line. Calculate the speed of the 1kg mass immediately after the collision.

Before	After
3kg → 1kg	3kg → 1kg →
$p_{3B} = 6\,Ns$ $p_{1B} = 0\,Ns$	$p_{3A} = 4\,Ns$ $p_{1A} = ?$

3

From $p_{before} = p_{after} \Rightarrow 6 = 4 + p_{1A}$

$\therefore p_{1A} = 2\,Ns$ and so speed of 1kg mass after collision is $v = p/m = 2/1 = 2\ ms^{-1}$