JUNE 2004

SECTION A

ANSWER ONLY TWO QUESTIONS FROM THIS SECTION

1. (a) (i) State Newton's second law of motion

(1 mark)

To investigate the above law a student mounts a trolley on an inclined plane shown in Figure 1 A, B, C, and D are the forces acting on the trolley.

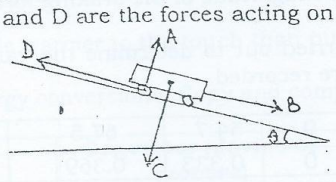

Figure 1

The trolley pulls a length of ticker tape through a timer (not shown) which has frequency of 50 HZ

(ii) Name each of the forces A, B, C and D.

(4 marks

(iii) Describe how the student uses the set-up to obtain the acceleration of the trolley f a fixed value of force

(1 mark)

(iv) How does he proceed to show finally that a α F, where,
a = acceleration of the trolley
F = the applied force

(2 marks

(b) Explain using relevant principles of Physics why a hunter who sits on a branch of a tree suc that his legs hand freely is pushed backwards, when he places his gun against his shoulder ar fires

(2 marks

(c) A simple weighting machine is made of a uniform bar of length, 1.0m and mass 0.6kg, whi is pivoted at a frictionless pivot 0.2m from one end. When a load of 350kg suspended at the er of the short arm, a weight W has to be suspended at the end of the long arm to balance the b horizontally.

(i) Draw a labelled force diagram to show the forces acting on the bar

(1 mark)

(ii) Calculate the magnitude of W

(2 marks

(iii) Would your answer in (ii) above be greater or smaller, if the point was n frictionless? Explain your answer

(2 marks

2. (a) (i) State the Principle of conservation of linear momentum

(1 mark)

A car of mass 2500kg and moving at a speed of 30m/s, collides with another moving car of mass 1500kg. After collision, both cars stick together and move with a common initial velocity of 15m/s in the initial direction of the car of mass 2500kg.

(ii) Calculate the initial speed and direction of motion of the car of mass 1500kg **(3 marks)**

After collision, the new composite car moves for 4 s in a straight line before coming to rest. Assume a uniform retardation acts on it.

(iii) Calculate the distance it moved during this time **(2 marks)**

(iv) Calculate the magnitude of the braking force, which brought the car to rest. **(2 marks)**

b) An experiment was carried out to determine the value of the acceleration due to gravity (g). The following readings were recorded.

$h/m \times 10^{-2}$	0	54.7	67.5	84.1	96.0	109.6
t/s	0	0.333	0.369	0.412	0.441	0.449
t^2/s^2						

Where h = vertical height through which a steel ball falls under gravity and t = time of fall.

(i) What is meant by acceleration due to gravity? **(1 mark)**

(ii) Copy and complete the above table by filling in values of t^2 (calculated to 2 decimal places) **(1 mark)**

(iii) Draw a graph of h (y-axis) against t^2 (x-axis) and calculate its gradient. **(5 marks)**

(iv) Use the gradient of your graph to calculate the value of g. **(2 marks)**

3. (a) For a tank used to store petrol or water, state and give reasons for;

(i) The nature of its colour. **(2 marks)**

(ii) The type of shape it has. **(2 marks)**

(b) Water ripples produced by a straight vibrator travel across the surface of water in a ripple tank. The distance between a crest and an adjacent trough is 2.0×10^{2}m.

(i) Calculate the wavelength of the wave **(2 marks)**

The wave travels 0.48m in 1.2s. Calculate:

(ii) The average speed of the wave **(1 mark)**

(iii) Frequency of the vibrator **(1 mark)**

In the middle of the tank is a partially immersed plane boundary (which projects above the water surfaces). As the wave moves across the tank it meets this boundary at an angle of incidence of 30^{0}.

(v) What is the name of this effect? **(1 mark)**

(c) A wire is stretched on a sonometer board between two bridges, one of which can be moved without altering the tension in the wire. When the bridges are 0.6m apart, the fundamental frequency is 300Hz. A light paper rider is placed on the wire and a tuning fork marked 256Hz is struck and its stem placed on one of the bridges.

(i) Calculate the new distance between the bridges when the rider is thrown off **(2 marks)**

(ii) Explain why the rider is thrown off at this new separation of the bridges **(2 marks)**

(iii) Name one practical application of the phenomenon involved in this experiment **(1 mark)**

SECTION B

ANSWER ONLY TWO QUESTIONS ROM THIS SECTION

4. (a) (i) Explain why water at 0°C feels warmer to the touch than pure ice at 0°C **(2 marks)**

(ii) The table below is about energy conversions. Copy and complete the table

	Initial energy	Converter (device or process)	Final energy
(i)	Electrical		
(ii)		Combustion (burning)	

(4 marks)

(b) A car of mass 1000kg steadily increase its speed to 12m/s in 10s. Calculate

(i) Its kinetic energy at the end of this process **(2 marks)**

(ii) The power it developed during the process **(1 mark)**

To bring the car to rest, the driver disengages the gears and allows the car freely run a straight slope. The slope is inclined at 30° to the horizontal and has a frictional force o 200N.

(iii) What is the magnitude of the work that must be done to bring the car to rest as i runs up to slope? Explain. **(2 marks)**

(iv) Calculate the total braking force acting on the car (as it runs up to slope). Henc calculate the distance the car moves along the slope before coming to rest. **(3 marks)**

(v) What is the name of the final energy the car possesses when it comes to rest Calculate its magnitude. **(3 marks)**

5. (a) There are two factors which determine the magnitude of atmospheric pressure at a give place. For each factor.

(i) State the relationship between it and atmospheric pressure **(2 marks)**

(ii) Name and explain one every day occurrence which is due to the effect of the factor

(2 marks)

(iii) State the principle on which the functioning of a hydraulic machine is based

(1 mark)

(b) The cylinder in Figure 2 above has an ideal gas initially at 27°C. See Page 14

(i) Without calculation, compare the pressures at point A and B. Explain your answer

(2 marks

(ii) Calculate the pressure of the gas in excess of atmospheric pressure. (assuming the volume remains constant).

(2 marks

(iii) Calculate the new temperature the gas would need to have in order to double it initial pressure, (assuming the volume remains constant).

(2 marks)

(iv) Explain in terms of the Kinetic Theory why this change in temperature doubles th pressure of the gas.

(2 marks)

(v) Copy the manometer only and indicate the relative levels of liquids in its two arms when the gas cylinder no longer delivers gas even when its nozzle is fully opened Give a reason for your levels.

(2 marks)

(vi) At what temperature (in °C) would the gas theoretically exert no pressure on it container? Explain.

(2 marks)

6. (a) There are two types of images that can be formed by plane mirrors or lenses.

(i) Name them

(1 mark)

(ii) For each type of image draw a labelled ray diagram to show how it is formed at named surface.

(4 marks)

(iii) The real depth of water in a measuring cylinder is 0.4m. Calculate how deep th water would appear to someone who looks vertically done through the water to th bottom of the cylinder (refractive index of water = 4/3).

(2 marks)

(b) An object of height 0.1m is placed 0.15m in front of a converging lens of focal lengt 0.12m. The image produced is 0.4m tall.

(i) Calculate the magnification produced

(1 mark)

(ii) Use your answer in (i) above to calculate the distance of the image from the lens

(1 mark)

(iii) Name any other two properties of the image

(1 mark)

(iv) Name one practical application (or device), which uses this type of object and len arrangement.

(1 mark)

(c) (i) What is a pure spectrum of white light?

(1 mark)

(ii) Draw a labelled diagram of the set up you would use to produce a pure spectrun include in your diagram the paths of at least two rays from the light source throug the set up.

(4 marks)

(iii) Name the phenomenon responsible for the formation of a spectrum

(1 mark)

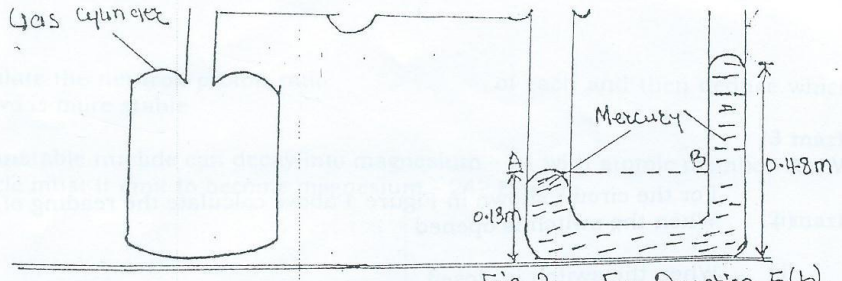

Fig 2 For Question 5(b).

SECTION C

ANSWER ONLY TWO QUESTIONS FROM THIS SECTION

7 In Figure 3, the spherical conductor A is uncharged and is suspended midway between the two plates. The negative charge on plate B is three times the positive charge on plate C.

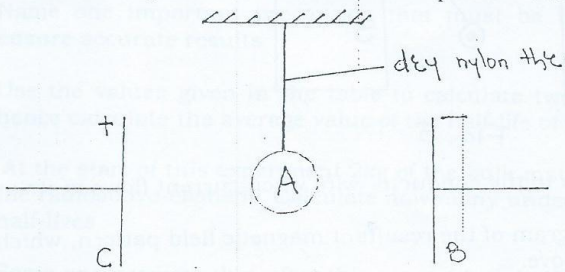

Fig. 3

(a) (i) Towards which of the plates will conductor A move? Explain your answer with the aid of a diagram

(3 marks)

(ii) Conductor A will swing away immediately after making contact with this plate. Explain why.

(2 marks)

(b) Describe the ammeter-voltmeter method of measuring the resistance of a metallic conductor. Your description should include

- a circuit diagram of the set up
- the procedure followed and the reading taken
- how the readings are analyzed to obtain the value of the resistance
- one important precaution taken to ensure accurate results.

(6 marks)

(c) (i) You are given two conductors, one of copper, the other a semi conducting diode. For each draw a sketch graph of current (y-axis) voltage (a-axis) to show how the current through it carries with the voltage across it.

(2 marks)

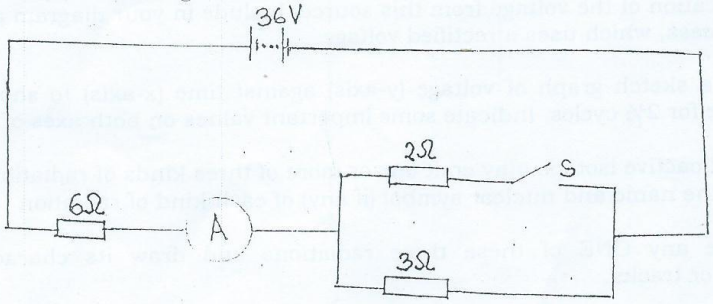

Fig. 4

For the circuit shown in Figure 4 above calculate the reading of the ammeter,

(i) When the switch is opened

(ii) When the switch is closed **(2 marks)**

(2 marks)

3. (a) In Figure 5 a conductor is arranged such that its length is perpendicular to the magnetic field due to two pole pieces.

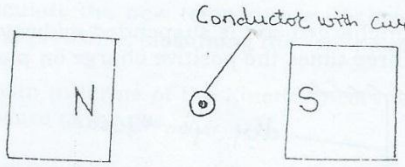

Fig. 5

(i) State what happens to the conductor wire when current flows in its as shown **(1 mark)**

(ii) Draw a labelled diagram of the resultant magnetic field pattern, which explains your observation in (i) above. **(2 marks)**

(iii) Name two independent modifications that can increase the magnitude of the effect you observed in (i) above **(2 marks)**

(iv) Name one instrument whose functioning is an application of this effect **(1 mark)**

(b) (i) Explain the functioning of a transformer **(2 marks)**

A transformer has 400 turns in its primary coil and 250 turns in its secondary coil. A current of 0.5 A flows in the primary coil when the transformer is connected to a 250V supply.

(ii) Calculate the voltage across the secondary coil

(iii) Calculate the maximum current that can flow in the secondary coil if the transformer is 80% efficient. **(2 marks)**

(c) You have a 12 V 50Hz a.c. source **(2 marks)**

(i) Draw a labelled diagram of the circuit you will set up to produce half wave rectification of the voltage from this source. Include in your diagram a named device or process, which uses a rectified voltage.

(ii) Draw a sketch graph of voltage (y-axis) against time (x-axis) to show the rectified voltage for 2½ cycles. Indicate some important values on both axes of your graph. **(2 marks)**

(a) A natural radioactive isotope may emit one or more of three kinds of radiations **(3 marks)**

(i) Write the name and nuclear symbol (if any) of each kind of radiation

(ii) Choose any ONE of these three radiations and draw its characteristic cloud chamber tracks. **(3 marks)**

b) The nuclides 24 Na and 23 Na are isotopes **(1 mark)**

(i) Calculate the neutron proton ratio of each and then deduce which the two is more stable

(3 marks)

(ii) The unstable nuclide can decay into magnesium – 24 with atomic member 12. Wh particle must it emit to become magnesium – 24? Explain.

(2 marks)

(c) In an experiment to measure the half-life of a radioactive element, the following reading were recorded.

Count rate (counts)	1000	250	125
Time (s)	0	110	160

(i) Name one important precaution that must be taken in such an experiment to ensure accurate results.

(1 mark)

(ii) Use the values given in the table to calculate two different values of half-life an hence calculate the average value of the half-life of the element.

(3 marks)

(iii) At the start of this experiment 2kg of the bulk material contains 2.4×10^{24} atoms the radioactive element. Calculate how many undecayed atoms will be left after fou half-lives

(2 marks)

(iv) Some one predicts that after this time of four half-lives, the new measured mass the bulk will be 0.125kg. is this likely to be so? Explain your answer.

(2 marks)