JUNIOR LYCEUM ANNUAL EXAMINATIONS 2004

Educational Assessment Unit – Education Division

FORM 5 **PHYSICS** **TIME: 1h 45min**

Name: ________________________ **Class:** _________

Answer all questions.
All working must be shown. The use of a calculator is allowed.

Where necessary take acceleration due to gravity g=10m/s^2.

SECTION A: Answer all questions in the spaces provided.
This section carries 55 marks.

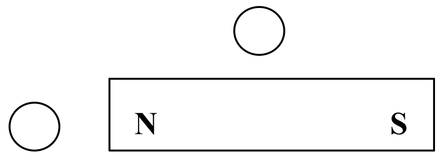
You may find some of these formulae useful.

Area of a triangle = ½ base x height

v = s/t   v = u + at   s = (u + v)t/2   w = mg   p=F/A or F=pA

refractive index of glass = $\dfrac{\text{speed of light in air}}{\text{speed of light in glass}}$

1. a The diagram shows a permanent bar magnet.



(i) Name: a metal which is magnetic. ____________________
a metal which is non-magnetic. ____________________ 2 marks

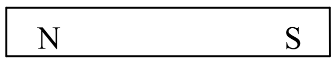
(ii) What is meant by <u>permanent magnetism</u>?

____

____ 1mark

(iii) Draw the position of the plotting compass needles in the diagram above. 2 marks

b (i) Draw the shape and show the direction using arrows, of the magnetic field around the bar magnet. 2 marks



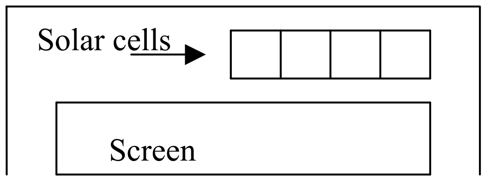
(ii) What are the lines showing the magnetic field called?

____ 1 mark

(iii) Draw the shape and show the direction of the field between these poles:

2 marks

2 A student bought a calculator which can work using solar cells (solar power) or a pencil battery.



a Write down the energy change when the calculator works on:

(i) solar cells: from ______________ to ________________ 2 marks

(ii) pencil battery: from ______________ to ________________ 2 marks

b What do you understand by:

(i) Renewable energy source ____ 1 mark

(ii) Non-renewable energy source ____ 1mark

c When is the calculator unable to work using solar cells?

____ 1 mark

d (i) Rechargeable batteries are more environmentally friendly. Why? ___________

____ 2 marks

(ii) How would you dispose of (throw away) used batteries?

____ 1 mark

3 Satellites **X** and **Y** are orbiting the earth above the Equator.

a (i) Name the force which the Earth exerts on each satellite. _______________________ 1 mark

(ii) Draw an arrow on satellite Y to show the direction of this force. 1 mark

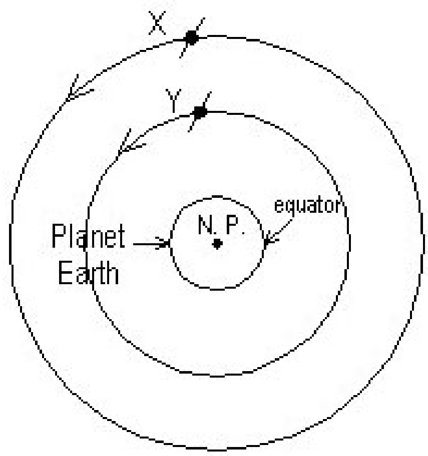
(iii) Give a reason why this force acting on each satellite is different .

____

___________________________________ 1 mark

(iv) On which satellite is this force greater?

______________________________ 1 mark



N.P. = North pole

b Satellites **X** and **Y** are in a geostationary orbit.

(i) What do you understand by 'a geostationary orbit'? __________________

____ 1 mark

(ii) On the above diagram (on page 2) draw the orbit of a third satellite **Z** which is in a polar orbit. 1 mark

Give one use for a satellite in

(iii) geostationary orbit ____ 1 mark

(iv) polar orbit ____ 1 mark

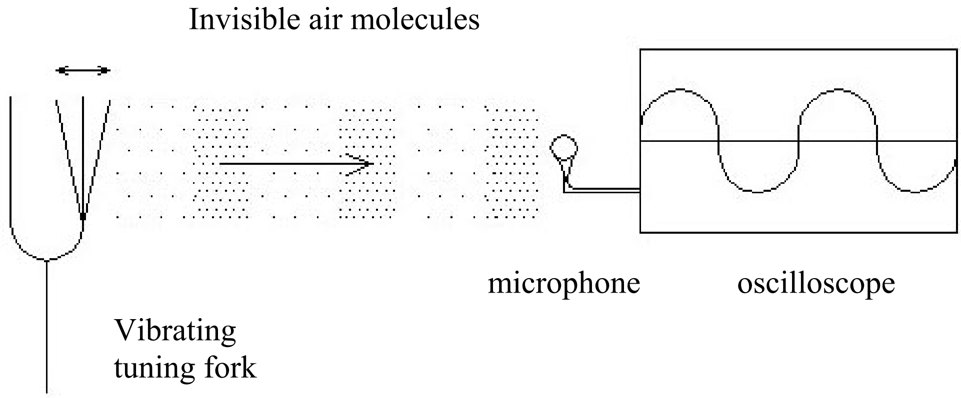
c Earth stations communicate with the 3 satellites. Give one reason why sound waves are never used for satellite communication. ___________________

____ 1 mark

d The geostationary orbit of satellite **Y** is 42000km. Calculate its speed (velocity) in kilometres per hour (km/h) ____

____ 1 mark

4.



As the tuning fork vibrates it sends longitudinal sound waves in air. As the sound wave reaches the microphone, a transverse wave appears on the oscilloscope.

a Mark on the above diagram:

(i) C to show a compression of air molecules 1 mark

(ii) R to show a rarefaction of air molecules. 1 mark

b On the transverse wave on the oscilloscope:

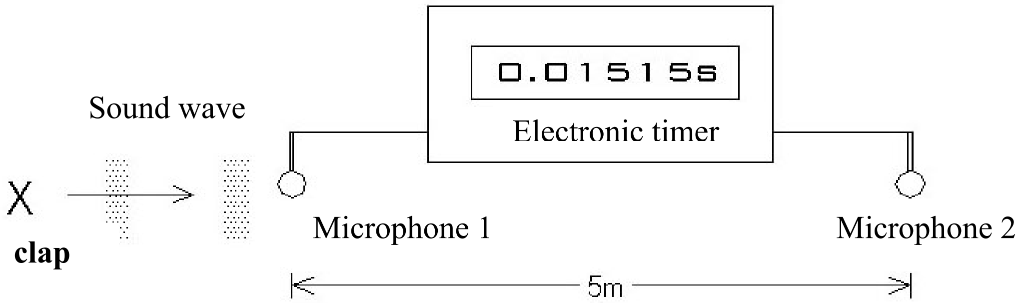
(i) Draw a line labelled **a** to show the amplitude of the wave. 1 mark

(ii) Draw a line labelled **λ** to show the wave length of the wave. 1 mark

c The same tuning fork is banged harder producing a louder note.
Draw the wave now seen on the same oscilloscope screen in the rectangle below.

2 marks

d Two microphones are now connected to an electronic timer as shown.



(i) The timer starts as the sound reaches microphone 1, and stops as the same sound reaches microphone 2. If the readings are as shown above, calculate the speed of sound in air.

____

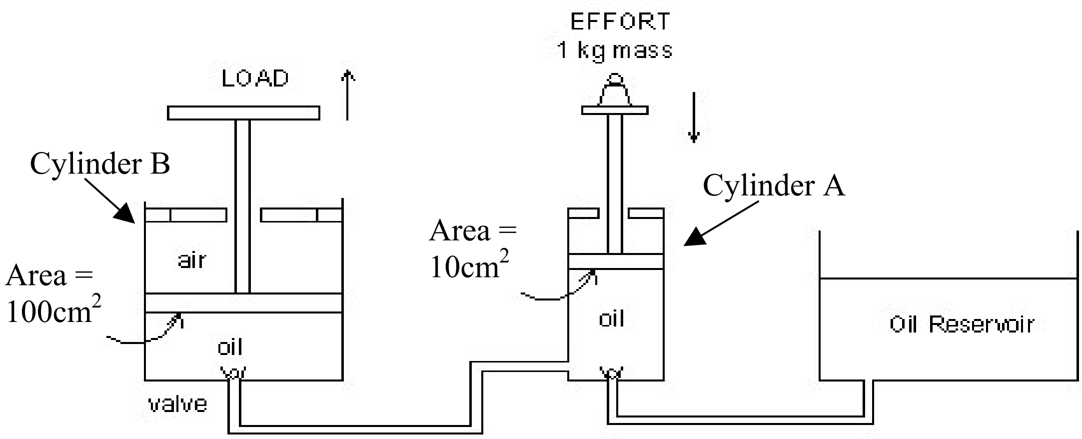
____ 2 marks

(ii) Give **two** reasons why you consider this method a more accurate one than that using a starting pistol and a stop clock held by two students standing 200m away from each other.

____

____ 2 marks

5 This diagram shows a simple hydraulic machine.



a (i) What is the weight of the 1kg mass in newtons? ______________________ 1 mark

(ii) Using the details shown for cylinder A, calculate the pressure in N per cm^2.

____

____ 2 marks

The pressure created in cylinder A is transferred to cylinder B.

(iii) Give one property of liquids which causes the pressure created in A to pass to B.

____

____ 2 marks

(iv) What is the value of the pressure in B in N/cm^2? ______________________ 1 mark

b (i) Calculate the maximum load (force) in newtons that can be raised in cylinder B.

____

____ 2 marks

(ii) A pressure of $1N/cm^2 = 10^4 N/m^2$ (10 000N/m^2)

Calculate the pressure in B in Pascals.

____

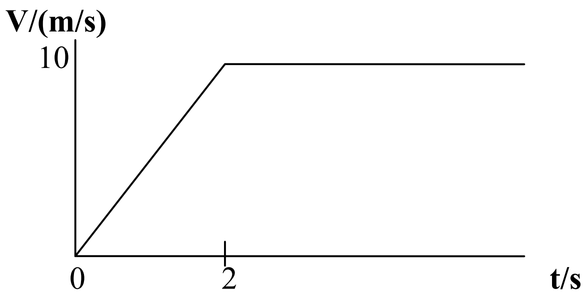
____ 1 mark

(iii) Why is the reservoir necessary if the load is to be lifted to the top?

____

____ 1 mark

6 This graph shows the motion of a sprint runner in a 100m race.



Starting from rest she reaches a maximum speed of 10 m/s in 2s.

(i) Calculate the acceleration of the sprinter.

____

____ 1 mark

(ii) What distance does she travel in the first 2 seconds?

____

____ 1 mark

(iii) What distance does she travel at constant speed?

____ 1 mark

(iv) What is the total time she takes to finish the 100m race?

____

____ 1 mark

(v) What is her average speed during the race?

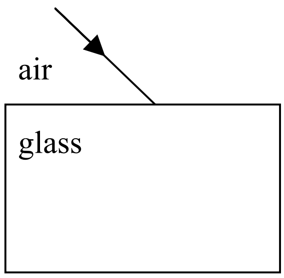
____

____ 1 mark

SECTION B: Answer all questions on the sheets provided.
This section carries 45 marks.

7 This question is about refraction and total internal reflection of light.

a (i) Copy and complete the ray diagram by drawing and labelling the:



- normal,
- the refracted ray,
- the angle of incidence,
- the angle of refraction.

4 marks

(ii) Given that the speed of light in air is 3×10^8 m/s and that the refractive index of glass is 1.5, calculate the speed of light in glass. 2 marks

b Mario wants to show his classmates total internal reflection. He uses a 45º-90º-45º glass prism of critical angle 42º and directs a ray of light as shown in the figures below.

Fig. 1 Fig. 2

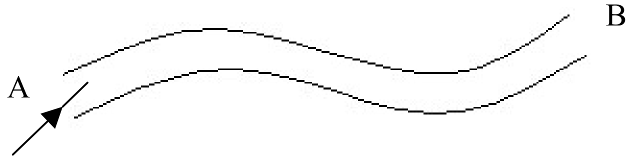
(i) Draw the two diagrams on the foolscaps provided and complete the path of the ray of light through and out of each prism. 2 marks

(ii) Which figure shows: Total Internal Reflection?
Refraction? 2 marks

(iii) Mark with an **X** on the diagram the point where total internal reflection occurs. 1 mark

(iv) By examining the above figures write one condition necessary for total internal reflection to occur. 1 mark

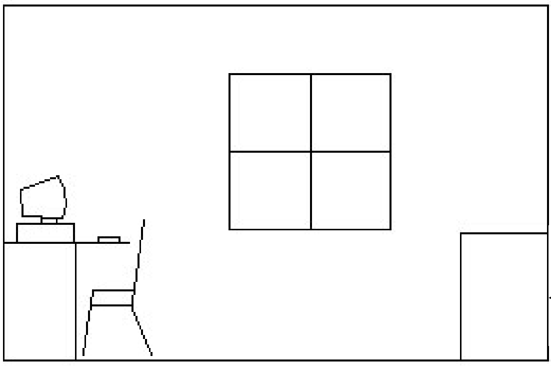
c Total internal reflection is used in optical fibres.



(i) Copy the above ray diagram and draw the path taken by a light ray entering end A to reach end B. 2 marks

(ii) State one practical application of optical fibres. 1 mark

8 This question is about heat transfer and heat losses.



Joan heats her room using a gas convection heater.

a (i) What energy changes occur in the gas heater as it heats the room? 2 marks
(ii) Which part of the room heats up first? 1 mark
(iii) Explain why. 2 marks

b Joan finds that her room gets cold during the night when the heater is turned off. She notices that the heat energy loss through the window depends on the temperature difference between the warm temperature inside and the cold air temperature outside.

The following are her observations:

Temperature difference θ/°C	0	5	10	15	20	25
Heat energy loss W/(J/s)	0	20	40	60	80	100

(i) Plot a graph of energy loss (y-axis) against temperature difference (x-axis). 6 marks

(ii) By extending your graph find the heat energy loss when the temperature difference is 26°C. 1 mark

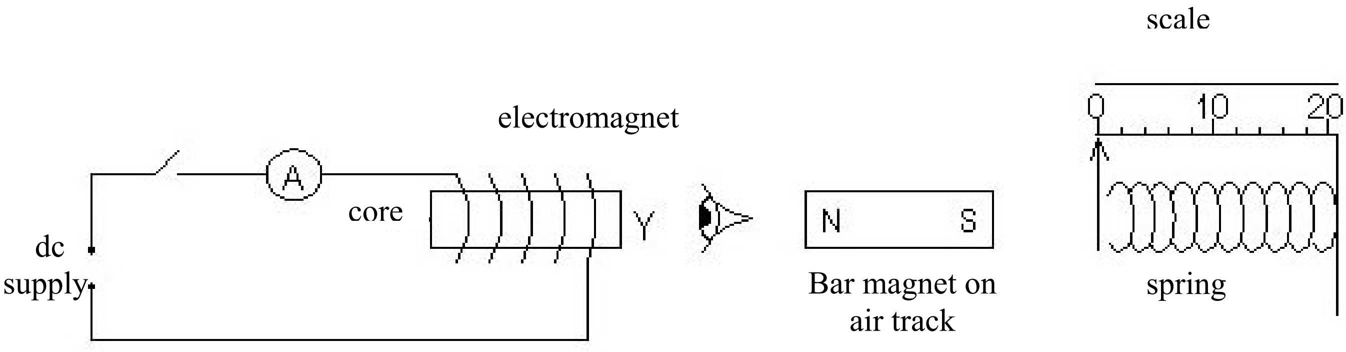
(iii) What can you say about the relationship between the temperature difference and the heat energy loss? 1 mark

(iv) How do you know this from the graph? 1 mark

c State one way how Joan can reduce the heat losses from her room. 1 mark

9 This question is about electromagnetism and an investigation.

Lisa and Karl set up the following apparatus to investigate how the magnetic force of an electromagnet changes as the current flowing through it changes.



When switched on, the electromagnet is expected to repel the bar magnet which lies on a frictionless air track. The repelled magnet then bumps into and compresses a spring. The compression of the spring is directly proportional to the force and can be read on the scale above it.

a (i) What material is suitable for the core of the electromagnet? 1 mark

(ii) Which pole must be present at end **Y** of the electromagnet to repel the bar magnet? 1 mark

(iii) By looking at end **Y**, how must the current in the turns flow to produce this pole? 1 mark

(iv) What additional apparatus is required in the circuit to change the size of the current in the electromagnet? 1 mark

(v) Draw its symbol. 1 mark

They observe that when above circuit is switched on, the electromagnet, by mistake, attracts the bar magnet.

(vi) What must they do **to the circuit** so that the bar magnet is repelled? 1 mark

b (i) Explain briefly how they can carry out their investigation. 5 marks

They wish to display their results graphically.

(ii) What readings must they take? 1 mark

(iii) Draw and label the axes of the graph they plot. 1 mark

(iv) What is the likely conclusion of such an experiment? 1 mark

(v) Name one precaution they should take for an accurate result. 1 mark