SECONDARY SCHOOL ANNUAL EXAMINATIONS 2004

EDUCATIONAL ASSESSMENT UNIT-EDUCATION DIVISION

FORM 3 **PHYSICS** **Time: 1h 30 min**

NAME: _____ **CLASS:** _____

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

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

You may find some of these formulae useful.

Area of triangle $= \frac{\text{base} \times \text{height}}{2}$ **area of trapezium** $= \frac{h}{2}$ **(sum of parallel sides)**

v = s/t **v = u + at** **$s = at^2/2$** **W = mg** **density = mass/volume**

work done = F s **PE = mgh** **Power** $= \frac{\text{work done}}{\text{time}}$ **KE** $= \frac{mv^2}{2}$

moment of a force = Force × perpendicular distance

magnification $= \frac{\text{height of image}}{\text{height of object}} = \frac{\text{image distance}}{\text{object distance}}$

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

frequency $= \frac{\text{number of waves}}{\text{time}}$ **$v = f\lambda$**

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

1. A microwave oven operating at a frequency of 2 500MHz (2.5×10^9 Hz) is used to cook food placed in a glass dish.

   a. Calculate the wavelength of the microwaves if wave velocity in air is 3×10^8 m/s.

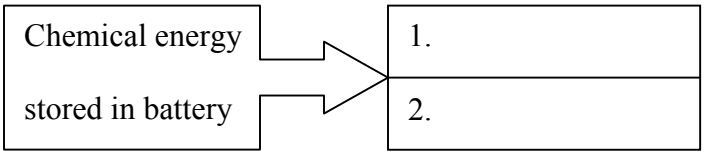
   _____ **[2]**

   b. Explain why food in a glass dish can be cooked in a microwave but the same food wrapped in aluminium foil cannot.

   _____ **[3]**

2. A toy car whose mass is 0.4kg is driven by a battery-operated electric motor. At a particular moment, the car is travelling with a constant velocity of 10m/s.

   a. Complete the energy flow diagram below, naming 2 forms of energy into which the chemical energy stored in the battery is changed.



[2]

   b. Is the energy supplied by a non-rechargeable battery, renewable or non-renewable?

   _____ **[1]**

   c. Calculate the kinetic energy which the car has when travelling with a velocity of 10m/s.

   _____ **[2]**

   d. If the car is only 50% efficient, what energy is supplied by the motor at this particular moment?

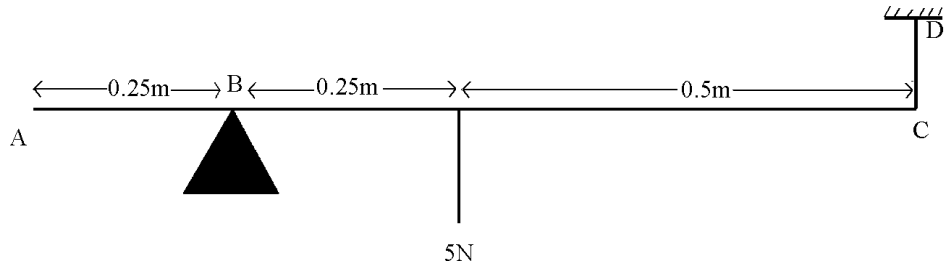
   _____ **[2]**

e. Cars driven by an electric motor may in future replace fuel-operated vehicles. Give one advantage of using electric cars rather than fuel-operated vehicles.

[3]

_____

3.



AC is a uniform metre ruler resting on a point at B. It is held in equilibrium by a vertical length of elastic (CD) fixed to the ceiling at D.

a. What is the weight of the ruler? _____ **[1]**

b. In which direction does the weight act? _____ **[1]**

c. The stretching force in elastic CD is called _____ **[1]**

d. In which direction does the stretching force in CD act? _____ **[1]**

e. Calculate the moment about the pivot of the weight of the ruler and state its direction.

Moment: _____ Direction: _____ **[2]**

f. What is the moment about the pivot of the stretching force in CD and state its direction?

Moment: _____ Direction: _____ **[2]**

g. What can you conclude about a body in equilibrium?

_____ **[2]**

4. Three wires of different materials were suspended vertically. 1N weights were loaded to each wire and the extension was measured. This was repeated using weights of 2N, 3N, 4N and 5N. Below is a table with results:

Weight suspended /N	0	1	2	3	4	5
Length of wire A/mm	500	505	510	515	522	530
Length of wire B/mm	500	502	504	506	508	510
Length of wire C/mm	500	503	506	509	512	515

a. What is the length of each unloaded wire? _____ **[1]**

b. Calculate the extension for each wire when a weight of 3N was suspended.

Wire A _____ Wire B _____ Wire C _____ **[3]**

c. Which of the wires was extended beyond the elastic limit? _____ **[1]**

d. State what would finally happen to the wire in question c, if more loads were added after the elastic limit has been exceeded.

_____ **[2]**

e. When an object of unknown weight was suspended from wire C, the length of the wire was stretched to 510mm. Calculate:

(i) the extension _____ **[1]**

(ii) the weight of the unknown object _____ **[2]**

5. A new car model was tested on a race track for brake performance. The following are the results:

Speed	Stopping distance	Stopping time
10m/s	12.5m	2.5s
20m/s	40.0m	4.0s
30m/s	90.0m	6.0s

a. Calculate the deceleration when the speed of the car is 20m/s.

_____ **[2]**

b. *You may find the equation below useful.*

Stopping Time = Reaction Time + Braking Time

(i) What do you understand by reaction time?

_____ **[1]**

(ii) If the reaction time is **always** 0.8s, find the braking time when the car is travelling at :

10m/s _____ 20m/s _____ 30m/s _____ **[3]**

(iii) Name 1 factor on which a driver's reaction time depends.

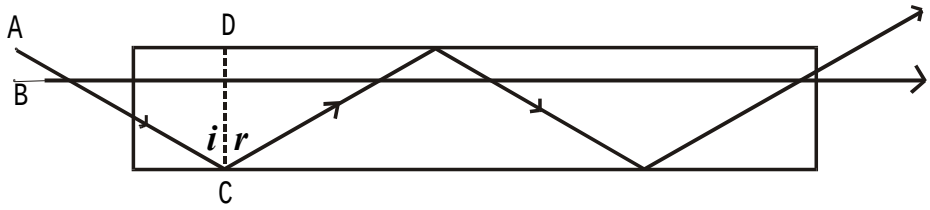
_____ **[1]**

(iv) Work out the distance travelled by the car during the reaction time when the speed is 10m/s.

[3]

_____

6. The diagram shows a section of an optical fibre



a. What is the effect at point C called? _____ **[1]**

b. CD is known as the _____

Angle *i* and angle *r* are _____

i must be greater than the _____

The light travelling from point B is not _____ **[4]**

c. The light ray travelling from point A takes longer to travel the length of the fibre than that travelling from point B. Why?

_____ **[2]**

d. State why an optical fibre must always be thin.

_____ **[2]**

e. Give 1 practical use of optical fibres.

_____ **[1]**

Section B: Answer ALL questions. This section carries 45 marks.

_____

7. **This question is about distance and velocity.**

The distance covered every 20 seconds by a competitor taking part in the first 500m of a marathon is shown in the table below.

Time/s	0	20	40	60	80	100	120	140	160	180
Distance/m	0	120	230	315	360	410	440	465	485	500

a. Plot a graph of **distance** on the Y-axis against **time**. **[6]**

b. From your graph, find the distance the competitor covers after 50 seconds.

_____ **[1]**

c. From the table above, find the distance the competitor covers:

(i) between the 20th and 40th second _____ **[2]**

(ii) between the 120th and 140th second _____ **[2]**

d. Explain why the answers to questions c.(i) and c. (ii) are different.

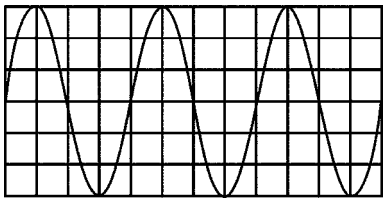
_____ **[2]**

e. Find the competitor's average velocity for the first 500m of the marathon.

_____ **[2]**

8. **This question is about sound waves and wave patterns.**

A tuning fork of frequency 256Hz is struck and its stem is placed in contact with a hollow bench. A microphone connected to an oscilloscope is brought near the vibrating tuning fork. The wave pattern on the screen is shown below.



a. The sound produced, reaches the microphone as _____ waves. **[1]**

b. How many complete waves are there in the oscilloscope pattern? _____ **[1]**

c. Why is it advisable to hold the stem of a vibrating tuning fork in contact with a **hollow** bench? _____

_____ **[2]**

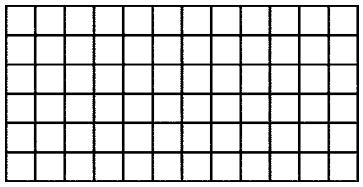
d. The grid above (**not** to scale) contains squares of side 1cm. Find a value for:

(i) the amplitude _____ (ii) the wavelength _____ **[2]**

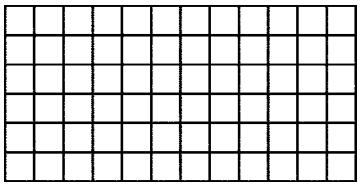
e. In the grids below, draw what you would see on the oscilloscope screen when:

(i) the loudness of the vibrations reaching the microphone is halved

(ii) a tuning fork of frequency 128Hz is used instead.

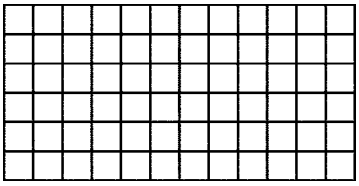


loudness halved



frequency 128Hz **[6]**

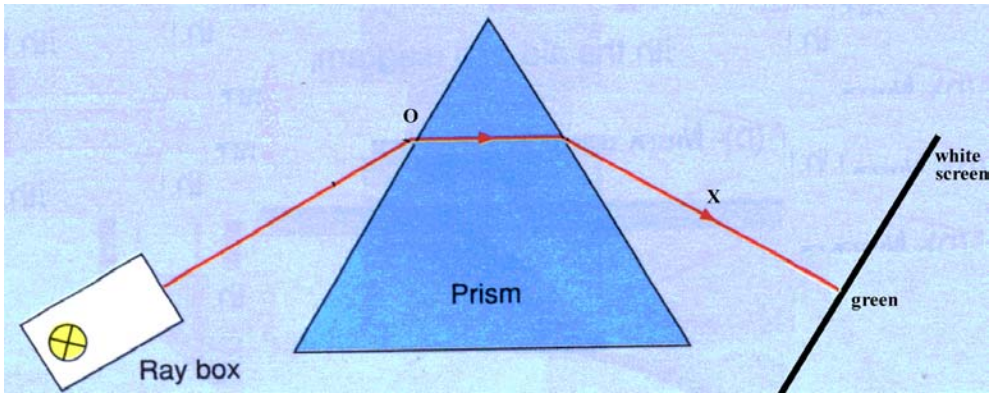
f. Instead of using a tuning fork, a piece of music is played in front of the microphone. Draw a **sketch** of the wave pattern you think is produced.



[3]

9. **This question is about dispersion and the electromagnetic spectrum.**

The diagram shows how a 60° glass prism produces a spectrum from a source of **white** light.



a. The diagram shows a light ray labelled X from the raybox onto a white screen. The light ray reached the screen where the spectrum was **green**. From point O, sketch on the diagram above:

(i) a ray which reaches the screen where the spectrum is **red**. Mark this Y. **[2]**

(ii) a ray which reaches the screen where the spectrum is **violet**. Mark this Z. **[2]**

b. State one similarity between red light and violet light.

_____ **[1]**

c. State how the spectrum on the screen changes when the source is replaced by a red lamp. _____ **[2]**

d. Write down in order of **decreasing** wavelength the 7 colours of the spectrum.

_____ **[2]**

e. (i) Name 2 waves from the electromagnetic spectrum whose wavelength is larger than that of red light. _____ _____ **[2]**

(ii) Rewrite the waves in (i) in order of **increasing** wavelength.

_____ _____ **[1]**

f. (i) Name 2 waves from the electromagnetic spectrum whose wavelength is less than that of violet light. _____ _____ **[2]**

(ii) Rewrite the waves in (i) in order of **increasing** wavelength.

_____ _____ **[1]**