**JUNIOR LYCEUM ANNUAL EXAMINATIONS 2003**
**Educational Assessment Unit - Education Division**

| **FORM 5** | **PHYSICS** | **TIME: 1hr 45min** |
|---|---|---|

**NAME:** ____________________ **CLASS:** ____

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

Where necessary take the acceleration due to gravity, $g = 10\ \text{m/s}^2$.

**You may find some of these formulae useful.**

area of triangle $= \dfrac{\text{base x height}}{2}$ area of trapezium $= \dfrac{h}{2}$ (sum of parallel sides)

$v = \dfrac{s}{t}$ $v = u + at$ $s = \dfrac{at^2}{2}$ $W = m g$ density $= \dfrac{\text{mass}}{\text{volume}}$

work done $= F s$ $PE = m g h$ $P = \dfrac{\text{work done}}{\text{time}}$ $KE = \dfrac{mv^2}{2}$

moment of a force = Force x perpendicular distance $F = m a$

momentum = mass x velocity Pressure $= \dfrac{\text{Force}}{\text{area}}$ $P = h \rho g$

heat energy = mass x specific heat capacity x temperature change

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

$v = f \lambda$ power $= \dfrac{\text{energy}}{\text{time}}$ Force $= \dfrac{\text{(change in momentum)}}{\text{time}}$

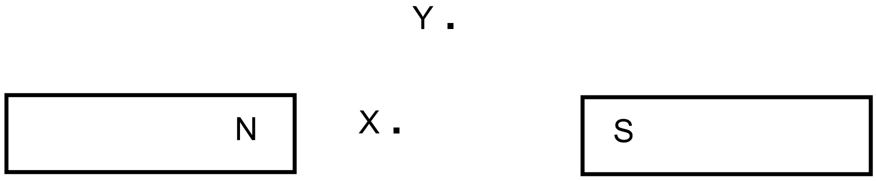
$V = I R$ $P = V I = I^2 R$ $R = R_1 + R_2 + R_3$

$\dfrac{N_p}{N_s} = \dfrac{V_p}{V_s}$ $V_p I_p = V_s I_s$

**Section A. Answer the questions in this section in the spaces provided.**
**This section carries 55 marks.**

1. a) Sketch the magnetic field between the two poles shown below: [2

[2]




(b).Indicate the direction of the magnetic field on your diagram. [1

(c) At which point is the magnetic field stronger, at X or at Y?

______________________________ [2

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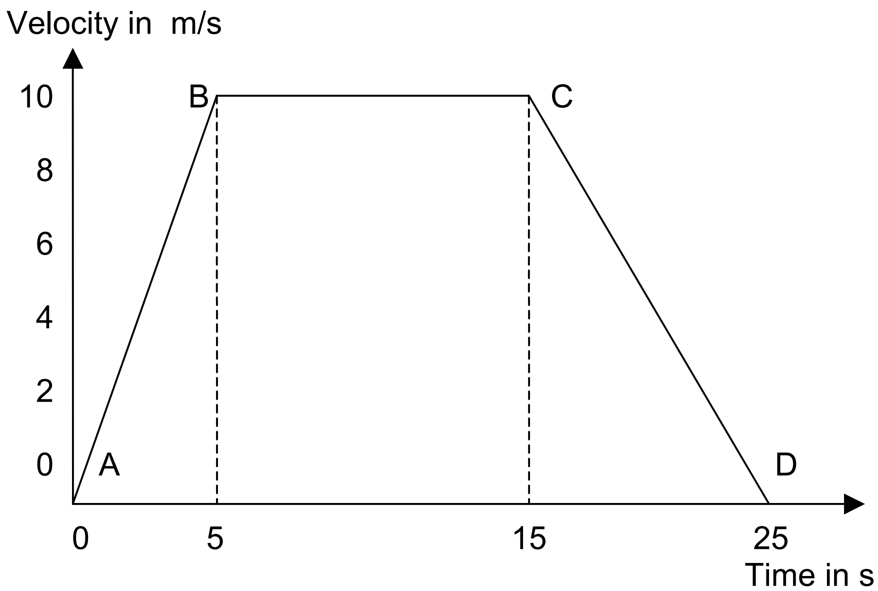
2.




[2]

[2]

[2]

[3]

The velocity-time graph shows how the velocity changed with time for a bicycle.

[1]

a) Calculate:

i) the acceleration over the region AB.

______________________________ [2

ii) the deceleration over the region CD

______________________________ [2

b) Calculate the total distance traveled during the whole 25 s.

______________________________ [1]

______________________________

[4

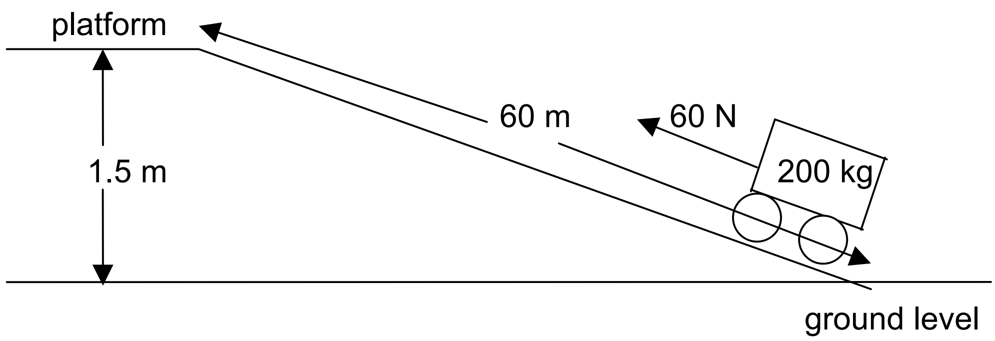
(c)~~Find the average speed for the journey.~~

______________________________

[3]

3. A trolley of mass 200 kg is pulled up with a force of 60 N, as shown in the diagram, to move it from ground level to the platform at the top.

[2]




[2]

(a) Find the work done by the 60 N force to pull up the trolley from ground level to the platform. [2]

___

(b) What is the gravitational P.E. gained by the trolley when it arrives on the platform?

___

(c) What is the difference between the work done in (a) and the P.E. gained in (b)?

___

(d) Give one reason for this difference.

___

(e)State one way of making this difference smaller.

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4. Water at 20$^{o}$C flows past an instant heater of a shower unit and flows out at 40$^{o}$C. The hot water comes out of the shower unit at the rate of 1kg every 10s. The specific heat capacity of water is 4 200 J/kg$^{o}$C.

[2]

(a) What is the temperature change of the water?

[2]

___

(b) Calculate the heat energy required to heat 1 kg of water in 10s.

[2]

___ [1]

___

[1]

(c) What is the power of the heater? Assume there are no heat losses.

___

[2]

(d) Without changing the power of the heater, what other change could one make to obtain hotter water?

________________________________________________

________________________________________________

(e) If hard water of specific heat capacity 3 900 J/kg$^{o}$C is used instead of normal fresh water, what effect would this have on the temperature of the water leaving the shower unit? Assume everything else is unchanged.

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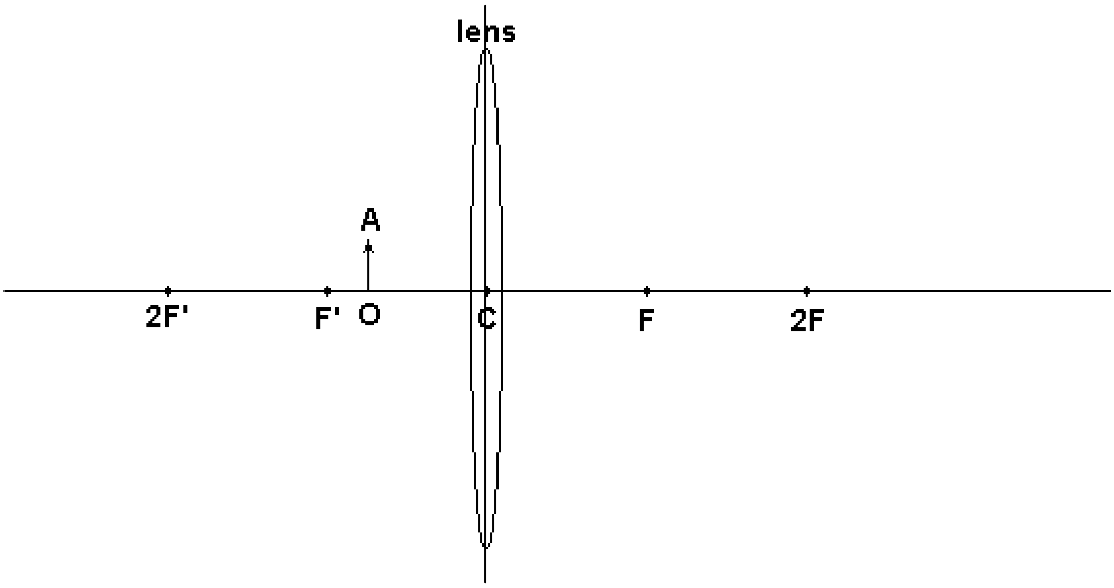
5.




[1]

[1]

(a) An object OA is placed in front of the converging lens shown above.
i) Draw two rays from A and show how they are refracted after passing through the lens. [1]
ii) Use your two rays to show how an image is formed. Mark your image IB.
iii) Give two properties of the image formed. (You can choose from the following words:
real; virtual; upright; inverted; magnified; diminished.)
iv) Give one use of the arrangement above.

________________________________________________

(b) i) Where must the object be placed to enable the set up to be used in a slide projector? [2]

________________________________________________

[1]

ii) Give two differences between the image formed by the projector compared to that formed in case (a)

________________________________________________ [1]

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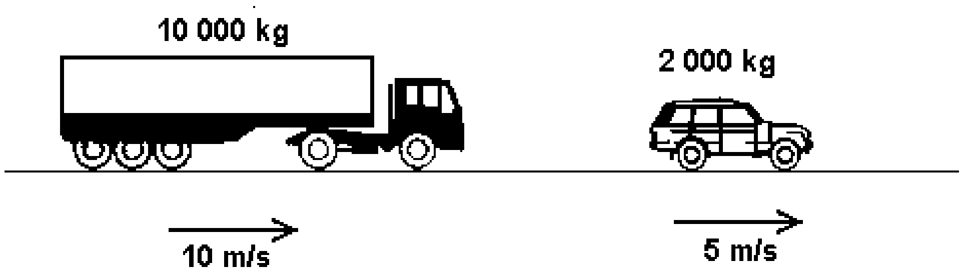
6. A large 4-wheel drive car slows down as it nears a roundabout. Unfortunately, the lorry behind it is slow to react and collides into the back of the car. The lorry and the car DO NOT stick together after the collision, but move separately. [1]




[1]

[1]

After the collision, the lorry moves at 9 m/s.

(a) Calculate the momentum of the lorry before the collision.

(b) Calculate the momentum of the car before the collision.

(c) Calculate the momentum of the lorry after the collision.

(d) What is the velocity of the car after the collision?

[2]

[3]

[1]

[1]

(e) The lorry driver has a mass of 70 kg. What is

i) his momentum before collision? [2]

ii) his momentum after collision?

iii) his change in momentum?

(f) If the car and lorry were in contact for 0.2 s during collision, what force acts on the lorry driver? [1]

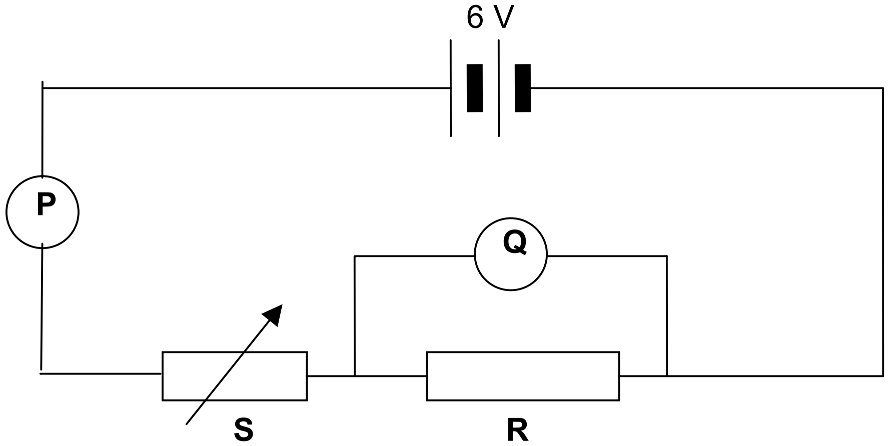
(g) What safety factor in the lorry helps to reduce serious injury due to this force?

[2]

**Section B: Answer all questions in this section on the foolscap provided. This section carries 45 marks.** [3]

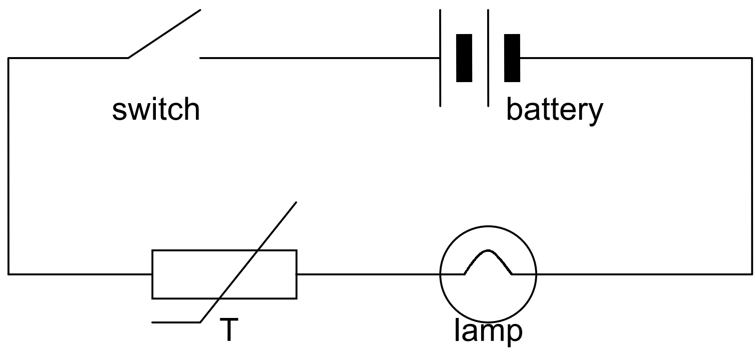
*This question is about circuits.*

7. Mary set up the circuit shown in the diagram below:




[2]

(a) Identify the ammeter and the voltmeter?
(b) If the ammeter reads 0.2A when the voltmeter reads 4V, find the resistance of the resistor R.
(c) What does component marked S represent?
(d) The voltage across the battery is 6V. The voltmeter reads 4V. What is the voltage across the component marked S?
(e) How can Mary increase the current through R without changing the battery?
(f) Now Mary sets up the following circuit:




[5]
[2]
[2]
[1]
[2]

i) What does the component marked T represent?
ii) This circuit is used to protect the delicate filament of a lamp used in a slide projector, which is easily damaged if a high initial current suddenly flows through it when the circuit is first switched on. You are told that the thermistor's resistance decreases with increasing temperature. [1]
Is the resistance of the thermistor high or low when cold?

iii) Explain how the thermistor protects the delicate lamp when the switch is first switched on.

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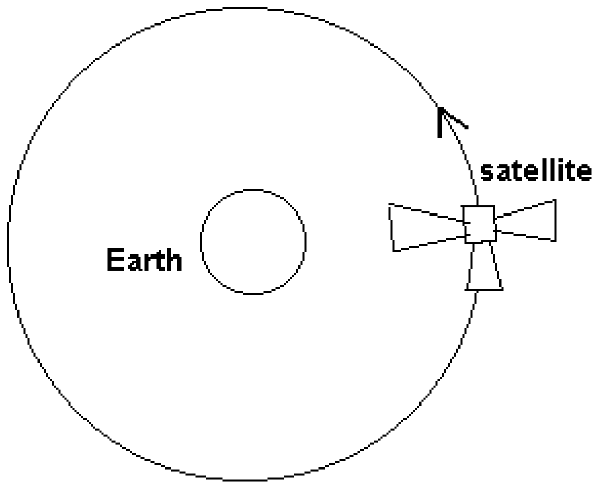
8. *This question is about satellites.*

The diagram shows a satellite in orbit round the Earth.

(a) Mark with an arrow on the diagram and name the force acting on the satellite.

(b) The table below shows how the time taken by a satellite to orbit the Earth once, varies with height above the surface of the Earth.




| **Height above the Earth (H / km)** | 5000 | 10000 | 15000 | 20000 | 30000 | 40000 | 45000 |
|---|---|---|---|---|---|---|---|
| **Time to orbit the Earth (T / hours)** | 3.2 | 5.6 | 8.5 | 11.8 | 19.4 | 28.1 | 37.5 |

[2]

[2]
[2]

[2]
[1]
[1]

i) Plot a graph of height above the Earth on the Y-axis against time to orbit the Earth on the X-axis.

ii) What can you say from the graph about how height above the Earth affects the time to orbit the Earth?

(c) i) From your graph determine the height above the Earth's surface at which the satellite takes exactly 1 day to orbit the Earth.

ii) What is such an orbit called?

iii) What type of satellite is put in such an orbit?

(d) To cover a bigger surface of the Earth, should a satellite be positioned at a high or a low orbit?

[3]

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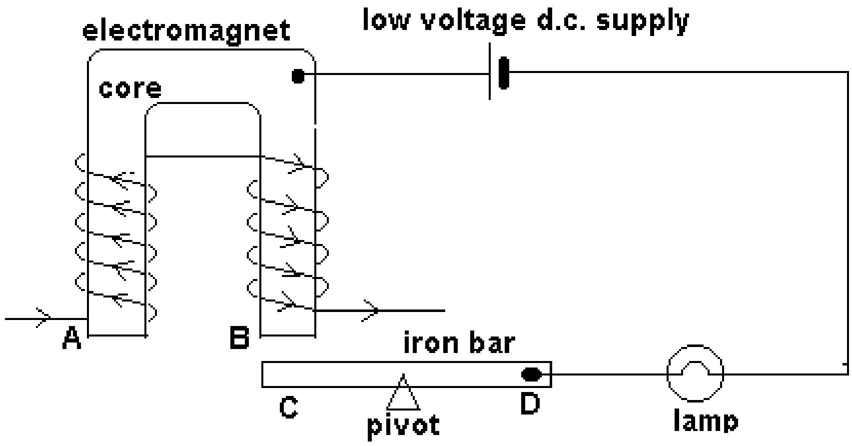
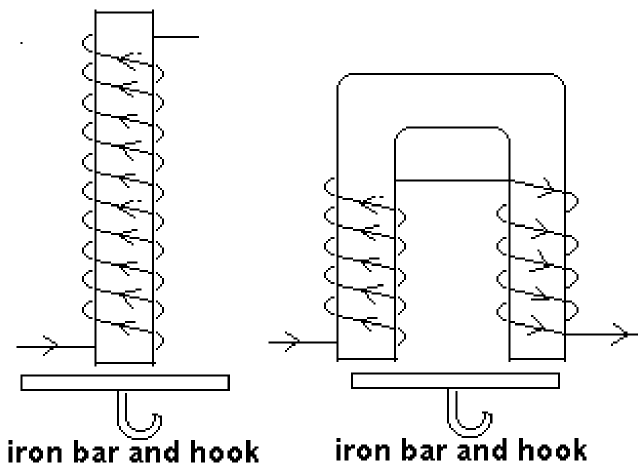
[1]
[1]

*This question is about electromagnetism and the design of an experiment.*

9. Two students set up the following circuit which consists of an electromagnet and another circuit containing a lamp as shown below.




(a) What will be the polarity of ends A and B of the electromagnet when current flows through it as shown?
(b) Name a suitable material for the core of the electromagnet. Give a reason for your choice.
(c) State two ways of increasing the strength of the electromagnet.
(d) What force acts on the side C of the iron bar which is pivoted at its center as shown? Why?
(e) In what direction does the iron bar rotate?
(f) What happens to the lamp when the electromagnet is switched on?
(g) The students are now given two electromagnets with the cores as shown:




They are asked to investigate which core produces the stronger electromagnet. They are also given a set of standard weights.
Describe briefly how the experiment can be carried out. In your answer include:

i) a brief description of how the experiment is done,
ii) any one precaution which needs to be taken to obtain a good result,
iii) a possible result of this investigation.