JUNIOR LYCEUM ANNUAL EXAMINATIONS 2010

Directorate for Quality and Standards in Education
Educational Assessment Unit

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

Name: ______________________________ **Class:** ______________

Answer ALL questions in the spaces provided on the Exam Paper.
All working must be shown. The use of a calculator is allowed.
Where necessary take the acceleration due to gravity, g = 10 m/s^2.

Equations for Annual Exam Physics

Density	$m = \rho V$	
Pressure	$P = h \rho g$	$P = F/A$
Energy and Work	$PE = m g h$	$KE = \frac{1}{2} m v^2$
	$E \text{ (or W)} = P t$	$W \text{ (or WD)} = F s$
Force	$F = m a$	$W = m g$
Motion	$\text{average speed} = \frac{\text{total distance}}{\text{total time}}$	$v = u + a t$
	$s = \frac{(u + v) t}{2}$	$s = \frac{1}{2} a t^2$
	$\text{momentum} = m v$	$h = \frac{1}{2} g t^2$
Electricity	$Q = I t$	$W = Q V$
	$V = I R$	$R = R_1 + R_2 + R_3$
	$P = I V = I^2 R = \frac{V^2}{R}$	$R \propto \frac{\text{length}}{\text{area}}$
Electromagnetism	$\frac{N_1}{N_2} = \frac{V_1}{V_2}$	
Heat	$H = m c \Delta\theta$	
Waves and Optics	$c = f \lambda$	$m = \frac{h_i}{h_o} = \frac{\text{image distance}}{\text{object distance}}$

Marks Grid: For the Examiners' use ONLY

Question	1	2	3	4	5	6	7	8	Theory	Practical	Total
Max. Mark	8	8	8	8	8	15	15	15	85	15	100
Score											

Section A. **This Section carries**

1. The driver of a car of mass 1200 kg, travelling in a straight line at 20 m/s re 16m as 'thinking distance' and 34 m as 'braking distance' to stop the car.

a. Explain:

i. thinking distance, **1**

ii. braking distance. **1**

b. Calculate the:

i. total stopping distance of the car, **1**

ii. kinetic energy in J of the car when travelling at 20m/s, **1**

iii. momentum of the car in kgm/s just before braking, **1**

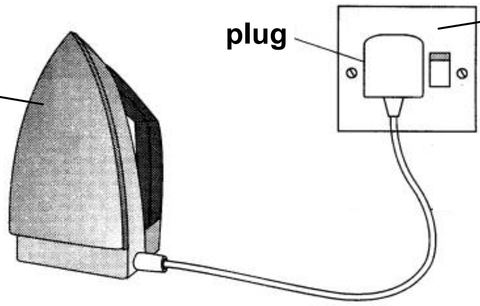
iv. momentum of the car in kgm/s when it comes to rest, **1**

v. average braking force in N given that the braking time is 3.4 s. **1**

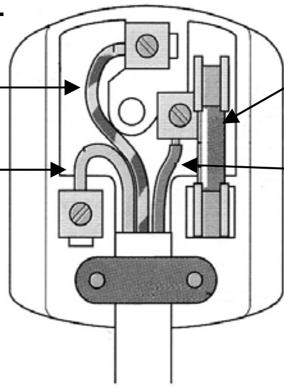
c. Explain why the use of a mobile phone while driving is not advisable? **1**

2. André-Marie Ampère (20 January 1775 – 10 June 1836), was a French physicist and mathematician. The SI unit of measurement of electric current, the ampere, is named after him.

The figure below shows an electric iron connected to the mains supply.



a. The top cover of the plug is removed as shown in this diagram.



i. P is the _________ wire and its colour is brown. **1**

ii. Q is the _________ and its colour is yellow-green. **1**

iii. T is the neutral wire and its colour is _________. **1**

iv. C is the _________. **1**

b. The heating element of the electric iron has a power rating of 1920 W when used on a 240 V supply. Calculate the:

i. current flowing through the heating element in Amps (A). **1**

ii. resistance of the heating element in Ohms (Ω). **1**

iii. number of kWh consumed when the iron is turned on for 45 minutes. **2**

3. The electromagnetic spectrum consists of a number of different radiations e
its own particular properties and uses.

a. i. What type of wave are **ALL** the radiations of the electromagnetic spect
made up of?

ii. State why sound energy is **NOT** a member of the electromagnetic spectrum. 1

b. Complete the table below by naming the radiation having the particular distinguishing property described.

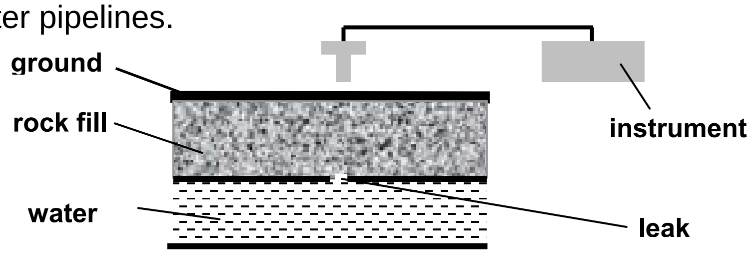
	Property	Radiation	
i.	detected by the eye		1
ii.	causes sun-tanning of the skin		1
iii.	emitted by decaying nuclei		1
iv.	used to detect broken bones		1

c. A radio station transmits at a frequency of 95 MHz.

i. Give the frequency of transmission in Hz. 1

ii. Calculate the wavelength of these radio waves in metres given that their velocity is 3×10^8 m/s (300 000 000 m/s). 1

4. Cobalt-60, which emits gamma radiation, is used to detect leakage points in long underground water pipelines.



a. Name the instrument used to measure radioactivity. 1

b. The symbol for Cobalt 60 is $^{60}_{27}\text{Co}$. Give the value of the:

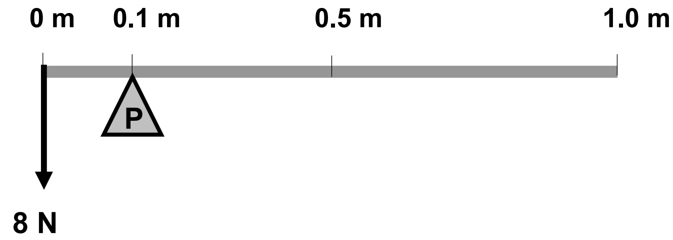
i. proton number Z of cobalt, ____________ 1
ii. mass number A of Cobalt, ____________ 1
iii. the neutron number N of Cobalt. ____________ 1

c. Name the **two** other radiations given out by decaying nuclei of other radioactive substances. 2

d. State **one** advantage of detecting leakage points in this way. 1

e. Give **one** precaution taken when handling gamma radiation. 1

5. The figure below shows a uniform metal meter ruler, of weight W, bala[illegible]e 0.1 m mark when a load of 8 N is placed at the 0 m mark.



a. **i.** Mark with an '**X**' the position of the centre of gravity of the uniform metal ruler. **1**

ii. Indicate by means of an arrow the weight W of the uniform ruler. **1**

b. Calculate the:

i. anticlockwise turning effect in Nm of the 8 N force about the pivot P, **1**

ii. weight W in N of the uniform metal ruler, **1**

iii. reaction R in N at the pivot P. **1**

c. A pile of 50 similar metal meter rulers rest on a concrete floor of a store covering an area of 0.08 m^2. Calculate the:

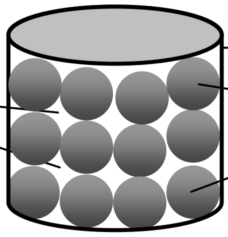
i. total weight of the pile in N, **1**

ii. pressure the pile exerts on the concrete floor. **2**

Section B. This section carries

6. **This question is about finding the density of nickel.**

Andrew and Martha have 50 loose large nickel ball bearings in a container as shown in the diagram below.



They are told by their teacher that the:

- total volume of the container is 0.00004 m^3,
- volume of the trapped air in the container when all the 50 ball bearings are placed into it is 0.00001 m^3.

a. Calculate the

i. total mass of nickel in kg in the container given that the mass of each ball bearing 0.0054 kg, **1**

ii. total volume in m^3 of the nickel in the container, **1**

iii. density in kg/m^3 of nickel, **1**

iv. mass in kg of the trapped air in the container given that the density of the air is $1.2 kg/m^3$. **1**

b. Andrew and Martha are now required to investigate the density of nickel in the school laboratory using the fifty nickel ball bearings. Describe how they should carry out this experiment. Your description should include a:

i. diagram of the experimental set up to find the **volume** of 50 nickel ball bearings, **2**

ii. brief description how to determine the volume of the fifty ball bearings. **1**

iii. brief description how to find the mass of the fifty nickel ball bearings using a named appropriate instrument. **2**

iv. **<u>one</u>** precaution to ensure that the density of nickel obtained through this experiment is as accurate as possible. **1**

c. Explain why it is better to;

i. carry out the experiment at least twice over, **1**

ii. use 50 ball nickel ball bearings rather than one nickel ball bearing in order to find the density of nickel. **1**

d. **i.** Maria, Martha's sister, working on her own, used 100 similar nickel ball bearings in order to find the density of nickel. Will Maria's value for the density of nickel, within limits of experimental error be bigger, smaller or the same as the value obtained by Andrew and Martha? **1**

ii. Give **<u>one</u>** reason for your answer. **1**

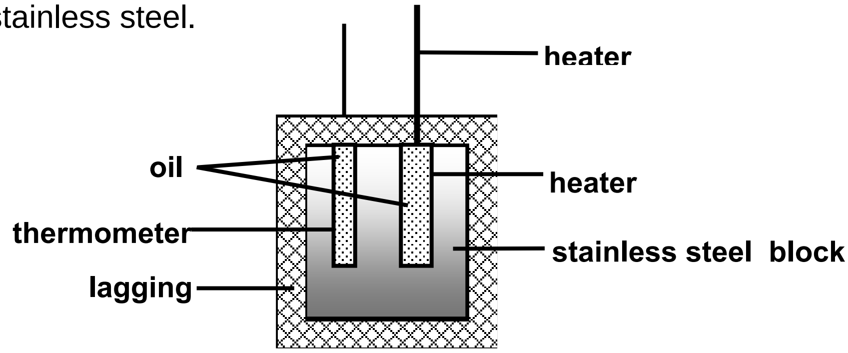
e. State **from where** Andrew and Martha can check whether the value obtained for the density of nickel through their experiment is correct within limits of experimental error. **1**

7. This question is about specific heat capacity of stainless steel.

a. Complete:

The specific heat capacity of stainless steel is the heat required to raise the temperature of 1 kg of stainless steel by ________. The units of specific heat capacity are ________.

b. The diagram below represents the experimental set-up to find the specific heat capacity of stainless steel.



i. What is the purpose of the oil in the thermometer and heater holes? **1**

ii. Why is the use of lagging material important? **1**

c. The table below shows the temperature changes of a well-lagged stainless steel block as it is heated above room temperature. Assume lagging is 100% efficient.

Temperature θ / °C	20	25	30	35	40
Heat supplied Q / J	0	5000	10000	15000	20000

i. Plot a graph of temperature (y-axis) against heat supplies (x-axis). **4**

ii. Explain why temperature θ is plotted on the y-axis and **NOT** on the x-axis. **1**

iii. From the graph, it can be concluded that temperature θ is not directly proportional to heat supplied Q. Give a reason for this conclusion. **1**

d. From your graph determine the:

i. room temperature, __________°C. **1**

ii. rise in temperature when the stainless steel block is 35°C, __________°C. **1**

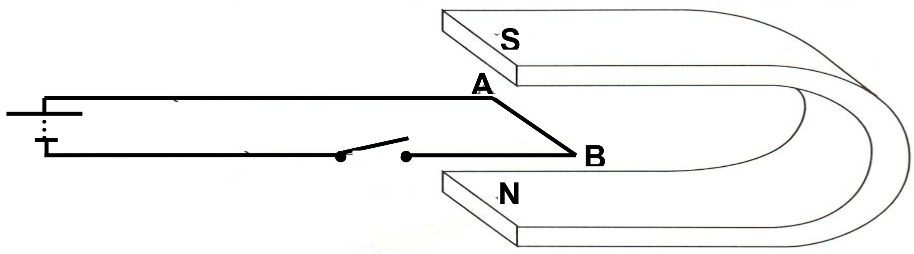
iii. heat supplied in Joules when the temperature of the stainless steel block rises from room temperature to 35 °C. __________ **1**

e. The mass of the stainless steel block is 2 kg. Calculate the specific heat capacity of stainless steel.

2

8. This question is about magnetic fields and the motor effect of curren

A length of wire AB is placed between the poles of a C-shaped magnet as shown diagram below.



a. On the diagram mark by means of an arrow the direction of current flow along AB when the switch is closed. **1**

b. When the current is turned on, section AB of the circuit experiences a force.

i. Explain why the wire experiences a force. **2**

ii. Show by means of an arrow marked **F** the direction of this force. **2**

iii. Which rule helps you to determine the direction of this force? **1**

iv. Name **<u>one</u>** use of this motor effect. **1**

c. State how direction of the current through the circuit can be reversed. **1**

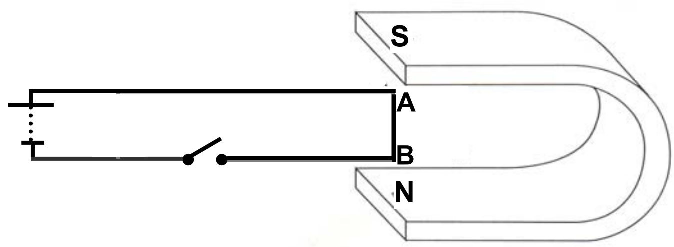
d. What effect does reversing current direction have on the:

i. size of the force, **1**

ii. direction of the force? **1**

e. Give **<u>two</u>** ways through which the size of the force on the wire AB can be increased. **2**

f. The circuit is turned vertically as shown in the diagram below



i. Would wire AB experience a force when the switch is turned on? ________ **1**

ii. Explain your answer. **2**