

SECONDARY SCHOOL ANNUAL EXAMINATIONS 2011

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, $g = 10 \text{ m/s}^2$.**

<u>Equations for Annual Exam Physics</u>		
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	average speed = $\frac{\text{total distance}}{\text{total time}}$	$v = u + a t$
	$s = \frac{(u + v) t}{2}$	$s = \frac{1}{2} a t^2$
	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	Heat energy = $m c \Delta\theta$	
Waves and Optics	$c = f \lambda$ $f = \frac{1}{T}$	$m = \frac{h_i}{h_o} = \frac{\text{image distance}}{\text{object distance}}$

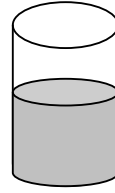
Marks Grid: For the Examiners' use ONLY

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.

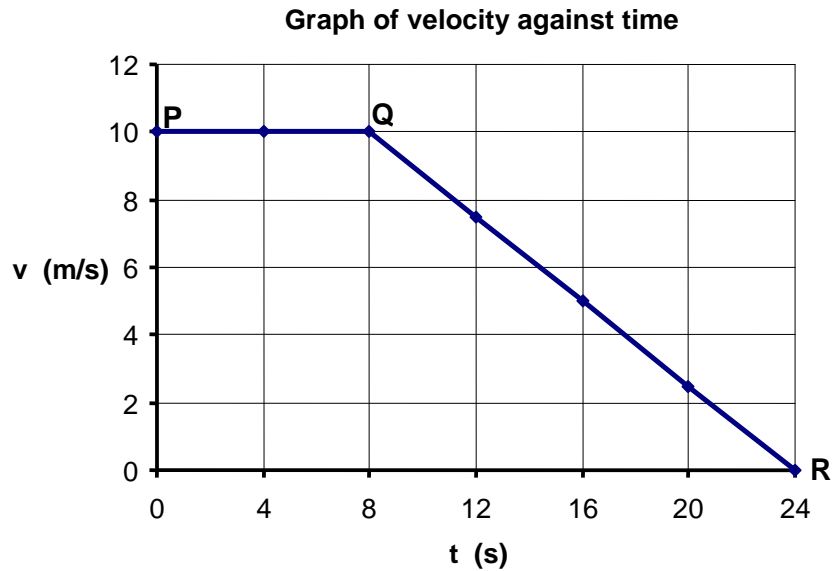
This Section carries 40 marks

- 1.** A volume of $6 \times 10^{-5} \text{ m}^3$ (0.00006 m^3) of olive oil is poured into a heat resistant container having a base area of 0.03 m^2 . The density of olive oil at $20 \text{ }^\circ\text{C}$ is approximately 900 kg/m^3 .



- a.** Calculate the:
- i.** mass of the olive oil in kg, **1**
- ii.** weight of the olive oil in N, **1**
- iii.** pressure this mass of the olive oil exerts on the base of the heat resistant container, in Pa **1**
- b.** The olive oil in the heat resistant container is heated from $20 \text{ }^\circ\text{C}$ to $45 \text{ }^\circ\text{C}$. The specific heat capacity of olive oil is approximately $1970 \text{ J/kg}^\circ\text{C}$. Calculate the heat energy required assuming no energy losses. **2**
- c.** What changes, if any, take place when the olive oil is heated from $20 \text{ }^\circ\text{C}$ to $45 \text{ }^\circ\text{C}$ to the:
- i.** volume occupied by the olive oil, _____ **1**
- ii.** mass of the olive oil, _____ **1**
- iii.** density of the olive oil. _____ **1**

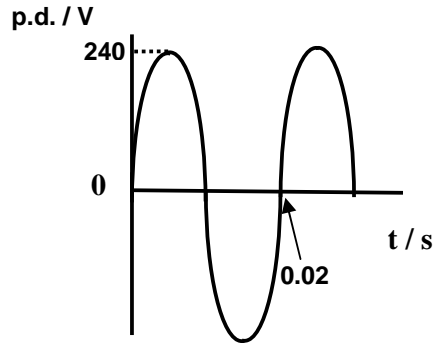
2. The graph below shows the motion of Luca's car during the last 24 s before coming to a complete stop in front of his house.



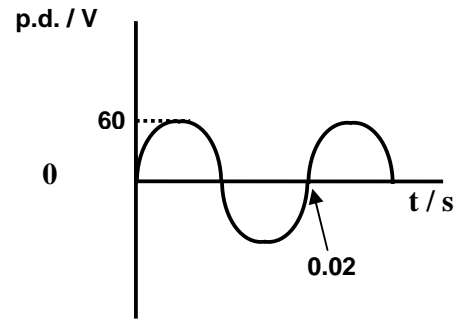
- a. From the graph:
- i. PQ shows that the car was moving at a constant velocity of _____ m/s 1
 - ii. The car decelerates uniformly during the last _____ s of Luca's journey. 1
- b. Luca's car has a mass of 920 kg while Luca has a mass of 80 kg. Calculate the:
- i. total mass of Luca and his car, 1
 - ii. total kinetic energy in J of Luca and his car just before he started to brake, 2
- c. Using the graph or otherwise calculate the:
- i. value of the deceleration of Luca and his car in m/s^2 , 2
 - ii. average force in N required during deceleration. 1

3. In 1831, Michael Faraday conducted the first experiments about electromagnetism. Later he invented the first transformer.

The figures below show the input and output voltage waveforms obtained on the screen of a cathode ray oscilloscope for Transformer X.



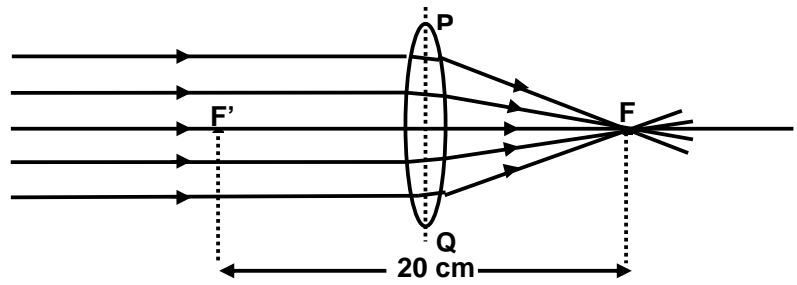
Input voltage



Output voltage

- a. Complete the statements below:
- Transformer X is a **step-down** transformer because the output peak voltage is _____ than the input peak voltage. 1
 - What kind of electrical supply is a 9 V battery? _____. 1
 - What kind of electrical supply is the input and output voltage of any transformer? _____. 1
- b. Using waveforms shown above obtained for Transformer X:
- Calculate the frequency of the **input** voltage. 2
 - What is the value of the frequency of the **output** voltage? _____. 1
- c. Referring to the above waveforms, calculate the number of turns of the secondary coil of Transformer X given that its primary coil has 2000 turns and assuming 100% efficiency. 2

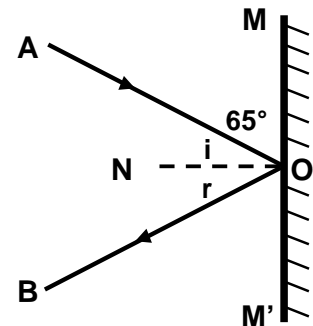
4.
a. The figure shows a parallel beam of light incident on to a convex lens PQ.



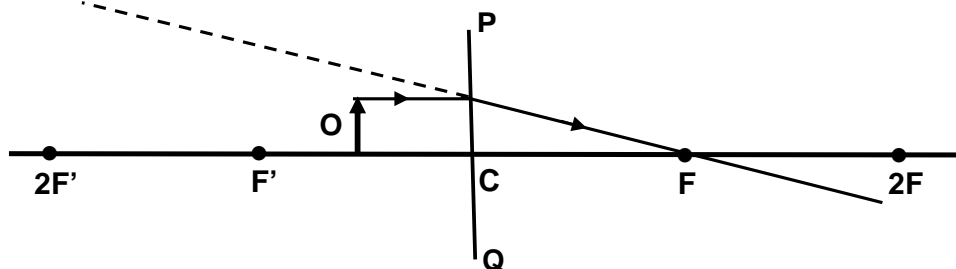
- i. What kind of beam is the emergent beam? _____ 1
- ii. Determine the size of the focal length of the lens PQ. _____ 1
- iii. Name the phenomenon which takes place when light rays bend as they pass through the glass lens. _____ 1
- b. The speed of light in air is 3×10^8 m/s (300 000 000 m/s).

Calculate the speed of light through the lens in m/s given that the refractive index of air to glass (n_g) lens is 1.5. _____ 1

- c. The ray diagram shows a ray of light AO incident on to a plane mirror MM' and the corresponding reflected ray OB. Use this ray diagram to determine the angle of reflection r. _____ °

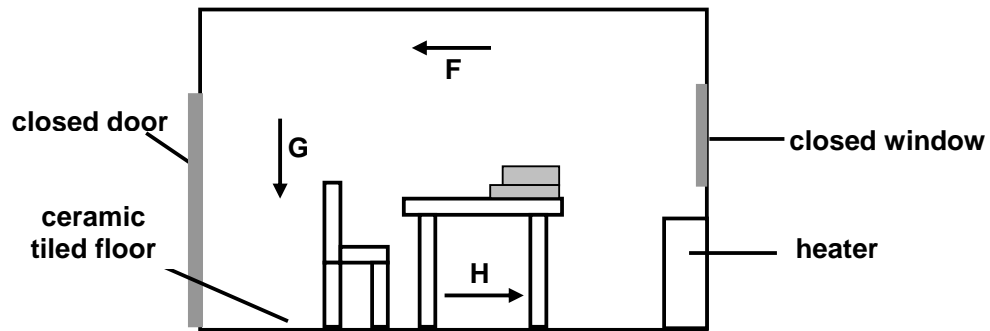


- d. An object O is placed in front of the lens PQ as shown in the incomplete ray diagram below.

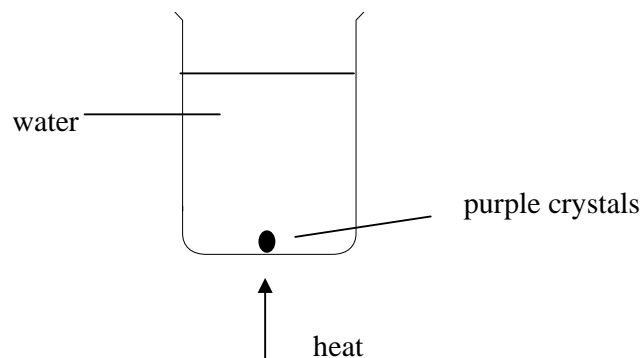


- i. Complete the above diagram by drawing a ray to show the position of the virtual image obtained. _____ 1
- ii. On the above diagram draw the **virtual** image obtained. _____ 1

5. The diagram below shows Martha's study. On a very cold Sunday evening, Martha turns the gas heater on. The three arrows F, G and H show the air movement in the room while the heater is turned on. 1



- a. Which **arrow** shows the:
- coldest volume of the air in the room? _____ 1
 - hottest volume of the air in the room? _____ 1
- b. Heat energy is transferred throughout Martha's room by _____. 1
- c. Martha turns the gas heater on for 1 hour. Assuming that no air escapes from the room, state what changes, if any, take place to the:
- mass of the air inside the room, _____ 1
 - total volume of the air inside the room, _____ 1
 - density of the air **directly above** the heater, _____ 1
 - average air pressure inside the room. _____ 1
- d. A few purple crystals were placed in a beaker full of water as shown in the diagram below. Draw what is observed when the beaker is heated.



1

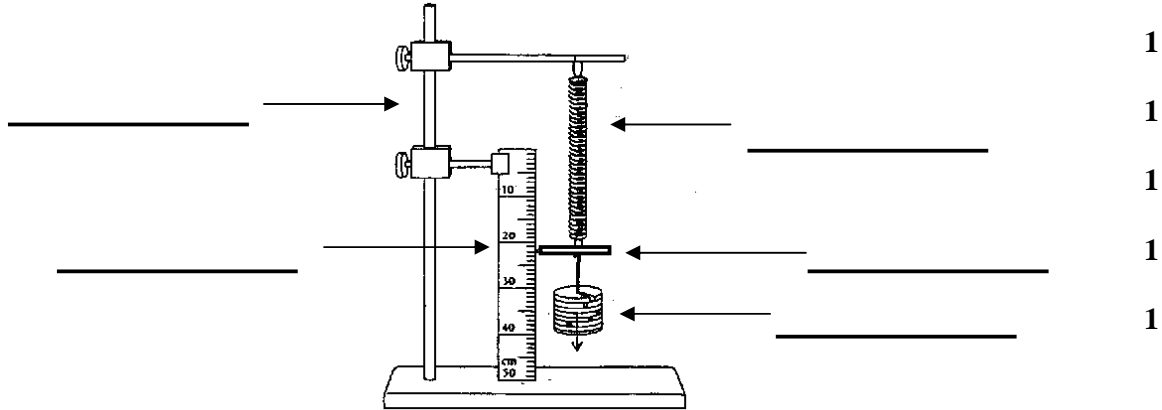
Section B.

This Section carries 45 marks

6. This question is about the design of an experiment to study Hooke's Law.

The diagram below shows the experimental set up by Robert to investigate the behaviour of a spring **without permanently deforming it**.

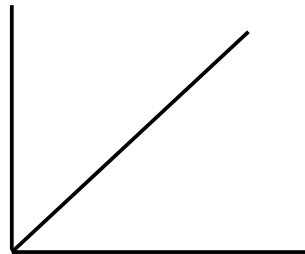
a. Label the diagram of Robert's experimental set-up.



b. Fill in the missing **titles/units** in the table of results drawn by Robert.

Reading	Load W in ____	_____ e in mm

c. Robert plotted the graph with the results obtained.



i. On the above graph, label both axes by entering the appropriate quantities and their units. 2

ii. From the graph, it can be concluded that the _____ of the spring 1
is _____ proportional to the _____. 1, 1

iii. The elastic limit of the spring is 5 N. This means that the spring loses its elasticity and becomes _____ if the load is greater than 5 N. 1

iv. Calculate the greatest **mass** which can be applied to this spring without damaging it using the formula $m = \frac{W}{g}$ 2

7. This question is about Nuclear Physics.

Carbon-14 is a radioactive substance. The symbol for a carbon-14 nucleus is ${}^{14}_6\text{C}$

a. Using this information about ${}^{14}_6\text{C}$ determine its:

- i.** proton number Z , _____ **1**
- ii.** mass (nucleon) number A , _____ **1**
- iii.** neutron number N . _____ **1**

b. Carbon-14 decays by emitting beta particles. Write down the:

- i.** symbol for a beta particle, _____ **1**
- ii.** mass (nucleon) number of a beta particle, _____ **1**
- iii.** charge of a beta particle. _____ **1**

c. There are three naturally occurring **isotopes** of carbon on Earth: 99% of the carbon is carbon-12, less than 1% is carbon-13, and carbon-14 which occurs in very small amounts.

i. Complete the following statement about isotopes:

Isotopes are nuclei of the same element having the same _____ number but different mass number. **1**

ii. The following symbols represent five nuclei.

$\frac{40}{18}\text{A}$	$\frac{41}{19}\text{B}$	$\frac{12}{6}\text{C}$	$\frac{39}{19}\text{D}$	$\frac{40}{20}\text{E}$
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Which **two** nuclei are isotopes of each other? **1**

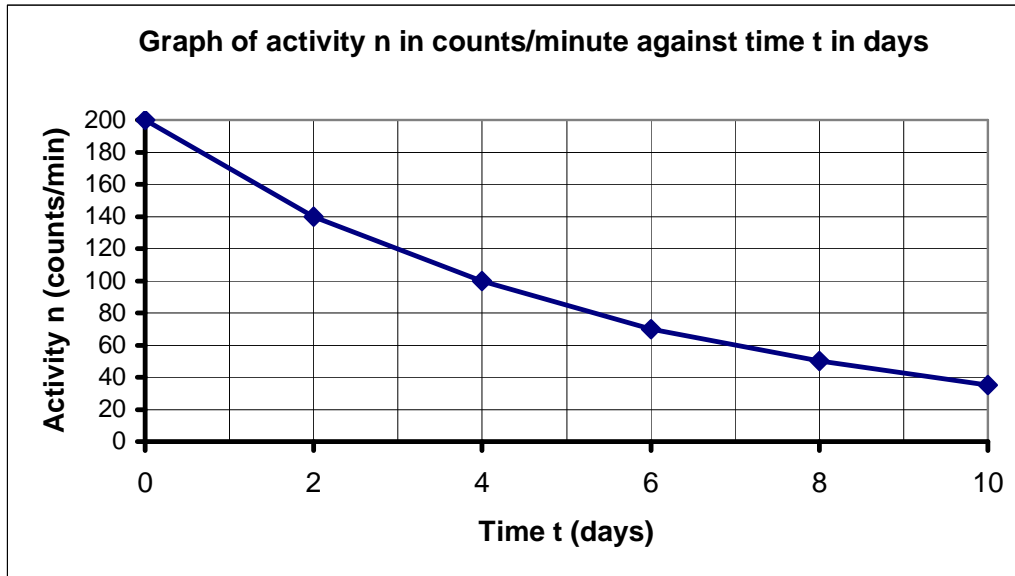
d. A radioactive detector connected to a counter gives a count even though a radioactive source is not present.

i. This radioactive count is due to _____ **1**

ii. State **two** sources of this radiation. **2**

iii. Name the instruments used to **detect and measure** background radiation rate. **1**

- e. A radioactive sample Y is placed in front an appropriate instrument and the count rate recorded. A graph of the corrected count rate n in counts per minute is plotted against time t in days as shown:



- i. Complete the following statement about half-life:

Half-life is the time taken for _____
_____.

1

- ii. The count rate n in counts/min for a radioactive sample Y after 4 days drops from 200 counts/min to 100 counts/min. This means that the half-life of radioactive sample Y is ____ days.

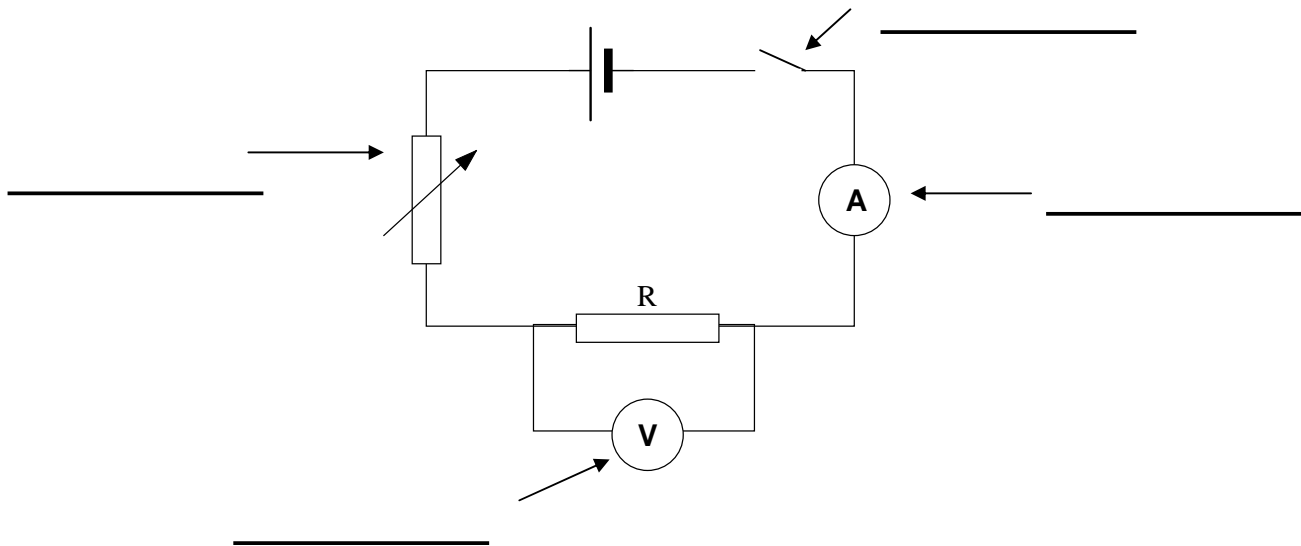
1

- iii. Use the graph to find count rate, n in counts/min, of radioactive sample Y after 6 days.
_____ counts/min.

1

8. This question is about the relationship between current and voltage for an unknown resistor R

David and Charlene set up the circuit using the apparatus shown below to investigate the effect on the size of current through an unknown resistor R as the voltage across R is changed.



- a. Label the four items indicated by an arrow in the circuit. 4
- b. Name the apparatus which:
- i. shows the size of the current flowing through the resistor R, _____ 1
 - ii. is used to change the voltage across the resistor R, _____ 1
 - iii. shows the size of the potential difference (voltage) across resistor R, _____ 1
- c. Plot a graph of current I (y-axis) against voltage V (x-axis) using the table of results below completed by David and Charlene.

I /Amps	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
V / Volts	0	1	2	3	4	5	6	7

- d. From your graph determine the size of the: 5
- i. current flowing through the resistor when the voltage across it is 3.5 V. _____ 1
 - ii. voltage across the resistor when the current flowing through it 0.45 A. _____ 1
- e. Calculate the resistance of the resistor R using the formula $R = \frac{V}{I}$. 1

