THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

031/2 **PHYSICS 2**

ALTERNATIVE TO PRACTICAL

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2010**

Instructions

1. This paper consists of sections Five questions. Answer all questions

2. Each question carries ten marks.

1. Fill in the gaps with the correct responses.

Name of device		(i) Physical effect/principle	(ii) Application
(a) Barometer	Atmospheric pressure measurement	Used to measure atmospheric pressure
(b) Hope's Apparatus	Thermal expansion of liquids	Used to study the freezing and boiling points of liquids
(c) Resonance Experiment Tube	Resonance and wave propagation	Used to determine the speed of sound in air
(d) Transformer	Electromagnetic induction	Used to step up or step down voltage in power transmission
(e) Cathode Ray Oscilloscope (CRO)	Electron beam deflection	Used to display and analyze electrical signals

2. The graph given below is from the results of a certain experiment. Use the graph to answer the following questions.

(a) Determine the time when:
(i) The count rate was 4400 counts/min.
From the graph, the count rate of 4400 counts/min occurs at approximately 10 minutes.

(ii) The count rate was 2200 counts/min.
From the graph, the count rate of 2200 counts/min occurs at approximately 40 minutes.

(b) Calculate the time between the two count rates (a) above.
Time difference = 40 - 10 = 30 minutes.

(c) Determine the time when:
(i) The count rate was 2800 counts/min.
From the graph, the count rate of 2800 counts/min occurs at approximately 25 minutes.

(ii) The count rate was 1400 counts/min.
From the graph, the count rate of 1400 counts/min occurs at approximately 55 minutes.

(d) Calculate the time that elapsed between the count rates you have found in (c) above.
Time difference = 55 - 25 = 30 minutes.

(e) (i) What is the name given to the times you have calculated in (b) and (d) above?
The name given to these times is half-life.

(ii) What is the significance of this time?
Half-life is the time taken for a radioactive material to decay to half of its original count rate.

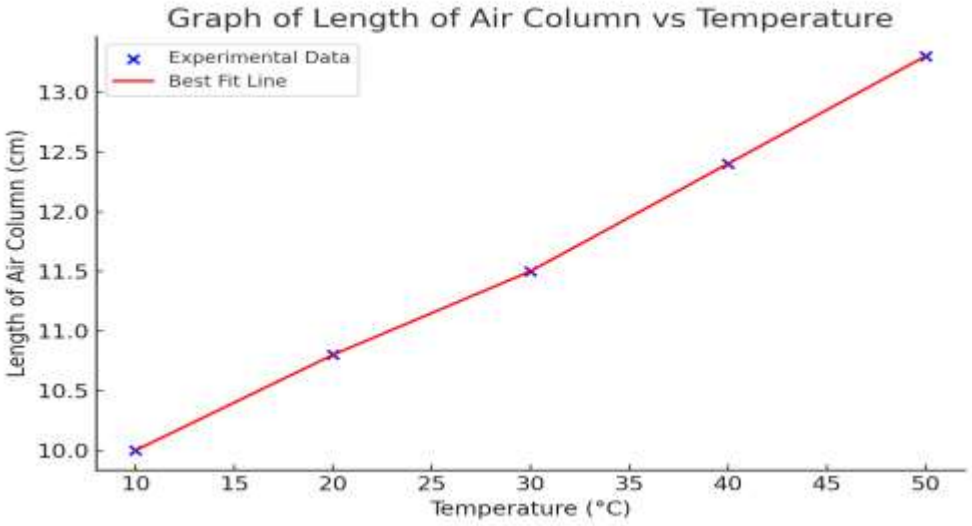
(iii) What experiment is represented by the graph?
The experiment represents radioactive decay and follows an exponential decay model.

(f) Mention one type of radioactive material decay.
Beta decay is an example of radioactive material decay.

2. In an experiment to study the change of the air column length with temperature, a capillary tube was placed vertically in a tall beaker of water with the open end at the top such that the air column was surrounded by water. The water was steadily heated, and the results obtained were as follows.

Temperature (°C)	Length of air column L (cm)
10	10.0
20	10.8
30	11.5
40	12.4
50	13.3

(a) Plot a graph of L against θ.



(b) Determine the length of the air column at the temperature of 30°C.
From the table, at 30°C, L = 11.50 cm.

(c) Estimate the length of the air column at 30°C.

This is the same as the previous question: L = 11.50 cm.

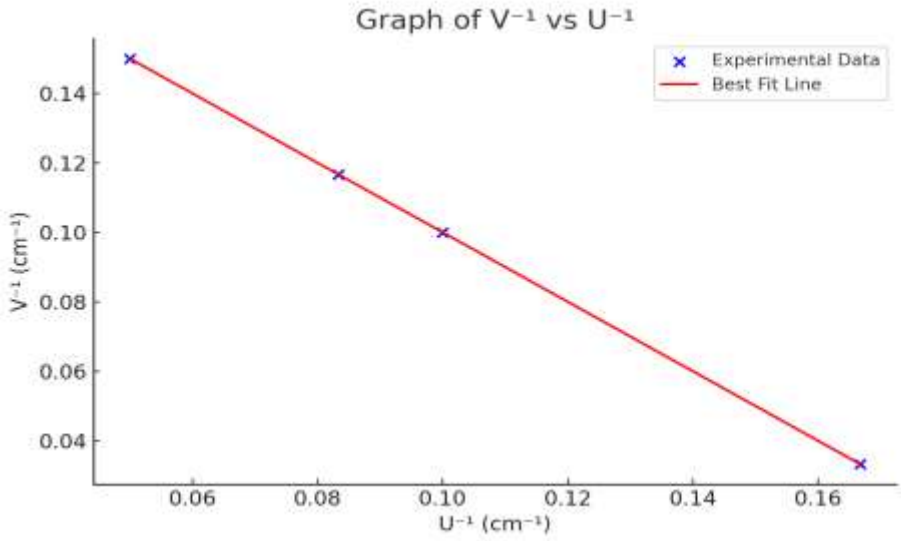
(d) Assume that the gas behaves in accordance with the gas laws. At what temperature would the volume of gas become zero?
Using Charles' Law:
$V = V_0 (1 + \alpha\theta)$, where absolute zero occurs when $V = 0$.
By extrapolating the graph, the temperature at which the volume becomes zero is approximately -273°C.

(e) Give one reason why the volume of the gas does not become zero in practice.
The volume does not reach zero because real gases do not follow ideal gas laws at very low temperatures due to intermolecular forces and condensation effects.

3. A concave mirror gave the following conjugate points (foci) with U and V as object and image distances, respectively.

U (cm)	V (cm)	U^{-1} (cm^{-1})	V^{-1} (cm^{-1})
6.0	30.0	0.16666666666666666	0.03333333333333333
10.0	10.0	0.1	0.1
12.0	8.57	0.08333333333333333	0.11668611435239207
20.0	6.67	0.05	0.14992503748125938

(a) Complete the table by filling in the corresponding values of U^{-1} and V^{-1}.
The completed table is provided.
(b) Plot a graph of V^{-1} against U^{-1}. Extrapolate your graph to include X and Y intercepts.



(c) Use your graph to:

(i) Read off the value of Y-intercept.
The Y-intercept represents 1/f, and from the graph, it is approximately 0.2 cm^{-1}.

(ii) Read off the value of X-intercept.
The X-intercept represents -1/f, and from the graph, it is approximately -0.2 cm^{-1}.

(iii) Calculate the sum of the X- and Y-intercepts.
Sum = 0.2 + (-0.2) = 0.

(iv) Find the reciprocal of your answer in (iii) above.
Reciprocal of 0 is undefined, but in ideal conditions, it should give the focal length of the mirror.

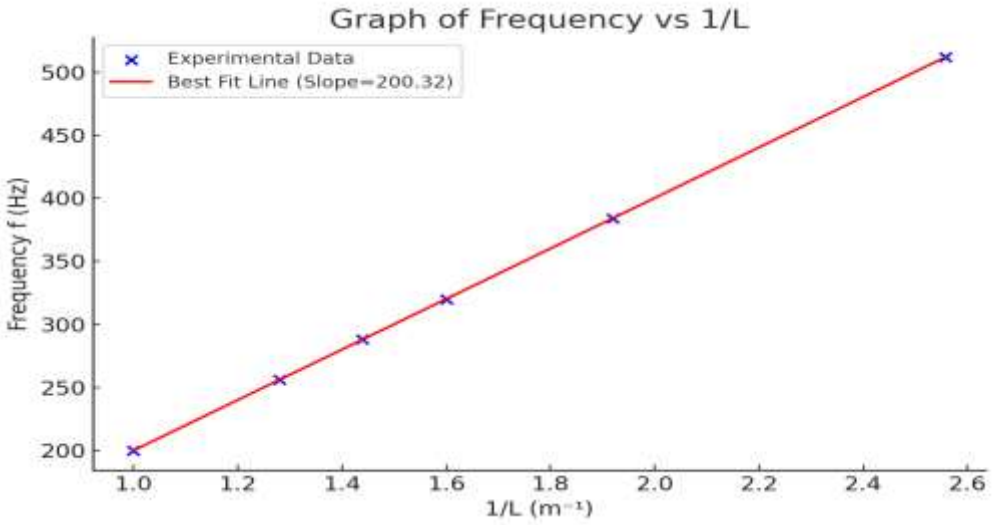
(d) What is the significance of the value in (c) (iv) above?
The reciprocal of the intercept values gives the focal length of the concave mirror used in the experiment.

5. An experiment was conducted to determine the relationship between the frequency and the length of the air column using the resonance tube placed in the vessel nearly filled with water. The following results were obtained.

Frequency f (Hz)	Length L (m)	1/L (m^{-1})
200	1.0	1.0
256	0.781	1.2804097311139564
288	0.695	1.4388489208633095
320	0.625	1.6
384	0.521	1.9193857965451055
512	0.391	2.557544757033248

(a) Calculate the reciprocal of L, for each value of L in the table.
The values have been calculated and included in the table above.

(b) Plot a graph of f against 1/L.



(c) Determine the formula for the relationship between the frequency of vibration and the length of the air column.

From the graph, the relationship follows the formula:

$f = k(1/L)$,

where k is a constant.

(d) What is the source of error or difficulty in this experiment?

One major source of error is the difficulty in accurately determining the resonance point, as small variations in water level and sound intensity can affect the measurement.