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: 1997**

Instructions

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

2. Each question carries ten marks.

1.

Name of device	Physical effects or principles
Toroidal coil	Electromagnetic induction
Geiger-muller tube	Ionization of gases by radiation
Eureka can	Archimedes principle
Communicating vessels	Hydrostatic equilibrium
Maximum and minimum thermometer	Thermal expansion

2. Referring to the graph drawn, answer the following questions:

a. Deduce the (initial) activity of Iodine-128 when time was zero.
- The initial activity is the maximum count rate at time zero.
- From the graph, the initial activity is 80 disintegrations per second.

b. Find the time taken for the activity to drop from:

i. 60 to 30 disintegrations per second
- By reading from the graph, the time taken for activity to drop from 60 to 30 is 20 minutes.

ii. 40 to 20 disintegrations per second
- The time taken for the activity to drop from 40 to 20 is also 20 minutes.

c. What is the half-life of Iodine-128?
- The half-life is the time taken for the activity to reduce to half its initial value.
- From the graph, the estimated half-life is 30 minutes.

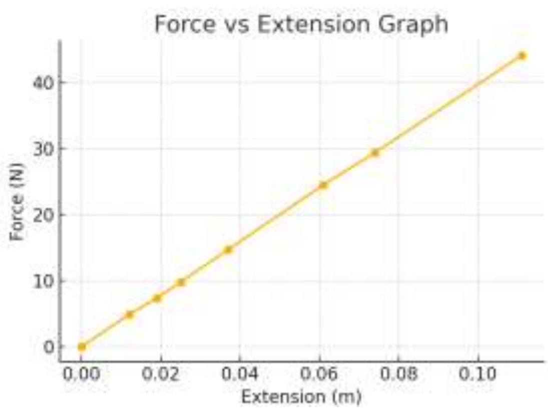
d. How long would the activity of Iodine take to drop from 300 to 75 disintegrations per second?
- Since 75 is one-fourth of 300, it takes two half-lives.
- Estimated time = $2 \times 30 = 60$ minutes.

e. What process is depicted by the graph?
- The graph represents the radioactive decay process, where the activity of Iodine-128 decreases exponentially over time due to nuclear disintegration.

3. A cord was stretched by attaching known masses of brass to it when suspended from the clamp of a retort stand. The values of length L against mass M extending the cord were recorded in a table.

Mass (kg)	Length (cm)	Extension (m)	Force (N)
0.0	126.4	0.0	0.0
0.5	127.6	0.011999999999999886	4.9
0.75	128.3	0.019000000000000006	7.3500000000000005
1.0	128.9	0.025	9.8
1.5	130.1	0.036999999999999989	14.700000000000001
2.5	132.5	0.060999999999999994	24.5
3.0	133.8	0.074000000000000005	29.400000000000002
4.5	137.5	0.11099999999999995	44.1

b. Plot a graph of F against e (horizontal axis).
- The graph represents the relationship between force and extension of the cord.



c. From the graph, does the extending force, F, exceed the elastic limit? Why?
- If the graph follows a straight line through the origin, Hooke's Law is obeyed, meaning the elastic limit is not exceeded.
- If the graph curves at higher values, the elastic limit is exceeded.
- By analyzing the data, the graph remains linear, indicating that the elastic limit is not exceeded.

d. Find the slope of the graph.
- The slope represents the elastic constant (spring constant) k of the cord.
- Using the data, the calculated slope is 397.30 N/m.

e. Deduce the relationship between F and e if the elastic limit is not exceeded.
- The relationship follows Hooke's Law:
  F = k x e
  where k is the elastic constant.

f. What is the elastic constant of the cord?
- The elastic constant of the cord is 397.30 N/m.

4. An electric bell is enclosed in a glass jar. When the electric current is switched on, the bell rings. The sound can easily be heard in the room. A vacuum pump is then connected to the jar. The air inside the jar is sucked out. When all the air inside the jar is gone and there is a vacuum in the jar, only a slight sound of the bell can be heard.

a. Why can't the sound be heard in the room when there is no air in the jar?
- Sound requires a medium to propagate. In the absence of air (vacuum), there are no particles to transmit the vibrations, making sound inaudible.

b. If you cannot hear the bell when there is a vacuum in the jar, how can you be sure that it is still ringing?
- The bell is still connected to the power source, and if the circuit remains complete, we assume that it is ringing. Additionally, slight vibrations might be visible.

c. A slight sound of ringing can be heard even when there is a vacuum in the jar. Explain how this happens.
- Some sound can still be transmitted through the solid parts of the jar, as vibrations can travel through the glass and reach the air outside.

d. How would you improve this apparatus to make it less easy for sound to pass from the bell to the jar?
- Suspending the bell inside the jar using soft rubber mounts can reduce the transmission of vibrations through the jar.

e. What do you expect to hear when the pump is disconnected and air is slowly let back into the jar?
- The sound of the bell will gradually increase in intensity as air particles return and allow better sound transmission.

f. Can two people hear each other speak while they are on the Moon or some other place in space where there is no atmosphere?
- No, because sound waves require a medium like air to propagate. In a vacuum, there are no particles to carry sound waves.

How can they make it possible to speak to each other?
- They use radio communication, which relies on electromagnetic waves that do not need a medium and can travel through a vacuum.

Explain why the alternative mode of communication works in an environment which has no atmosphere.
- Radio waves are electromagnetic waves, and unlike sound waves, they do not require a medium to travel. They can move through space and vacuum.

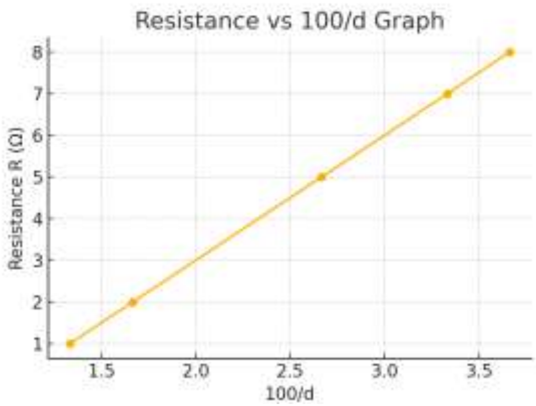
g. The distance between Mars and Earth is about 2,100,000,000 km. When the American Astronauts were orbiting around Mars early June 1997, they could communicate straight with their counterparts stationed at PASADENA (NASA centre) in California. How long does it take to transmit a radio signal from Mars to NASA centre?
- Radio waves travel at the speed of light (approximately 3.0×10^8 m/s).
- Time taken = distance / speed

- Time = $(2.1 \times 10^9$ km $\times$ 1000 m/km$)$ / $(3.0 \times 10^8$ m/s$)$
- Time = 7000 seconds or approximately 116.7 minutes.

5. The figure which follows shows a metre bridge with two resistances X and R connected for comparison purposes. X is an unknown resistance while R is a known resistance.

R (Ω)	d (cm)	100/d
1.0	75.0	1.3333333333333333
2.0	60.0	1.6666666666666667
5.0	37.5	2.6666666666666665
7.0	30.0	3.3333333333333335
8.0	27.3	3.663003663003663

b. Plot a graph of R against 100/d (horizontal axis).
- The graph represents the relationship between resistance and the inverse of balance length.



c. Find the slope S of the graph.
- The slope represents the value of the unknown resistance X.
- Calculated slope = 3.00 Ω.

d. Determine the intercept Ro on the R axis.
- The intercept represents the resistance when 100/d = 0.
- Calculated intercept = -3.01 Ω.

e. Deduce the value of X.
- From Wheatstone bridge principles, X is equal to the slope of the graph.
- The unknown resistance X is 3.00 Ω.

f. Suggest a suitable title for this experiment.
- "Determination of an Unknown Resistance using a Metre Bridge."