

Physics II

030

22/11/ 2017 8.30 AM – 11.30 AM



Rwanda Education Board

ADVANCED LEVEL NATIONAL EXAMINATIONS, 2017

SUBJECT: PHYSICS

PAPER II: THEORY

COMBINATIONS:

- PHYSICS-CHEMISTRY-MATHEMATICS (PCM)
- MATHEMATICS-PHYSICS-COMPUTER SCIENCE (MPC)
- PHYSICS-CHEMISTRY-BIOLOGY (PCB)
- MATHEMATICS-PHYSICS-GEOGRAPHY (MPG)
- PHYSICS-ECONOMICS-MATHEMATICS (PEM)

DURATION: 3 HOURS

INSTRUCTIONS:

1. Write your names and index number on the answer booklet as they appear on your registration form and **DO NOT** write your names and index number on additional sheets of paper if provided.
2. Do not open this paper until you are told to do so.
3. This paper consists of **two** sections: **A** and **B**.
 - Section A:** Attempt **all** questions. (55 marks)
 - Section B:** Attempt **only three** questions. (45 marks)
4. Non-programmable scientific calculators and mathematical sets may be used.
5. Use only a **blue** or **black** pen.

USEFUL CONSTANTS:

Radius of the Earth $R=6\ 370\ \text{km}$

Magnitude of the electronic charge = $1.6 \times 10^{-19}\ \text{C}$

Mass of electron = $9.1 \times 10^{-31}\ \text{kg}$

Speed of light in vacuum/air $C = 3 \times 10^8\ \text{m/s}$

Permeability of free space $\mu_0 = 4\pi \times 10^{-7}\ \text{H/m}$

SECTION A: ATTEMPT ALL QUESTIONS (55 MARKS)

1. Copy the following table and categorize each physical quantity as being either a vector or a scalar quantity.

Physical quantity	Category
Energy	
Linear momentum	
Pressure	

(3marks)

2. LASER light, gamma -rays, and X-rays are electromagnetic waves.

a) What does LASER stand for? **(1mark)**

b) Arrange the above waves in order of increasing frequency. **(1mark)**

c) From the above list of electromagnetic waves, name the waves produced by radioactive decay. **(1mark)**

d) Identify among the given list of waves, the radiation used in radiology. **(1mark)**

3. a)(i) Name the phenomenon by which the incident light falling on a surface is sent back into the same medium **(1mark)**

(ii) Explain why the image formed by a plane mirror cannot be formed on a screen. **(1mark)**

b) Construct a ray diagram to determine the nature of the image formed by a convex mirror when an object is placed between infinity and the mirror. **(2marks)**

4. From the equation of combined ideal gas law, show that the

density of an ideal gas is given by $\rho = \frac{M_m P}{RT}$

Where M_m is the molar mass of the gas,

P: the gas pressure,

T: absolute temperature of the gas,

R: Universal gas constant.

ρ : density of an ideal gas **(3marks)**

5. The following diagram (figure 1) shows 4 traces A, B, C and D produced by an oscilloscope for different sounds. For each trace the same settings (amplitude scale on vertical axis and time-base scale on horizontal axis) of the oscilloscope were used.

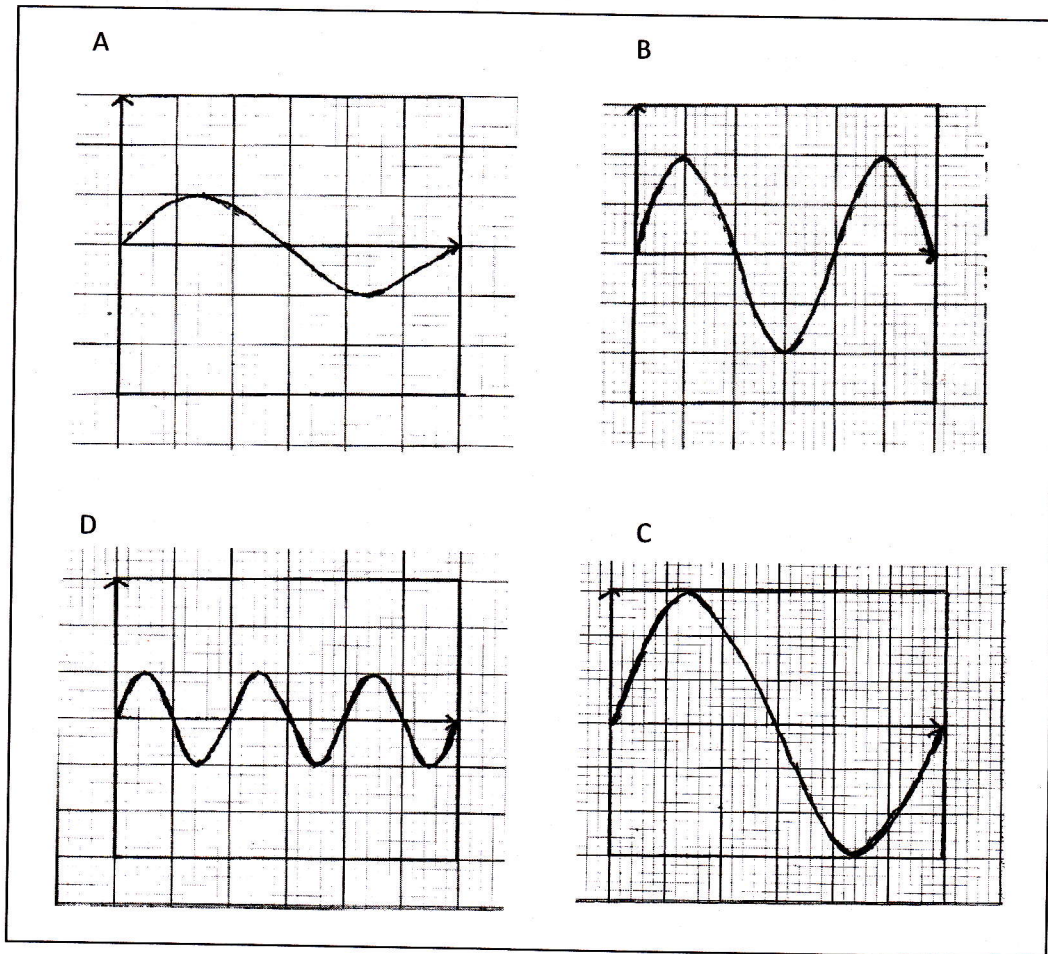


Figure 1

- Identify the trace showing the sound with the highest pitch and explain why. **(1 mark)**
- Which is the sound with the highest loudness? Explain your answer. **(2 marks)**
- Identify the traces of sounds with the same amplitude. **(1 mark)**

6. The basic block diagram of a certain radio receiver is shown in (Figure 2) below .

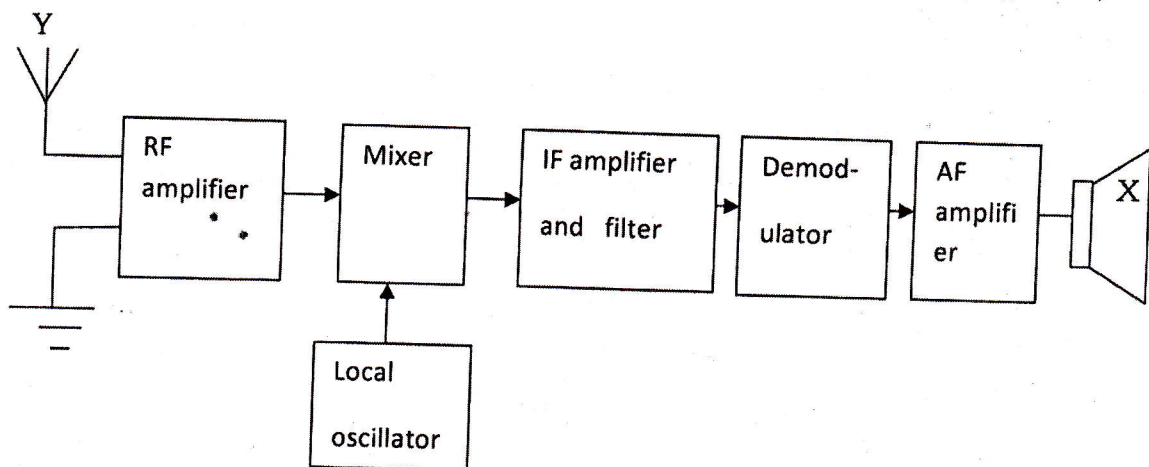


Figure 2

Analyze the above diagram and answer the following questions

- a) What does the acronym RF mean? **(1mark)**
- b) Name the components X and Y. **(2marks)**
- c) What is the role of the demodulator or the detector? **(1mark)**
7. a) State the property of a coil inducing electromotive force (e.m.f) in itself when the current through the coil changes. **(1mark)**
- b) Name the process of induction of an e.m.f in the coil due to the change of current in the neighbouring coil. **(1mark)**
- c) (i) What does the negative sign in the expression below of induced

electromotive force (e.m.f) imply? $\mathcal{E} = -\frac{d\phi_B}{dt}$ **(1mark)**

- (ii) Name the SI units of the physical quantities \mathcal{E} and ϕ_B that appear in the expression in 7c(i) **(1 mark)**

8. Examine figure 3 related to the graph lines A, B, and C of damped oscillations and answer the questions that follow.

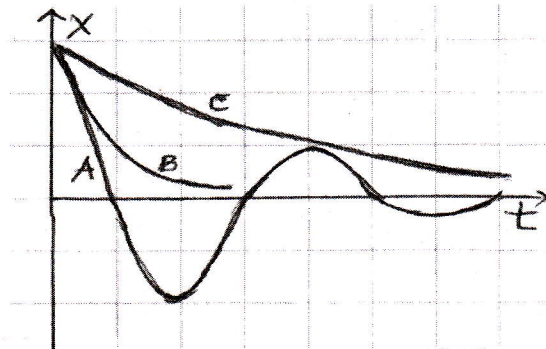


Figure 3

- a) Identify the graph line showing the critical damped oscillation. **(1mark)**
- b) What is the main cause of damped oscillations? **(1mark)**
- c) Name any one characteristic of damped oscillations. **(1mark)**
9. Two parallel metal plates have a potential difference between them of 12V. The distance between the plates is 1.0 mm. Find:
- a) the electric field strength between the plates **(2marks)**
- b) The work done on a charge of +2.5 μC to move the charge from the negative plate to the positive plate. **(2marks)**

10. A solenoid consists of 1000 windings and is 0.5 cm long.

A current of 2.0 A is supplied to the windings.

a) The diagram below is the solenoid drawn not to scale

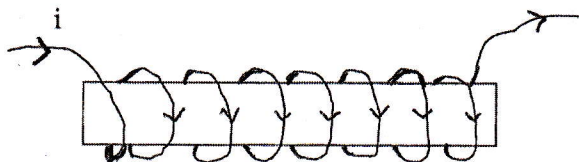


figure 4

Use the diagram above to show the direction of the magnetic field inside the solenoid and to name its magnetic poles.

(2marks)

b) What is the magnitude of the strong, constant magnetic field which runs through the centre of this solenoid?

(2marks)

11. A disc rotates through 10 radians in 4 seconds. The disc experiences uniform angular acceleration. If the disc starts from rest,

a) Find the angular acceleration.

(2marks)

b) What is the angular velocity after four seconds?

(2marks)

12. You are supplied with 3 identical dry cells, each of electromotive force (e.m.f) 1.5 V and internal resistance 0.3 Ω .

What are the overall e.m.f and internal resistance when the cells are connected in parallel?

(4marks)

13. The radius of a geostationary orbit from the centre of the earth (orbit completed by a communication satellite in 24 hours) is 42 200 km.

a) Use this information with Kepler's third law (law of periods) of planetary motion to estimate the radius of a circular orbit completed by a satellite around the Earth in 90 minutes.

(2marks)

b) What is the height of this satellite above the earth's surface?

(1mark)

14. In a certain process, 5000 J of heat is added to a system heat while the system does work equivalent to 7000 J work W by expanding against the surrounding atmosphere.

a) Use thermodynamics sign conventions to answer the question below:

Are the heat energy Q added to a system (absorbed by the system) and the work W done by the system positive or negative?

(2marks)

b) What is the change in internal energy for the system?

(2marks)

15. A telescope has two lenses which are 105 cm from each other.

The angular magnification of the telescope is 20.

What are the focal lengths of the objective and eye piece lenses?

(3marks)