MAR THOMA RESIDENTIAL SCHOOL,TIRUVALLA

MODEL EXAMINATION -2020

PHYSICS (12)

PAPER – 1

(THEORY)

(Maximum Marks: 70)

(Time allowed: Three hours)

(Candidates are allowed additional 15 minutes for only reading the paper.
They must NOT start writing during this time.)

All questions are compulsory.

This question paper is divided into 4 Sections, A, B, C and D as follows:

Section A

Question number 1 is of twelve marks. All parts of this question are compulsory.

Section B

Question numbers 2 to 12 carry 2 marks each with two questions having internal choice.

Section C

Question numbers 13 to 19 carry 3 marks each with two questions having internal choice.

Section D

Question numbers 20 to 22 are long-answer type questions and carry 5 marks each. Each question has an internal choice.

The intended marks for questions are given in brackets [ ].

All working, including rough work, should be done on the same sheet as and adjacent to the rest of the answer.

Answers to sub parts of the same question must be given in one place only. A list of useful physical constants is given at the end of this paper.

A simple scientific calculator without a programmable memory may be used for calculations.

Section A

Answer all questions.

Question 1

(A) Choose the correct alternative (a), (b), (c) or (d) for each of the questions given below: [5×1

(i) The force experienced by a charged particle in a magnetic field is maximum , when the particle

(a) moves in a direction parallel to the magnetic field

(b) moves in a direction perpendicular to the magnetic field

(c) is at rest

(d) moves in a direction making an angle 45 with the direction of magnetic field

(ii) The Kirchoff's first law $i = 0$ and second law $iR = E$, where the symbols have their usual meanings are respectively based on

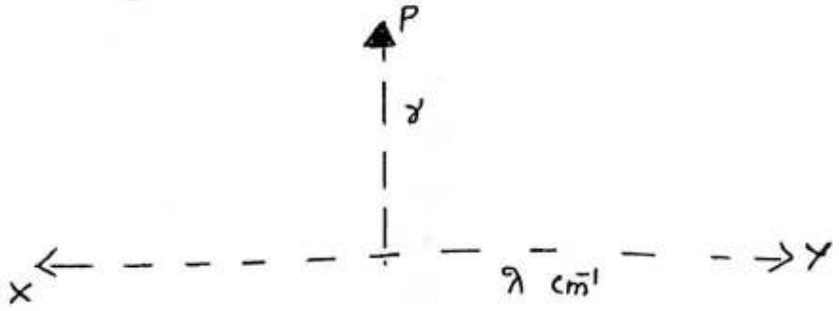
(a) conservation of charge, conservation of momentum

(b) conservation of energy, conservation of charge

(c) conservation of momentum, conservation of charge

(d) conservation of charge, conservation of energy

(iii) Electric field intensity E at a point (see fig) at a perpendicular distance 'r' from an infinite long line charge XY having linear charge density λ is given by



(a) $E=\left(\frac{1}{4\pi\epsilon_0}\right)\left(\frac{2\lambda}{r^2}\right)$ (b) $E=\left(\frac{1}{4\pi\epsilon_0}\right)\left(\frac{2\lambda}{r}\right)$

(c) $E=\left(\frac{1}{4\pi\epsilon_0}\right)\left(\frac{\lambda}{r^2}\right)$ (d) $E=\left(\frac{1}{4\pi\epsilon_0}\right)\left(\frac{\lambda}{r}\right)$

(iv) When $^{238}_{92}U$ decays to $^{206}_{82}Pb$ the number of alpha particles and beta particles emitted are

(a) $8\alpha, 6\beta$ (b) $6\alpha, 7\beta$ (c) $6\alpha, 6\beta$ (d) $4\alpha, 4\beta$

(v) A photon of energy 12Ev is incident on H-atom. The orbit to which the electron to be excited

(a) 2^{nd} (b) 3^{rd} (c) 4^{th} (d) 6^{th}

(v) Two polaroids are inclined by 45^0. An unpolarised light of intensity I_0 falls on the first Polaroid. What will be the intensity of light emerging out of the second Polaroid?

(vi) Write a balanced equation representing β^+ emission.

(vii) If the current gain of CB transistor is 0.98, calculate that of CE transistor.

(B) Answer the following questions briefly and to the point. [7×1]

(i) A given length of a conductor of rectangular cross section has a resistance R. If every linear dimension (length, breadth and height) were halved, what would the new resistance be?

(ii) Define time constant of an LR circuit.

(iii) How will you convert a galvanometer to an ammeter ?

(iv) Why should we prefer soft iron for making the core of a transformer ?

(v) Two polaroids are inclined by 45^0. An unpolarised light of intensity I_0 falls on the first polaroid . What will be the intensity of light emerging out of the second Polaroid?

(vi) Write a balanced equation representing β^+ emission.

(vii) If the current gain of CB transistor is 0.98, calculate that of CE transistor.

Section B

*Answer **all** questions.*

Question 2 [2]

Define dip at a place . What is the angle of dip at a place where the horizontal and vertical component of earth's magnetic field are equal. (2)

Question 3 [2]

(a) Derive the formula for the equivalent capacitance of three capacitors C_1 , C_2 and C_3 connected in series across a source . Hence write down the expression for equivalent capacitance , if they are identical capacitors .

OR

(b) Three identical cells each of emf E and internal resistance r are connected in parallel across an external resistance R . Find the expression for (i) total emf (ii) total current .

Question 4 [2]

Distinguish between paramagnetic and diamagnetic substances in terms of their relative permeability and susceptibility.

Question 5 [2]

Write down the expression for magnetic field at the centre of a circular coil of N turns , radius R ,carrying current I . How will this magnetic field change if the current through the coil is doubled and the radius of the coil is halved .

Question 6 [2]

Name the characteristic of the electromagnetic waves that (1) increases (2) remains constant in the electromagnetic spectrum as one moves from radiowave region towards ultra violet region.

Question 7 [2]

An object is kept in front of a concave mirror of focal length 15cm. The image formed is three times the size of the object. Calculate the two possible positions of the object.

Question 8 [2]

What will be the apparent position of an object placed below a rectangular block of glass (n=3/2) 6cm thick, if a layer of water 8cm is on the top of the glass (n=4/3).

Question 9 [2]

Monochromatic light of wavelength 198nm is incident on a metal whose work function is 2.5Ev.Calculate its stopping potential.

Question 10 [2]

Which of the following radiations :α-rays, β-rays and γ-rays

(1) Are similar to x-rays
(2) Are easily absorbed by matter
(3) Travel with greater speed
(4) Similar in nature to cathode rays

Question 11 [2]

(a) 1. What is the significance of binding energy per nucleon of a nucleus.
2. The binding energy per nucleon of helium nucleus is 7.0MeV. Find its mass defect.

OR

(b) 1. Show that the nuclear density is independent of its mass number.
2. A nuclear reactor using $_{92}U^{235}$ as fuel is operating at 2.5KW. What is the fission rate assuming that 200MeV energy is released in the fission of a single $_{92}U^{235}$ nucleus?

Question 12 [2]

Name the different modes of propagation of radio waves. Give the frequency range of each.

Section C

*Answer **all** questions.*

Question 13 [3]

(i) In an ac generator , obtain the expression for induced emf , when its coil rotates in a uniform magnetic field.

(ii) Draw the output waveform of the generator.

Question 14 [3]

Define potential at a point due to a point charge . Hence derive the expression for potential at a point due to a point charge .

Question 15

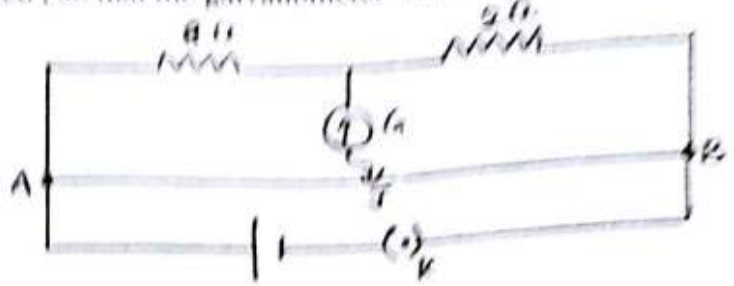
(i) What are the four different types of energy losses in a transformer?

(ii) A potentiometer wire is 1m long. It carries a steady current. A cell of emf 1.02V is balanced against a length of 68cm of wire. Find potential gradient across the wire.

Hence define it.

OR

(i) In the circuit given below, the length of the wire AB is 40cm. Where should the jockey be placed, so that the galvanometer shows no deflection.



(ii) Three point charges 25μC, 50μC and 75μC are at the corners of an equilateral triangle of side 5cm. Calculate the total potential energy of the system of charges.

[3]

Question 16

(a) A narrow beam of light is incident normally on one face of an equilateral glass prism with refractive index 1.45. When the prism is immersed in a liquid, the ray makes a grazing emergence along the other face. Find the refractive index of the liquid and draw a diagram showing the path of the ray.

OR

(b) Derive lens maker's formula for a thin lens. State the assumptions used.

Question 17 [3]

What is the effect on the interference fringes in Young's double slit experiment when

(1) The separation between the slits is increased
(2) The width of the source slit is increased
(3) The monochromatic source is replaced by source of white light.

Question 18 [3]

(i) Obtain the expression for the kinetic energy of the electrons in the Bohr model of hydrogen atom. Start from equating the electrostatic force with the centripetal force and then the quantisation condition for angular momentum.

(ii) An alpha particle having kinetic energy 1.8MeV incident on a thin gold foil, from a large distance. Find the distance of closest approach of alpha particle from the gold nucleus.(Z=79)

Question 19

[3]

(i) Explain the working of npn transistor.

(ii) Draw the V-I characteristics of zener diode.

Section D

*Answer **all** questions.*

Question 20

[5]

(i)Define rms value of alternating current .

(ii) Write two differences between reactance and impedance.

(iii) A resistance of 150 ohm and a capacitor of 15uF is connected in series with an ac souce . The peak value of current is 0.2A . calculate the average power consumed in the circuit .

If the capacitor is removed but the current is kept the same , what is the average power consumed in the resistor alone .

(5)

OR

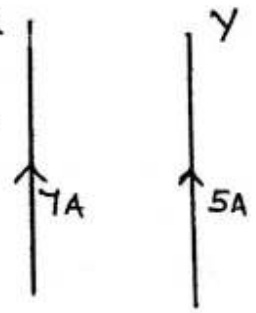
(i) State the law of parallel currents .

(ii) Two infinitely long current carrying conductors X and Y , kept parallel to each other 24cm apart in vacuum . They carry currents 7A and 5A respectively in the same direction . Find the position of neutral point (resultant magnetic field is zero)

(iii) If the current through Y is reversed , will the neutral point lie between X and Y , to the left of X or to the right of Y .

Mark the direction of force on each conductor in the above case .

Write down the force experienced by each of these conductors.



Question 21

[5]

(a) 1. Draw a labelled ray diagram of an astronomical telescope in normal use.

2.A compound microscope consists of an objective of focal length 2cm and eyepiece of focal length 5cm. When an object is kept at 2.4cm from the objective , the final image is formed at 25cm from the eye piece. Calculate the magnifying power of the compound microscope.

OR

(b) 1. With the help of a neat labelled diagram, derive the expression for the angular position of the first secondary minimum and secondary maximum of the diffraction pattern form by the single slit.

2. In Young's double slit experiment two wavelengths of 500nm and 700nm were used. What is the minimum distance from the central maximum, where their maxima coincide?

Question 22

(a) 1. With reference to semiconductor physics explain (i) depletion layer (ii) diffusion current. [5]

2. Draw a labelled circuit diagram of a half wave rectifier and give its output wave form.

3. Obtain OR gate using several NAND gates.

OR

(b) 1. With the help of a neat circuit diagram explain the input and output characteristics of a common emitter transistor.

2. Write the truth table of the following circuit. Name the logic gate represented by this circuit.