DBJ College, Chiplun
Semester I ACM Examination November 2024
Class: FYBSc Subject: Mathematics Paper No. I
Date: 14/11/2024 Time: 10.00 am to 12.30 pm

Time: 02.30 hours Total Marks: 75

Instructions: 1) All questions are compulsory.
2) Figure to the right indicates full marks.
3) Use of calculator is not allowed.

Q.1 A) Attempt any one questions of the following. (8)

a) State and prove Cauchy Schwartz Inequality.

b) State and prove Hausdorff property.

B) Attempt any two questions of the following. (12)

a) If a, b, c are positive real numbers then prove that, $(a+b)(b+c)(a+c) \geq 8abc$. Further if $a+b+c=1$ then prove that $(1-a)(1-b)(1-c) \geq 8abc$.

b) If $a=5$ & $b=7$ then find disjoint neighbourhoods of a and b.

c) Describe the set of real numbers x satisfying the following equality/inequality.
i) $|2x-3|<5$ ii) $7x+3=12$

Q.2 A) Attempt any one questions of the following. (8)

a) Prove that limit of convergent sequence in unique.

b) Show that $(-1)^n$ is not convergent.

B) Attempt any two questions of the following. (12)

a) If $a_n = \frac{n}{n+1}$ then find first 6 terms of the sequence.

b) Find limiting value of the sequence $a_n = \frac{5n^3+7n^2-4}{8n^3-8n+5}$.

c) Using Sandwich theorem prove that the sequence $a_n = \frac{3n+4\sin(nx)}{5n+3}$

Q.3 A) Attempt any one questions of the following. (8)

a) Prove that every convergent sequence is Cauchy.

b) State and prove Sandwich theorem.

B) Attempt any two questions of the following. (12)

a) If $f: \mathbb{R} \to \mathbb{R}$ is defined as $f(x) = 2x-4$, find the range of f.

b) If $f(x) = \sqrt{10-x}$, find domain, codomain and range of f.

c) Draw the graph of the function $y = |x-2|$.

Q.4 Attempt any three questions of the following. (15)

a) Show that the sequence $a_n = \frac{2n+3}{n+2}$ is monotonic increasing sequence.

b) Using definition of convergence show that $\lim_{n\to\infty} \frac{1}{n} = 0$

c) For a positive real number a, b and c. Prove that $\frac{a^2}{bc} + \frac{b^2}{ac} + \frac{c^2}{ab} \geq 3$.

d) Prove that every constant sequence is convergent.

e) By using monotone convergence theorem prove that $a_n = \frac{3n+1}{4^n}$.

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DBJ College, Chiplun
Semester I ATKT Examination November 2024
Class: FYBSC Subject: Zoology Paper No. I
Date: 14/11/2024 Time: 10:00 am to 1:00 pm

Time: Three hours. **Marks: 100**

N. B. 1) All questions are **compulsory.**
2) All questions carry **equal marks.**
3) Draw neat labeled diagrams wherever necessary.

Q. 1. A) Fill in the blanks by choosing the correct option given in the bracket. 05

a) Dolphins clicks..... sounds and use of these echoes to see in the under water.
(echosonic, ultrasonic, supersonic)

b) The pearl is formed by the secretion of.....
(Periostracum layer, Prismatic layer, Nacreous layer)

c) .....bird migration is less predictable and depending on available of food and water.
(nomadic, altitudinal, reverse.)

d) .....is the *in-situ* biodiversity conservation technique.
(Tissue culture, Gene bank, National parks)

e) Ashokvan project was started in 1955 by .....
(Anna Hazare, Baba Amte, Deepak Gadre)

Q. 1. B) Match the columns I and II and rewrite. 05

Column I	Column II
1) *Noctiluca*	a) Regeneration
2) Somnath project	b) Marsupial
3) Morphine	c) Bioluminescent
4) Kangaroo	d) Baba Amte
5) Earthworm	e) Opium poppy

Q. 1. C) State whether True or False. 05

a) About 90% of the bird species in the Palearctic realm are Migratory.
b) In Midwife toad, parental is care exhibited by the female.
c) Biodiversity is the degree of variation of life.
d) Tadoba National Park situated in the Uttarakhand.
e) Dr. Varghese Kurian is the Bird Man of India.

Q. 1. D) Answer the following in one sentence only. 05

a) Define the echolocation.
b) Name any two types of bird migrations.
c) Give full form of UNEP.
d) What is cryopreservation?
e) What is surimi?

(P.T.O.)

Q. 2. A) Describe briefly the bioluminescence in animals with suitable example. 10

OR

A) Explain the process of regeneration in earthworm and wall lizard. 10

Q. 2. B) Write short notes on (any two) 10

a) Echolocation in Bats.
b) Adaptive features in desert animals.
c) Batesian mimicry.
d) Types of coral reefs.

Q. 3. A) Describe the levels of biodiversity. 10

OR

A) What is biodiversity hotspot? Describe the Western Ghats hotspot. 10

Q. 3. B) Write short notes on (any two) 10

a) *ex-situ* conservation strategies of biodiversity.
b) Threats to biodiversity.
c) Convention on Biological Diversity.
d) Sanctuaries and National Parks.

Q. 4) Answer any two of the following 20

a) Describe the life sketch and work of Dr. Hargobind Khorana
b) Give an account of work and achievements of Anna Hazare.
c) Describe the life sketch and achievements of Dr. Varghese Kurian.
d) Describe the role of Kiran Mazumdar Shaw in developing BIOCON.

Q. 5) Write short notes on (any four) 20

a) Brood parasite.
b) Mechanism of pearl formation.
c) Man-wildlife conflict.
d) Desert adaptations in camel.
e) Lok Biradari Prakalp.
f) Gadre Fisheries.

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DBT college, Chiplun
Semester I ATKT Examination: November 2026
Class: FYBSc Subject: Zoology Paper No: I
Date: 15/11/26 Time: 10.00 am to 1.00 pm Marks: 100
Duration: 3 hrs

NB: 1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Draw neat labeled diagrams wherever necessary.

Q. 1 A) Choose appropriate answer and rewrite the sentence. 05

i) ---------- Is the long form of FDA.
(Food and Drug Administration, Food Department of America, Food Development Agency, Finance Development through Agriculture.)

ii) The most popular measure of Central tendency is----------
(Arithmetic mean, Madian, Mode, Standard deviation)

iii) The term Biotechnology was coined by----------
(Keshav mitani, Karl Sehgan, D'souza, Karl Ereky)

iv) ----------are used to create transgenic fishes with enhanced resistance to cold temperature.
(Growth hormones, Antifreeze proteins, Glycoproteins, Lipoproteins)

v) Objective lens is not fitted in----------
(TEM, scanning electron microscope, dissecting microscope, compound microscope)

Q. 1 B) Match the following columns. 05

Column I	Column II
Absolute zero	Optical density
Biosensor	Alkalosis
Colorimeter	Dr Lalji Singh
Abnormal calcium metabolism	Kelvin scale
Bkm	Reporter gene

Q. 1 C) State whether the following statements are **True or False.** 05

1. Oxidizing agents are capable of supporting combustion and intensifying violence of Fire.
2. The Metric system was designed in order to make it as neutral as possible.
3. An enzyme rennin is used to produce the best testing cheese.
4. In biological systems hydrogen ion concentration ranges from 10^{-2} moles/ litre to 10^{10} moles/ litre.
5. R_f value in chromatography refers to reference factor.

Q. 1 D) Answer in one sentence. 05

1. Why is agarose called neutral linear polymer?
2. Define spectroscopy.
3. Why is GFP used to create reporter gene construct?
4. State the chromosome number on which ADA gene is found.
5. Define frequency.

Q. 2 A) With suitable pictogram describe flammable chemicals and explosives. 10

Or

Q. 2 A) i) Define median. Calculate median by using following data on the height of students in inches of a class. 05

36, 34, 39, 38, 66, 72, 60, 64, 42, 40, 54, 48, 51.

(P.T.O.)

Q. 2 A) ii) By using following data on exports of fishes in tons, develop multiple bar diagram. 05

Exports of fishes in tonnes		
Year	USA	China
2010	52	60
2011	48	72
2012	34	44
2013	24	36

Q. 2 B) Attempt **any two** of the following. 10

i. Give the units of length and mass in tabular form.
ii. What is sample? Comment on simple random sampling.
iii. Enlist any five safety laboratory measures.
iv. Calculate the mode of the following data of haemoglobin level of the blood tests of patients in a medical camp.

10, 12, 06, 10, 12, 14, 06, 10, 08, 06, 16, 14, 10, 13, 12, 10.

Q. 3 A) Define transgenesis and comment on embryonic stem cell method of transgenesis. 10

OR

Q. 3 A) With suitable example explain the role of Aqua Bounty Technology in the development of transgenic fish. 10

Q. 3 B) Attempt **any two** of the following. 10

i) Briefly explain the industrial applications of biotechnology.
ii) Briefly explain the DNA fingerprinting technique.
iii) Briefly explain the experiment of Dolly.
iv) Describe the concept of green gene.

Q.4 A) With neat and labelled diagram describe compound microscope. 10

OR

Q. 4 A) Discuss the principle, types and applications of centrifuge. 10

Q. 4 B) Attempt **any two** of the following. 10

i. Enlist applications of PH meter.
ii. Describe thin layer chromatography.
iii. What are the applications of electrophoresis.
iv. Comment on the construction of dissecting microscope.

Q. 5. Write notes on **any four**. 20

i) PAGE
ii) Paper chromatography
iii) *In vivo* gene therapy
iv) Recombinant insulin
v) Irritants
vi) Normality

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DBJ College, Chiplun

Semester I ATKT Examination November 2024

Class: F.Y.B.Sc. Subject: Mathematics Paper No. II

Date: 15/11/24 Time: 10.00 am to 12.30 pm

Duration :2.30hrs Maximum marks:75

N.B. 1) All questions are compulsory.

2) Figures to right indicates full marks.

3) Use of calculator is not allowed.

Q 1. A] Attempt Any One. **(8)**

i) Prove that number of primes are infinite.

ii) Prove that, if $a \equiv b \ (mod\ n)$, $c \equiv d \ (mod\ n)$ then $a + c \equiv b + d \ (mod\ n)$ and $ac \equiv bd \ (mod\ n)$, for any $a, b, c, d \in \mathbb{Z}$.

B] Attempt any Two. **(12)**

i) State Wilson's theorem and verify it for $p = 7$.

ii) State and prove Euclid's lemma.

iii) Find g.c.d. of 567 and 123 and express it in the form of $567x + 123y$ for suitable $x, y \in \mathbb{Z}$.

Q 2. A] Attempt Any One. **(8)**

i) Show that $f: \mathbb{R} - \left\{\frac{5}{7}\right\} \to \mathbb{R} - \{0\}$ defined by $f(x) = \frac{1}{7x-5}$ is bijection and hence find its inverse.

ii) Define binary operation. In $\mathbb{Q}$, define a binary operation * as, For $a, b \in \mathbb{Q}$, $a * b = \frac{ab}{3}$. Show that * satisfies all the properties of binary operation.

B] Attempt any Two. **(12)**

i) Let $f: \mathbb{R} \to \mathbb{R}, f(x) = x^2$ and $g: \mathbb{R} \to \mathbb{R}, g(x) = 2x + 1$ .Then, Find $(fog)(x)$, $(gof)(x)$, $(gog)(x)$.

ii) Show that divisibility is an equivalence relation.

iii) Give an example of a function f such that f is
(a) injective but not surjective.
(b) surjective but not injective.

Q 3. A] Attempt Any One. **(8)**

i) State and prove Remainder theorem.

ii) State and prove Rational Root theorem.

B] Attempt any Two. **(12)**

i) Find Multiplicity of each root of $f(x) = x^4 + 6x^3 + 13x^2 + 12x + 4$.

ii) Find g.c.d. of the polynomials $f(x) = x^{12} - 1$, $g(x) = x^8 - 1$ over $\mathbb{R}[x]$.

iii) Find quotient and the remainder when $f(x) = x^4 - x^3 + 2x^2 + x - 6$ is divided by $g(x) = x^2 + x + 1$.

Q.4 Attempt any three of the following. (15)

i) Evaluate $\emptyset(378)$.

ii) Show that any two consecutive integers are relatively prime.

iii) Use mathematical induction to prove that,

$$1 + 2 + 3 \ldots + n = \frac{n(n+1)}{2}, \forall\, n \in \mathbb{N}.$$

iv) Expand $(x - y)^6$ by using Pascal's triangle.

v) Find a polynomial whose roots are $2, 6, -1, -1$.

Please check whether you have got the right question paper.

N.B. : 1. All questions are compulsory.

2. Answers to the same questions must be written together.

3. Figures to the right indicate full marks.

4. The use of log table/ non programmable calculator is allowed.

Q.1 A Select the correct option and complete the following sentences. (Attempt any nine) 9

i) Which of the following is an extensive property?
a) Density b) Entropy c) Pressure

ii) The system which can exchange only energy with surroundings but not matter is called.....system.
a) Closed system b) Open system c) Isolated system

iii) Equivalent weight of $KMnO_4$ in acidic medium is.....
a) 31.6 b) 52.66 c) 158

iv) 15 gram NaCl in 100 mL represents.....
a) 15% w/w NaCl b) 15% v/v NaCl c) 15% w/v NaCl

v) Stationary orbit concept was given by ---------
a) Dalton's theory b) Rutherford's Model c) Bohr's Model

vi) For Pfund series value of n_1 is --------.
a) 2 b) 4 c) 5

vii) Slater's rule is used for calculation of ----------.
a) ionization constant b) shielding constant c) electronegativity

viii) 2s orbital has ---------- radial nodes.
a) 1 b) 2 c) 3

ix) The prefix for keto group is used as -------- in IUPAC nomenclature.
a) Carbo b) Keto c) Oxo

x) Percentage of s-character in sp hybridized carbon is ---------.
a) 50 b) 75 c) 25

xi) The carbon-carbon bond energy increases as the hybridization changes from ------
a) sp^3 to sp^2 to sp
b) sp^3 to sp to sp^2
c) sp to sp^2 to sp^3

xii) Select correct stability order of alkyl carbocations.
a) Methyl > Primary > Tertiary > Secondary
b) Tertiary > Primary > Secondary > Methyl
c) Tertiary > Secondary > Primary > Methyl

xiii) Which of the following compound has zero dipole moment?
a) Chloroform b) Methyl Chloride c) Carbontetrachloride

B State whether the following sentences are **true** or **false. (Attempt any three)** 3

i) In isochoric process, temperature of system remains constant.

ii) Sum of mole fractions of all the components in solution is always equal to one.

iii) There are 9 periods in modern periodic table.

iv) Chromium is d-block element.

v) Electromeric effect is temporary effect.
vi) Chloroform is non-polar molecule.

3

C Match the following (Attempt any three)

1) Path function	a) Alkali metal
2) Neutron	b) Alkaline Earth Metal
3) Be	c) Work
4) Nitrile	d) Neutral
5) Lewis Base	e) R-CN
	f) R-OH
	g) $FeCl_3$
	h) Volume

20

Q.2 Attempt **any four** of the following

A Explain the terms- i) Enthalpy ii) Bond energy

B State first law of thermodynamics in different ways.

C Calculate the amount of work done on 1.5 mol of perfect gas at 300K when it is compressed isothermally and reversibly from a pressure of $1.01\times 10^5\ Nm^{-2}$ to $5.05\times 10^6\ Nm^{-2}$. (Given: R= 8.314 $JK^{-1}mol^{-1}$)

D Derive the equation $\Delta H_2-\Delta H_1=\Delta C_p(T_2-T_1)$

E Define Normality.
Calculate the weight of following substances that will be required to prepare 0.5L of 0.1N solution.i) HCl ii) H_2SO_4

F Define mole fraction.
10 g of urea (Mol. Wt. 60) was dissolved in 200 g water. Calculate mole fraction of each component.

20

Q.3 Attempt **any four** of the following

A Discuss the atomic spectrum of hydrogen atom.

B Give brief account of Heisenherg uncertainty principle.

C Write comphrensive note on Quantum Numbers.

D Explain the term Effective Nunclear Charge and calculate Zeff for 2p electron in oxygen.

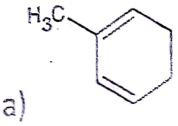
E What is ionization enthalpy? State factors influencing ionization enthalpy value.

F What is electronegativity?
Calculate the electronegativity value of chlorine atom. Given that ionization energy of Cl atom is 13.0 eV and Electron affinity of Cl atom is 4.0 eV.

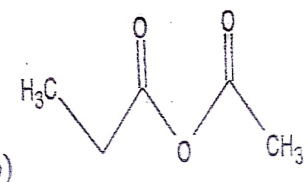
20

Q.4 Attempt **any four** of the following

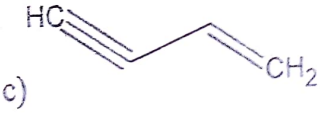
A i) Give IUPAC names for the following compounds.



a)

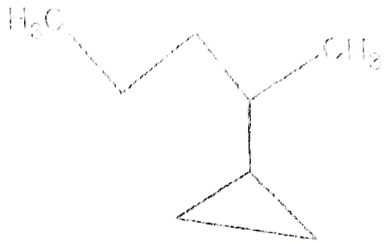


b)



c)

d) 

e) 

B i) Explain the sp^3 hybridization of carbon with suitable example.
ii) Draw the structures of the following compounds and mention the state of hybridization of each carbon and oxygen.
a) Acetone b) Methylacetate

C i) What is carbocation? Explain the structure and shape of carbocation.
ii) Discuss the stability of carbanion on basis of inductive effect.

D i) Explain the shape and bonding in ethane molecule.
ii) Why trichloroacetic acid is stronger than acetic acid?

E i) What are free radicals? How do they form?
ii) Explain the stability of free radicals on the basis of resonance.

F Write the structural formula for each of the following compounds.
a) 5-Oxohexanoic acid b) 2-Ethoxyethanol c) Hexane dial
d) 3-Methylcyclohexene e) 2-Bromobutanoyl chloride

DBJ College, Chiplun

Semester I ATKT Examination November 2024

Class : FYBSc Subject - Chemistry Paper No. II

Date : 18/11/24 Time - 10.00 am to 12.30 pm

Duration: 2 ½ hrs. **Marks: 75**

Please check whether you have got the right question paper.

N.B. :1. All questions are compulsory.

2. Answers to the same questions must be written together.

3. Figures to the right indicate full marks.

4. The use of log table/ non programmable calculator is allowed

Q.1 A Select the correct option and complete the following sentences. **(Attempt any nine)** 9

i) Unit of energy of activation is.....

a) $kJmol^{-2}$ b) kJK^{-1} c) $kJmol^{-1}$

ii) Acid catalyzed hydrolysis of methyl acetate is ..... reaction.

a) zero order b) pseudo first order c) second order

iii) Viscosity of liquid with higher intermolecular attractive force is.....

a) high b) low c) intermediate

iv) Molar refraction is product of specific refraction and .....

a) molar mass c) boiling point c) melting point

v) ------is most electronegative element in periodic table.

a) Fluorine b) Chlorine c) Hydrogen

vi) The s snd p block elements are collectively known as.....

a) Transition element b) Inner transition c) Main group elements

vii) -----has more affinity for carbon monoxide than oxygen.

a) Haemoglobin b) Chlorophyll c) Platelet

viii) Sodium Carbonate is also known as ----

a) Baking Soda b) Washing Soda c) Common Salt

ix) In flying-wedge formula, a broken wedge represents a bond projecting ----.

a) above the plane of the paper b) below the plane of the paper

c) in the plane of the paper

x) ---------- conformation of ethane has maximum energy.

a) Skew b) Staggered c) Eclipsed

xi) 2,3-Dibromobutane has ---------- stereoisomers.

a) two b) four c) three

xii) ---------- shows geometrical isomerism.

a) Ethane b) Propene c) But-2-ene

xiii) The isomer --------- has plane of symmetry.

a) threo-2,3-dichlorobutane b) erythro-2,3-dichlorobutane

c) erythro-3-bromo-2-butanol.

B State whether the following sentences are **true** or **false. (Attempt any three)** 3

i) For all chemical reactions, order and molecularity is always same.

ii) Refractive index is given by Snell's law.

iii) CO produces toxic effects on human beings due to its reversible reaction with haemoglobin in the blood.

iv) Group 13 to 18 elements are known as s-block elements.

v) Fischer projection formula represents eclipsed conformation.

vi) Geometrical isomers are also called diastereomers.

C Match the following (**Attempt any three**) 3

i)	Arrhenius equation	a) Similar physical properties
ii)	CFC	b) $A = ke^{-Ea/RT}$
iii)	Bucky ball	c) Achiral molecule
iv)	Lactic acid	d) $k = Ae^{-Ea/RT}$
v)	Enantiomer	e) Fullerene
		f) Chloroflurocarbon
		g) Chiral molecule

Q.2 Attempt **any four** of the following 20

A Derive integrated rate equation for second order reaction with equal initial concentration of reactants.

B Explain following kinetic characteristics of first order reactions.
i) Unit of rate constant ii) Half time of reaction

C In certain reaction, the half time was found to be 257 min when the initial pressure was 1.613×10^5 Nm^{-2} and 210 min when initial pressure was 2×10^5 Nm^{-2}. Find the oreder of reaction.

D Define viscosity. Explain method used to determine viscosity by Ostwald's viscometer.

E In stalagmometer method, two liquids A and B formed 40 and 60 drops for a given volume. If the densities of A and B are 0.85×10^3 kg/m^3 and 1×10^3 kg/m^3 respectively and the surface tension of B is 0.07 Nm^{-1}. Calculate surface tension of liquid A.

F What are liquid crystals? Give any four applications of liquid crystals.

Q.3 Attempt **any four** of the following 20

A What is diagonal relationship between elements? Explain it with respect to Lithium and Magnesium.

B Discuss oxidation states of group 16 and 17 elements.

C Describe the metallic and non-metallic character and explain variation in periodic table.

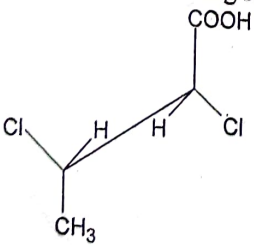
D Name any two oxides of Nitrogen .Write the sources and control measures for oxides of Nitrogen.

E Write short note on Greenhouse effect.

F Give important applications of quicklime.

Q.4 Attempt **any four** of the following 20

A Draw Fischer projection formulae and Newman projection formulae of threo-tartaric acid.
Convert the following structure to Fischer projection.

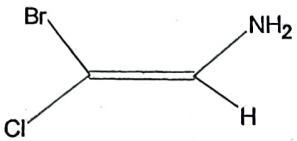


B i) What is stereoisomerism? Explain optical isomerism with suitable

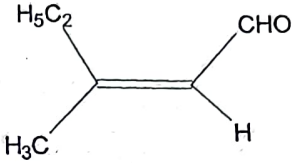
examples.

ii)Assign Z-E descriptors to the following compounds.

a)



b)

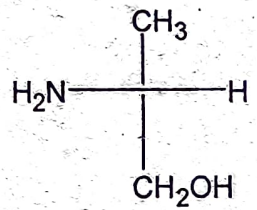


C Draw the conformations of n-butane for rotation about C_2-C_3 bond. Discuss their relative stabilities.

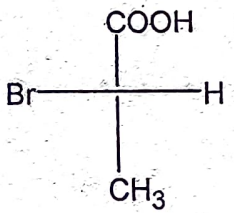
D i) What is optical activity? Explain the term dextrorotatory and laevorotatory isomers.

ii) Assign 'D' or 'L' configuration to the following compounds.

a)



b)



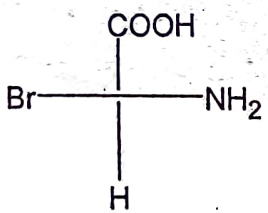
E Explain the following terms with suitable examples.

i) Diastereoisomers ii) Meso isomers

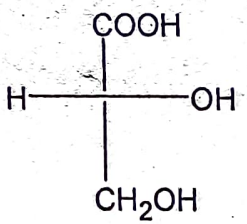
Write any two characteristics of enantiomers.

F Assign the configuration 'R' or 'S' the following molecules by mentioning the priority of substituents.

a)



b)



DBJ College, Chiplun

Semester I ATKT Examination November 2024

Class: FYBSc Subject - Physics Paper No - I

Date: 22/11/24 Time 10-00am to 12-30pm

[Time: 2 ½ Hours] [Marks: 75]

N. B.: (1) **All** questions are **compulsory**.
(2) **Figures** to the **right** indicate **full** marks.
(3) Draw **neat labeled** diagrams wherever **necessary**.
(4) Symbols have usual meaning unless otherwise stated.
(5) Use of **non-programmable** calculator is allowed.

Q. 1 (A) Attempt ANY ONE. 10

(i) An object of mass 2 kg is falling from a building of height 50 m. Calculate the speed of the object when it hits the ground surface.

(ii) A person of mass 70 kg is standing is an elevator moving downwards with an acceleration of 0.8 m/s^2. Calculate the effective mass as experienced by the person.

(B) Attempt ANY TWO. 10

(i) Define the term 'coefficient of friction'. State the four laws of friction.

(ii) Define the terms: Inertial frame. Non-inertial frame, Pseudo force. In the following situations, state whether a net force is acting on the body or not:
1. A box placed on a horizontal table
2. The Moon revolving round the Earth
3. A car moving with constant speed on a curved road
4. A ball free- falling through air

(iii) State and explain the work- energy theorem.

(iv) State and explain the Newton's laws of motion. Explain which force is responsible for motion of a car moving on a road.

Q. 2 (A) Attempt ANY ONE. 10

(i) Define stress and strain. Hence explain Young's modulus, Bulk modulus, modulus of rigidity and Poisson's ratio.

(ii) With the help of neat labelled diagram, explain the construction and working of Venturimeter.

(B) Attempt ANY TWO. 10

(i) Show that the velocity of efflux of a liquid passing through a narrow opening is proportional to $\sqrt{h}$.

(ii) Write a short note on Raynold's number.

(iii) Explain with a labelled graph, Hooks law.

(iv) For a steel material, $Y = 2 \times 10^{11}$ N/m^2 and Bulk modulus is 13.3×10^{10} N/m^2. Calculate Poisson's ratio and modulus of rigidity of the material.

Q. 3 (A) Attempt ANY ONE. 10

(i) For a real gas, show that; $C_p - C_v = \left[\left(\frac{\partial U}{\partial V}\right)_T + p\right]\left(\frac{\partial V}{\partial T}\right)_p$. Hence for a perfect gas show that; $C_p - C_v = R$.

(ii) Explain, how Van der Waal corrected an ideal gas equation for real gases.

Q.3 (B) Attempt ANY TWO. 10

(i) Calculate the diameter of the molecules of a gas for which the Van der Waals constant b is 115×10^{-4} when referred to one cc of a gas at NTP.

(ii) A reversible Carnot cycle does work which is equal to 150 KJ/cycle. At 227 ^{0}C, the heat supplied by cycle is 225 KJ/cycle. Calculate (i) the temperature at which heat is rejected, (ii) the thermal efficiency of engine.

(iii) Show that the heat supplied to a system in a cyclic process is equal to the area of the closed path on the indicator diagram.

(iv) Calculate the work done in joules when the volume of 16.0 gm of oxygen at 27 ^{0}C changes isothermally from 5.0 to 25.0 litres. (R = 8.314 J/K mole.)

Q. 4 Attempt ANY FIVE. 15

(i) The force acting on a particle of mass 30 gram is $10\hat{\imath} + 20\,\hat{\jmath}$ N. If it starts from rest, determine its position after 5 seconds.

(ii) Write a brief note on Einstein's Energy- Mass equivalence relation

(iii) Show that the Poisson's ratio of any material always lies between 0.5 and –1.

(iv) Find the terminal velocity of a steel ball bearing of radius 0.2 cm when it falls through a liquid in a tube. (ρ_{steel} = 8 gm/cc, ρ_{liquid} = (4/3) gm/cc, η_{liquid} = 8.5 poise, g = 980 cm/s^2)

(v) Efficiency of Carnot's cycle changes from 1/6 to 1/3 when source temperature is raised by100 K. Calculate the temperature of sink.

(vi) Two moles of an ideal gas expands isothermally and reversibly from 20 L to 30 L at 300 K. Find the work done. (R = 8.314 J/K mole.)

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DBJ College, Chiplun

Semester I ATKT Examination November 2025

class: FYBSc Subject – Physics Paper No - II

Date: 23/11/25 Time – 10.00 am to 12.30 pm

Total Marks: 75 **Duration: 2 hrs 30 min**

N.B: (1) All questions are compulsory. (2) Figures to the right indicate full marks.

(3) Draw neat diagram wherever necessary. otherwise (4) Symbols have usual meaning unless stated.

Physical Constants:

(1) Speed of Light, $C = 3 \times 10^8$ m/s (2) Planck's Constant, $h = 6.63 \times 10^{-34}$ Js

(3) $e = 1.6 \times 10^{-19}$ C (4) 1 eV = 1.6×10^{-19} joules

(5) Avogadro's Number = $N_o = 6.023 \times 10^{23}$ (6) Mass of Electron = $m_e = 9.11 \times 10^{-31}$ kg

(7) Mass of Proton = $m_p = 1.67 \times 10^{-27}$ kg (8) Mass of Neutron = $m_n = 1.67 \times 10^{-27}$ kg

Q.1 A] Attempt **any one** of the following. **(10)**

i) With the help of a Segre chart, explain the stability in various nuclides.

ii) What is radioactivity? State and explain the law of radioactive disintegration.Derive necessary relation.

B] Attempt **any two** of the following. **(10)**

i) Explain: (1) Atomic mass unit, (2) Nuclear mass and mass energy equivalence.

ii) Using the given data, find the B. E. of neutron in the $^{3}_{7}$Li. Express it inMeV and joules. (Given: $^{3}_{7}$Li = 7.016004a.m.u., $^{3}_{6}$Li = 6.015125 and $^{1}_{0}$n= 1.008665a.m.u.)

iii) Define half - life period of radioactive sample. Show that $\tau = 0.693 / \lambda$.

iv) In a successive disintegration series $X \rightarrow Y \rightarrow Z$ (stable) if half-life time (τ_1) ofX is 1.3 h and half-life time (τ_2) of Y is 10 h; calculate the time (t_m) in which thenumber of Y – atoms become maximum.

Q.2 A] Attempt **any one** of the following. **(10)**

i) What do you mean by mass-energy conservation of nuclear reaction?

ii) Define Q-value of the reaction. Derive its expression.With the help of a neat labelled diagram, explain the ionization chamber.

B] Attempt **any two** of the following. **(10)**

i) State the various conservative laws on which the balancing of nuclear reactionoccurs.

ii) Calculate the Q-value of a reaction $^{10}_{5}B(\alpha, p)\ ^{13}_{6}C$(Given: Atomic masses in a.m.u. for Boron = 10.013534, Carbon = 13.003354,Helium = 4.002603 and Proton = 1.007825)

iii) Write a note on proportional counter.

iv) Find the energy released when two deuterium nuclei fuse to form α-particle. (Given: Atomic mass of deuterium = 2.014102 a.m.u., mass of Helium = 4.002603a.m.u.)

Q.3 A] Attempt **any one** of the following. (10)

i) Discuss Davisson and Garmer experiment in detail and explain its importance.

ii) Explain the Compton effect. Show that the Compton shift is $\Delta\lambda = \frac{h}{m_0 c}[1 - \cos\theta]$

B] Attempt **any two** of the following. (10)

i) State and explain de Broglie hypothesis. How was de Broglie led to it.

ii) A monochromatic beam of neutrons at 27°C is allowed to fall on a crystalnormally. Calculate the interatomic spacing of the crystal if the first orderreflection is observed at a colatitude angle of 77.5°.
(Given: $m_n = 1.67 \times 10^{-27}$ kg, $k = 1.38 \times 10^{-23}$ Joule/degree)

iii) Describe single crystal Bragg's spectrometer.

iv) Find the shortest wavelength present in the radiation from an X–ray machinewhose accelerating potential is 50,000 V.

Q.4 Attempt **any five** of the following. (15)

i) Show that the radius of an atomic nuclei is: $R = Ro\ A^{1/3}$

ii) What is radioactive equilibrium? Explain ideal equilibrium.

iii) If a sample of radium has half-life time of the order 22 years. Find the time takenby a sample to decrease to 10 %.

iv) Write a note on Bremsstrahlung process.

v) Find the quantity of energy released by10^{-3}kg of Uranium, if one atom of ^{235}Ureleases the energy of 200 MeV in nuclear fission reaction.

vi) Write a note on nuclear fusion.

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