PHYSICS

Time: 3 Hrs **Marks : 70**

General Instructions:

1. All questions are compulsory.
2. There are 30 Questions in total Question no. 1 to 8 are very short answer type questions and carry 1 mark each.
3. Question no. 9 to 18 are short answer questions and carry 2 marks each.
4. Question no. 19 to 27 are also short answer questions and carry 3 marks each.
5. Question no. 28 to 30 are long answer questions and carry 5 marks each.
6. There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions of five marks each. You have to attempt only one of the given choice in such questions.
7. Use of calculators is not permitted. However, you may use log tables if necessary.
8. You may use the following values of physical constants wherever necessary.

$c = 3 \times 10^8 ms^{-1}$

$h = 6.63 \times 10^{-34} J\,s$

$e = 1.6 \times 10^{-19} C$

$\mu_0 = 4\pi \times 10^{-7} TmA^{-1}$

$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 Nm^2/C^{-2}$

Very short answer type Questions (1 to 8)

Q.1 What is the value of phase change in total internal reflection ? **[1]**

Q.2 If ultraviolet radiation are incidenting over a metal surface. Now it is replaced with X-rays then what happens to kinetic energy of emitted electrons. **[1]**

Q.3 Define decay constant. **[1]**

Q.4 If a substance can decay by two methods and half life for two methods is T_1 and T_2. Now if the substance decays by both methods then calculate effective half-life. **[1]**

Q.5 The maximum velocity of electrons, emitted from a metal surface of negligible work function, is 'V', when frequency of light falling on it is 'f'. What will be the maximum velocity when the incident light frequency is made '4f' ? **[1]**

Q.6 A 500 μC charge is at the centre of a square of side 10 cm. Find the work done in moving a charge of 10 μC between two diagonally opposite points on the square. **[1]**

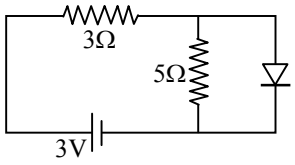
Q.7 Calculate the temperature at which the resistance of a conductor becomes 20% more than its resistance at 27ºC. The value of the temperature coefficient of resistance of the conductor is 2.0×10^{-4}/K. **[1]**

Q.8 Write the relation for the force $\vec{F}$ acting on a charge carrier q, moving with a velocity $\vec{v}$ through a magnetic field $\vec{B}$ in vector notation. Using this relation, deduce the conditions under which this force will be (i) maximum (ii) minimum. **[1]**

Short answer Questions (9 to 18)

Q.9 What is the momentum of photon of energy 3 MeV. **[2]**

Q.10 Find current in 3Ω resistor in given circuit. **[2]**



Q.11 A change of 8 mA in the emitter current brings a change of 7.9 mA in collector current. How much change in base current is required to have same change of 7.9 mA in collector current ? Find values of α & β. **[2]**

Q.12 Draw circuit diagram for AND gate and write its truth table. **[2]**

Q.13 If height of antennae is H and radius of earth is Re then derive a relation for distance upto which signals can be sent. **[2]**

Q.14 A luminiscent object is placed at a depth 'd' in a (optically) denser medium of refractive index 'μ'. Prove that radius r of the base of the cone of light from the object, that can emerge out from the surface is. $r = \frac{d}{\sqrt{\mu^2 - 1}}$ **[2]**

Q.15 Derive the expression for the electric potential at any point along the axial line of an electric dipole ? **[2]**

Q.16 Draw a labelled diagram of a moving coil galvanometer. State the principle on which it works. **[2]**

Q.17 Prove that an ideal inductor does not dissipate power in an a.c. circuit. **[2]**

Q.18 'Microwaves are used in Radar.' Why ? **[2]**

Short answer Questions (19 to 27)

Q.19 In the double slit experiment, the pattern on the screen is actually a superposition of single slit diffraction from each slit and the double slit interference pattern. In what way is the diffraction from each slit related to the interference pattern in a double slit experiment ? Explain.
Hence draw the intensity distribution curve, obtained on the screen, in the double slit experiment
(i) when the width of each slit is comparable to wavelength of monochromatic light used
(ii) when the width of each slit is relatively large compared to wave length of monochromatic light **[3]**

Q.20 Derive the expression for the radius of the n^{th} orbit of hydrogen atom using Bohr's postulates. Show graphically the (nature of) variation of the radius of orbit with the principal quantum number, n.

OR

What is the frequency of radiation emitted when a hydrogen atom de-excites from level x to level $(x - 1)$? For large x, show that this frequency equals the classical frequency of revolution of the electron in the orbit. **[3]**

Q.21 Give reason for each of the following observation.
(i) The resultant intensity at any point on the screen varies between zero and four times the intensity, due to one slit, in Young's double slit experiment

(ii) A few coloured fringes, around a central white region, are observed on the screen, when the source of monochromatic light is replaced by white light in Young's double slit experiment

(iii) The intensity of light transmitted by a polaroid is half the intensity of the light incident on it **[3]**

Q.22 Complete the following block diagram depicting the essential elements of a basic communication system.

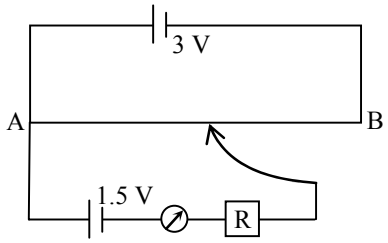
Name the two basic modes of communication. Which of these modes is used for telephonic communication ?

OR

Is it necessary for the transmitting antenna and the receiving antenna to be of the same height for line of sight communication ? Find an expression for maximum line of sight distance d_m between these two antennas of heights h_T and h_R. **[3]**

Q.23 Derive an expression for the resistivity of a good conductor, in terms of the relaxation time of electrons. **[3]**

Q.24 A potentiometer wire of length 1 m is connected to a driver cell of emf 3 V as shown in the figure. When a cell of 1.5 V emf is used in the secondary circuit, the balance point is found to be 60 cm. On replacing this cell and using a cell of unknown emf, the balance point shifts to 80 cm.



(i) Calculate unknown emf of the cell

(ii) Explain with reason, whether the circuit works, if the driver cell is replaced with a cell of emf 1 V

(iii) Does the high resistance R, used in the secondary circuit affect the balance point ? Justify your answer. **[3]**

Q.25 Define magnetic flux. Give its SI unit. **[3]**

Q.26 Explain, with the help of a neat and labelled diagram, the principle, construction and working of a transformer. **[3]**

Q.27 Write any four characteristics of electromagnetic waves. Give two uses each of
(i) Radio-waves
(ii) Micro-waves **[3]**

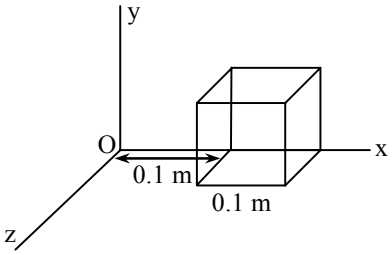
Long answer Questions (28 to 30)

Q.28 Draw a ray diagram for a compound microscope. Derive an expression for the magnifying power when the final image is formed at the least distance of distinct vision. State the expression for the magnifying power when the image is formed at infinity. Why is the focal length of the objective lens of a compound microscope kept quit small ?

OR

Derive the lens formula giving the relation between u, v and *f* for a thin convex lens. Define the term 'linear magnification' and draw a graph showing the variation of linear magnification with image distance for a thin convex lens. How can this graph be used for finding the focal length of the lens ? **[5]**

Q.29 (a) Define electric flux. Write its SI units
(b) The electric field components due to a charge inside the cube of side 0.1 m are as shown
$E_x = \alpha x$, where $\alpha = 500$ N/C-m
$E_y = 0$, $E_z = 0$



Calculate (i) the flux through the cube, and (ii) the charge inside the cube. **[5]**

Q.30 Explain briefly, with the help of a labelled diagram, the basic principle of the working of an a.c. generator.
In an a.c. generator, coil of N turns and area A is rotated at v revolutions per second in a uniform magnetic field B. Write the expression for the emf produced.
A 100 turn coil of area 0.1 m^2 rotates at half a revolution per second. It is placed in a magnetic field 0.01 T perpendicular to the axis of rotation of the coil. Calculate the maximum voltage generated in the coil. **[5]**

CHEMISTRY

Time: 3 Hrs **Marks : 70**

General Instructions:

1. All questions are compulsory.
2. Question no. 1 to 8 are very short answer questions and carry 1 mark each.
3. Question no. 9 to 18 are short answer questions and carry 2 marks each.
4. Question no. 19 to 27 are also short answer questions and carry 3 marks each.
5. Question no. 28 to 30 are long answer questions and carry 5 marks each
6. Use log tables if necessary, use of calculators is not allowed.

Very short answer type question (Q.1 to Q.8)

Q.1 A and B liquids on mixing produce a warm solution. Which type deviation from Raoult's law is there ? **[1]**

Q.2 Why is Ferric chloride preferred over Potassium Chloride in case of a cut leading to bleeding ? **[1]**

Q.3 What happens when cane sugar ishydrolysed ? **[1]**

Q.4 In solid state PCl_5 behaves as an ionic species give reason **[1]**

Q.5 Mention two froth stabilizers used in froth floatation process **[1]**

Q.6 Why is sulphuric acid not used during the reaction of alcohols with KI ? **[1]**

Q.7 Give the equations of reactions for the preparation of phenol from cumene. **[1]**

Q.8 Write the structural formula of 1- phenylpentan-1-one **[1]**

Short answer type question (Q. 9 to Q.18)

Q.9 Classify each of the following as being either a p-type or an n-type semi-conductor. Give reason- **[2]**
(a) Si dopped with In (b) Si dopped with P

Q.10 Describe the construction of a H_2–O_2 fuel cell and the reactions taking place in it. **[2]**

OR

Define the terms given below-

(a) Conductivity

(b) Molar conductivity

What are their units ?

Q.11 On dissolving 19.5 g of CH_2FCOOH in 500g of water, a depression of 1°C in freezing point of water is observed. Calculate the Van't Hoff factor and dissociation constant of fluoro acetic acid.

Given K_f = 1.86 K kg mol^{-1} **[2]**

Q.12 (a) Heat of adsorption is greater for chemisorption than for physisorption. Why ?

(b) Mention two common properties of sol and emulsions

(c) Differentiate between electrophoresis and electro-osmosis **[2]**

Q.13 Determine the molarity of an antifreeze solution containing 250 g water mixed with 222 g ethylene glycol ($C_2H_6O_2$). The density of this solution is 1.07 g/ml. **[2]**

Q.14 (a) State the role of silica in the metallurgy of copper.

(b) Differentiate between roasting and calcinations **[2]**

Q.15 Draw the shapes of the following compounds:

(a) SF_4 (b) XeF_2 **[2]**

Q.16 Explain giving reason

(a) The enthalpies of atomization of the transition metals are high

(b) Transition metals in their many compounds act as good catalyst **[2]**

Q.17 Predict, giving reasons, the order of basicity of the following compounds in (i)gaseous phase and (ii) in aqueous solutions

$(CH_3)_3$ N, $(CH_3)_2$ (NH), CH_3NH_2, NH_3 **[2]**

Q.18 Account for the following : **[2]**

(a) Aniline does not undergo Friedel Crafts alkylation

(b) Although-NH_2 group is an ortho and para-directing group, nitration of aniline gives alongwith ortho and para-derivatives meta-derivative also.

Short answer type question (Q. 19 to Q.27)

Q.19 (a) Two electrolytic cells containing silver nitrate solution and dilute sulphuric acid solution were connected in series. A steady current of 2.5 amp was passed through them till 1.078 g of silver was deposited. [Ag = 107.8g mol^{-1}, If = 96, 500C]

(i) How much electricity was consumed ?

(ii) What was the weight of oxygen gas liberated ?

(b) Give reason-

(i) The equilibrium constant K is related to E^0_{cell} and not E_{cell}.

(ii) Conductivity of an electrolytic solution decreases with the decreases in concentration **[3]**

OR

(a) What is a fuel cell ? What is its main advantage ?

(b) What are the reactions occurring at the cathode and anode of a Leclanche cell ?

(c) In the button cell widely used for watches and other devices, the following reaction takes place-

$Zn(s) + Ag_2O(s) + H_2O(l) \longrightarrow Zn^{2+}(aq) + 2Ag(s) + 2OH^-(aq)$

Give the cell representation and determine the value of K_c for the above reaction using the following data-

$Ag_2O(s) + H_2O(l) + 2e^- \longrightarrow$

$2Ag(s) + 2OH^-(aq)$ $(E^0 = 0.344V)$

$Zn^{2+}(aq) + 2e^- \longrightarrow Zn(s)$ $(E^0 = -0.76V)$

Q.20 (a) Give one main difference between lyophillic and lyophobic colloids

(b) What is observed when

(i) A beam of light is passed through a colloidal solution.

(ii) Electric current is passed through a colloid solution. **[3]**

Q.21 (A) What is denaturation of protein

(B) What is difference between nucleotide & nudeoside

(C) What is isoelectric point **[3]**

Q.22 (A) Define the terms thermoset polymer and theromoplastic. Give one example of each

(B) How will you prepare the following ? Give chemical reaction only

(i) PVC (ii) PAN (iii) Terylene (iv) Buna-S **[3]**

Q.23 (A) Write the structural formula of the following compounds- **[3]**

(i) Aspirin (ii) Paracetamol (iii) Bithionol (iv) Chloroxylenol

(B) What are antacids? List some compounds which are used as antacids ?

Q.24 (a) Among ionic species Sc^{+3}, Ce^{+4} and Eu^{+2}, which one is a good oxidizing agent

(b)Complete the following reactions: **[3]**

(i) $Cr^2 O_7^{-2} + Sn^{+2} + H^+ \rightarrow$

(ii) $Mn\,O_4^- + Fe^{+2} + H^+ \rightarrow$

Q.25 (a) Which isomer of $[Co(en)_2\,Cl_2]^+$ does not show optical isomerism ?

(b) $[NiCl_4]^{-2}$ is paramagnetic while $[Ni(CO)_4]$ is diamagnetic though both are tetrahedral why ? **[3]**

Q.26 Explain as to why haloarenes are much less reactive than haloalkanes towards nucleophilic substitution reactions. **[3]**

OR

Which compound in each of the following pairs will react faster in S_N2 reaction with–OH ? Why ?

(i) CH_3Br or CH_3I (ii) $(CH_3)_3CCl$ or CH_3Cl

Q.27 Give chemical tests to distinguish between compounds in each of the following pairs **[3]**

(i) Phenol and Benzyl alcohol

(ii) Butane-2-ol and 2-Methyl propan-2-ol

Long answer type question (Q.28 to Q.30)

Q.28 For the reaction

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+} C_6H_{12}O_6 + C_6H_{12}O_6$$

Write :

(i) Rate of reaction expression

(ii) rate law equation

(iii) molecularity

(iv) order of reaction

(b) The following data were obtained during the first order thermal decompostiotion of SO_2Cl_2 at constant volume-

$SO_2Cl_2(g) \rightarrow SO_2(g) + Cl_2(g)$

Experiment	Time/s	Total pressure/atm
1	0	0.5
2	100	0.6

Calculate the rate of reaction when total pressure is 0.65 atm. **[5]**

OR

(a) Illustrate graphically the effect of catalyst on activation energy.

(b) Catalysts have no effect on the equilibrium constant. Why ?

(c) The decomposition of A in to product has value of k as $4.5 \times 10^3\ s^{-1}$ at 10°C and activation energy is 60 kJ mol^{-1}. Calculate the temperature at which the value of k will be $1.5 \times 10^4\ s^{-1}$

Q.29 (a) Assign reasons for the following: **[5]**

(i) The acidic strengths of acids increases in the order: HF < HCl< HBr < HI

(ii) H_3PO_2 behaves as a monoprotic acid

(b) Complete following reactions:

(i) $Pb(NO_3)_2 \xrightarrow{\Delta}$

(ii) $XeF_2 + H_2O \longrightarrow$

(iii) $Ca_3P_2\ H_2O \longrightarrow$

Q.30 (a) How will you bring about the following conversions ?

(i) Ethanol to 3-hydroxybutanal

(ii) Benzaldehyde to Benzophenone

(b) An organic compound A has the molecular formula $C_8H_{16}O_2$. It gets hydrolysed with dilute sulphuric acid and gives a carboxylic acid B and an alcohol C. Oxidation of C with chromic acid also produced B. C on dehydration reaction gives but-1-ene. Write equations for the reactions involved. **[5]**

BIOLOGY

Time: 3 Hrs **Marks : 70**

General Instructions:

1. All questions are compulsory.
2. This questions paper consists of four Sections A, B, C and D. Section A contains 8 questions of one mark each, Section B is of 10 questions of two marks each, Section C is of 9 questions of three marks each and Section D is of 3 questions of five marks each.
3. There is no overall choice. However, an internal choice has been provided in one question of 2 marks, one question of 3 marks and all the three questions of 5 marks weightage. A student has to attempt only one of the alternatives in such questions.
4. Wherever necessary, the diagrams drawn should be neat and properly labelled.

SECTION - A

Q.1 Give example of analogues organs. **[1]**

Q.2 Name any two industrially important enzymes. **[1]**

Q.3 Name an immunosuppressive agent. **[1]**

Q.4 A bilobed, dithecous anther has 100 microspore mother cells per microsporangium. How many male gametophytes this anther can produce ? **[1]**

Q.5 Mention one application of pollen bank. How are pollens stored in a bank ? **[1]**

Q.6 What is meant by 10% law ? **[1]**

Q.7 In *Pisum sativum*, which is dominant, inflated pod or constricted pod ? **[1]**

Q.8 Name the cells of immune system that are affected by HIV ? **[1]**

SECTION - B

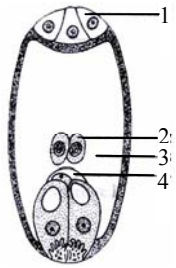
Q.9 Amniocentesis for sex determination is banned in our country. Is this ban necessary ? Comment. **[2]**

Q.10 Explain what is meant by biofortification. **[2]**

Q.11 A human female experiences two major changes, menarche and menopause during her life. Mention the significance of both the events. **[2]**

Q.12 Draw a diagram of fully developed male gametophyte. **[2]**

Q.13 In the given figure of embryo sac label the parts (1), (2), (3) and (4) **[2]**



Q.14 Name any five hybrid varieties of crop plants which have been developed in India. **[2]**

Q.15 Differentiate between diagnostics and therapeutics. Give one example of each **[2]**

Q.16 Construct a pyramid of biomass starting with phytoplanktons. Label 3 trophic levels. Is the pyramid upright or inverted ? Why **[2]**

Q.17 What happens when a red-coloured homozygous 4 'O' clock plant is crossed with a heterozygous 4 'O' clock plant ? Work out all the genotypes and phenotypes. **[2]**

Q.18 What is contact inhibition ? How does this phenomenon operate in cancer cells ? **[2]**

SECTION – C

Q.19 What is Biological evolution based on Lamarkism **[3]**

Q.20 Describe adaptive radiation with an suitable example ? **[3]**

Q.21 For which variety of Indian Rice, the patent was filed by U.S.A. company ? **[3]**

Q.22 Discuss the advantages of GMOs. **[3]**

Q.23 Describe humoral immunity **[3]**

Q.24 What is interspecific hybridization ? Give one example of a crop in which it is practiced and mention one advantage derived from it. **[3]**

Q.25 What is inbreeding in plants ? What happens to the recessive alleles in this process ? **[3]**

Q.26 Why do generally human males suffer from haemophilia ? Can women also suffer from it ? Explain. **[3]**

Q.27 In garden pea (Pisum sativum), a plant with yellow seeds was crossed with a plant with green seeds. Work out all the possible genotypes and phenotypes of F_1 and F_2 generations. Comment on the pattern of inheritance in this cross. **[3]**

SECTION – D

Q.28 Describe menstrual cycle in detail **[5]**

Q.29 What is meant by the following : **[5]**
(i) Somatic hybrid
(ii) Micropropagation
(iii) Explant
(iv) Somaclones
(v) Tissue culture

Q.30 Describe the components of an ecosystem. **[5]**