

SECTION - A

There are **FOUR** questions in this section. **Question 1** is compulsory. Answer any **TWO** from other **THREE**.

1. (a) Determine the location of the centroid of the shaded area (figure 1) with respect to x-axis.

[Given, R is the last two digit of your student id.]

15

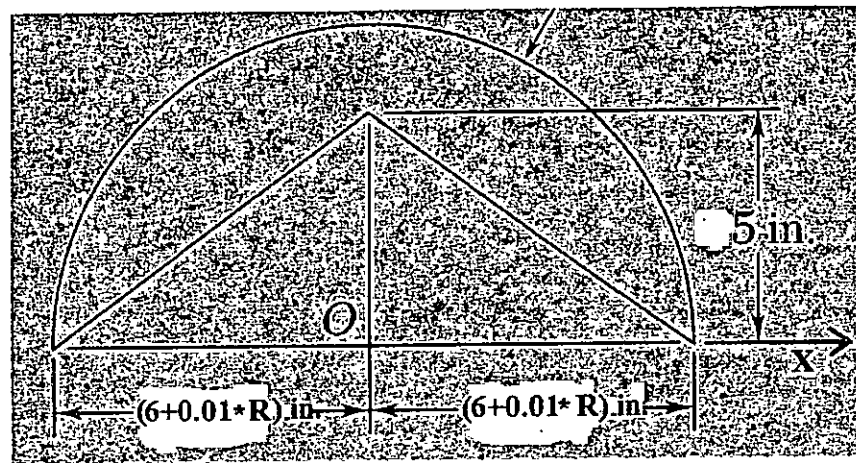


Figure 1: For question 1(a)

(b) Determine the moment of inertia of the shaded area shown (figure 2) with respect to the x-axis.

[Given, R is the last two digit of your student id.]

15

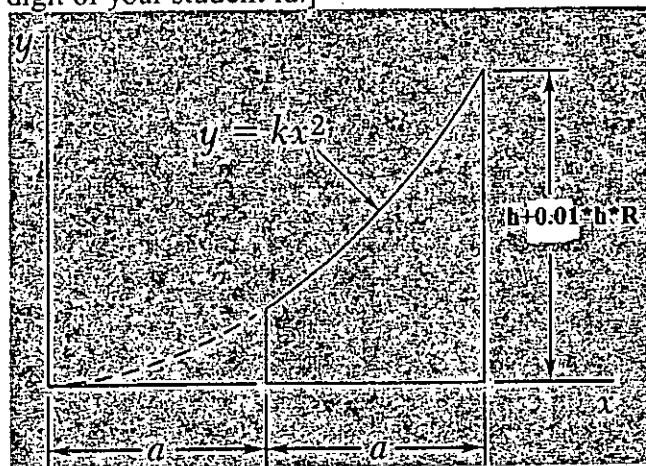


Figure 2: For question 1(b)

2. A $(10+0.1 \cdot R)$ kg block where R is the last two digits of your student id, is attached to the rim of a 300-mm-radius disk as shown in figure 3. Knowing that spring BC is unstretched when $\theta=0$, determine (a) the position or positions of equilibrium, and (b) state in each case whether the equilibrium is stable, unstable, or neutral.

15+15=30

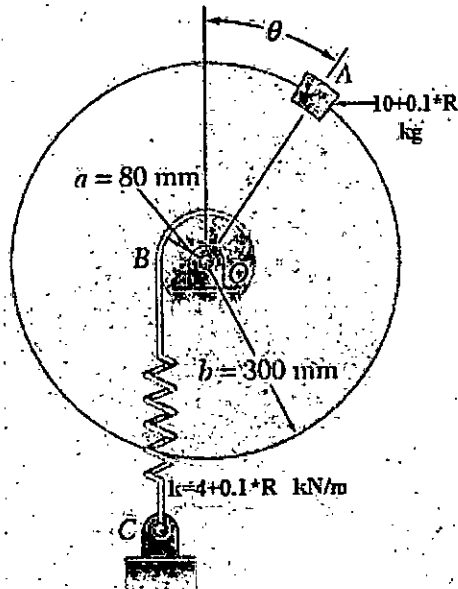


Figure 3: For question 2

3. (a) Block B of mass $(10+r)$ kg rests as shown on the upper surface of a $(20+r)$ kg wedge A. Knowing that the system is released from rest and neglecting friction, determine the acceleration of B. [Given, r is the last two digit of your student id.]

10

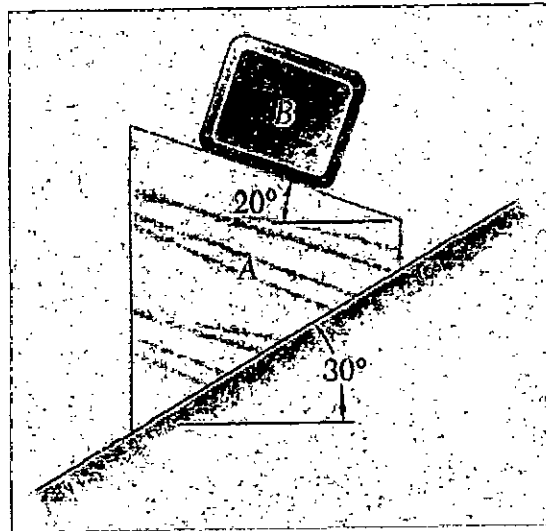


Figure 4: For question 3(a)

(b) The nozzle shown discharges a stream of water at a flow rate of $Q = (500+r)$ gal/min with a velocity v and a magnitude of 60 ft/s. The stream is split into two streams with equal flow rates by a wedge that is kept in a fixed position. Determine the components (drag and lift) of the force exerted by the stream on the wedge. [Given, r is the last two digit of your student id., $1 \text{ ft}^3 = 7.48 \text{ gal}$.] 20

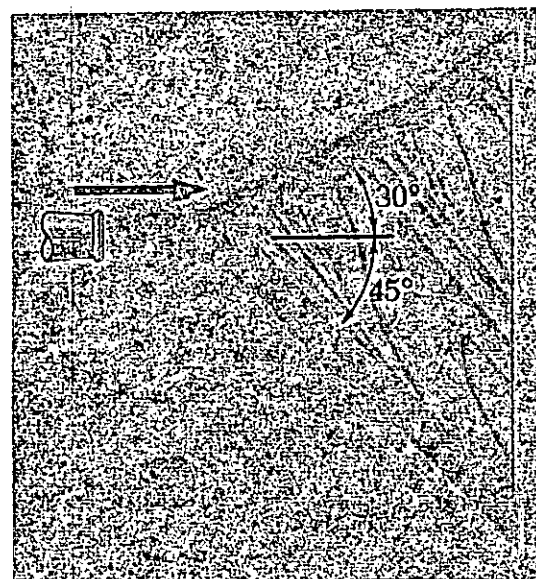


Figure 5: For question 3(b)

4. The double pulley shown has a mass of 15 kg and a centroidal radius of gyration of 160 mm. Cylinder A and block B are attached to cords that are wrapped on the pulleys as shown. The coefficient of kinetic friction between block B and the surface is 0.2. Knowing that the system is at rest in the position shown when a constant force $P = (200+r)$ N is applied to cylinder A, determine (a) the velocity of cylinder A as it strikes the ground, (b) the total distance that block B moves before coming to rest. [Given, r is the last two digit of your student id.] 20+10= 30

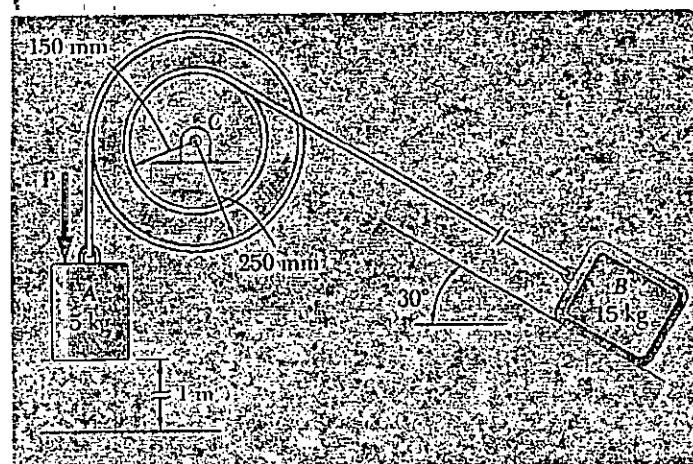
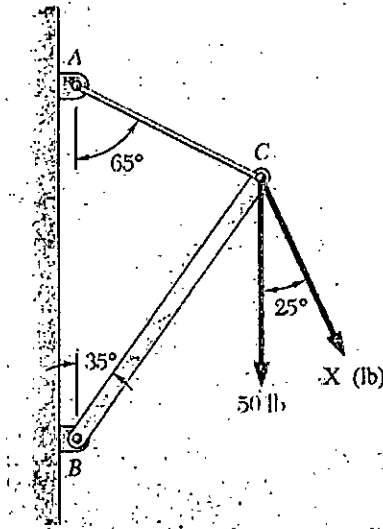


Figure 6: For question 4

SECTION - B

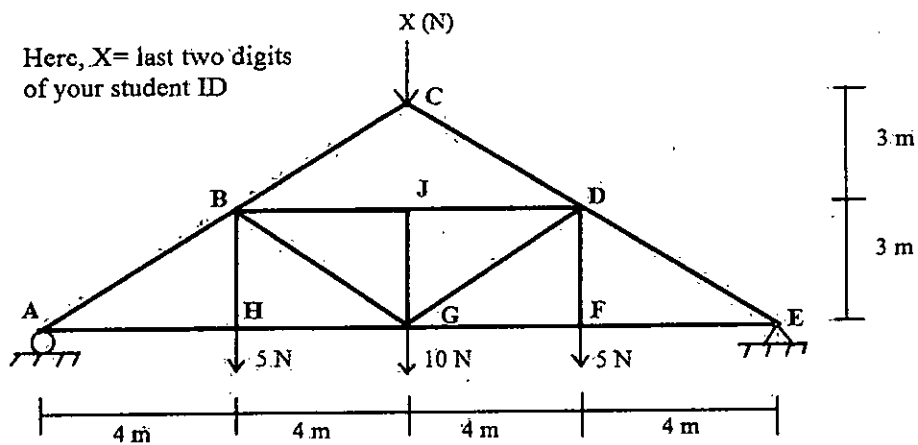
There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Determine (i) the required tension in cable AC, knowing that the resultant of the three forces exerted at point C of boom BC must be directed along BC, (ii) the corresponding magnitude of the resultant. (Here $X = 2 \times$ Last two digits of your student ID) 25

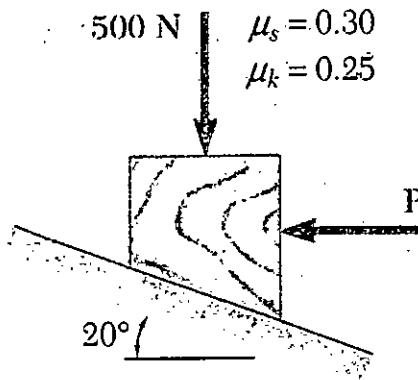


- (b) Draw tentative diagrams of different types of support system with reactions. 5

6. Find the member forces at BC, BJ and BG for the following truss. 30

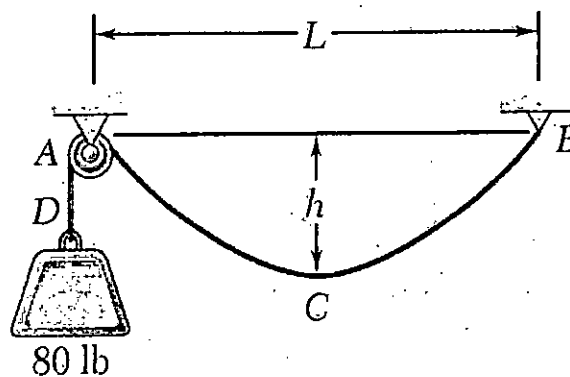


7. (a) Determine whether the block shown is in equilibrium, and find the magnitude and direction of the friction force when $P = (100 + 2 \times \text{Last two digits of your student ID}) \text{ N}$. 25



- (b) Do you think friction force is important for our everyday life? Justify your answer. 5

8. A counterweight D is attached to a cable that passes over a small pulley at A and is attached to a support at B . Knowing that $L = 45 \text{ ft}$ and $h = (10 + 0.1 \times \text{Last two digits of your student ID}) \text{ ft}$, determine (a) the length of the cable from A to B , (b) the weight per unit length of the cable. Neglect the weight of the cable from A to D . 30



L-1/T-1/WRE

Date: 21/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B.Sc. Engineering Examinations- January 2020

Sub: HUM 111 (English)

Full Marks: 120

Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 3 page(s) in this question paper.

SECTION – A

There are **FOUR** questions in this section. Answer **Q. No.1** and any **TWO** from the rest.

All the symbols have their usual meanings

Figures in the brackets indicate the marks of the questions

1. Answer any one of the following: (20)
 - (a) What philosophical viewpoints do you get reading the story 'The Bet'?
 - (b) How does the author delineate the social dichotomy between the rich and the poor in the story 'The Garden Party'? How can we reduce this disparity prevailing in the society?

2. (a) Explain with reference to the context any one of the following: (10)
 - i) It was disgusting and sordid. They came out with a shudder. But still one must go everywhere; one must see everything.
 - ii) ".....You may be proud, wise, and fine, but death will wipe you off the face of the earth as though you were no more than mice burrowing under the floor, ..."

(b) Answer any two of the following: (10)

 - i) Who is Mrs. Forestier? What is her role in the story 'The Diamond Necklace'?
 - ii) Why did Laura find the workmen extraordinarily nice?
 - iii) What didactic lesson do you get from the story 'The Diamond Necklace'?

3. Write a dialogue between two students of your department on how they can contribute to the development of the country as water resource engineers. (20)

4. Write a precis of the following passage with a suitable title: (20)

The aim of education is to make a man fully equipped to be useful to himself and to the society. It is to develop the whole man, his body, mind and soul. Education aims at providing a child with opportunities to bring out all the talents that it possesses. A truly educated person should be self-reliant with regard to his personal needs. He should also help others in attaining self-reliance. He should be well-mannered, thoughtful, creative, kind, respectful, sympathetic and co-operative. It is by cultivating these virtues that a human being transcends all limitations life imposes upon him and becomes the most dignified creation of God. If at the distress and suffering of a fellow human being, your love and empathy or such other human feelings are not roused, if you do not feel anguish in your heart and you do not feel an urge to try to alleviate the sufferings of other human beings, you have not been properly educated. A person who has acquired knowledge and skill for mere material development and personal gain is not fully educated either. A good education should aim at developing not only the body and the mind but also the soul.

SECTION - B

There are **FOUR** questions in this section. Answer **Q.No.5** and any **TWO** from the rest.

5. Read the following passage and answer the questions given below: (20)

A strict vegetarian is a person who never in his life eats anything derived from animals. The main objection to vegetarianism on a long-term basis is the difficulty of getting enough protein - the body-building element in food. If you have ever been without meat or other animal foods for some days or weeks (say, for religious reasons) you will have noticed that you tend to get physically rather weak. You are glad when the fast is over and you get your reward of a succulent meat meal.

Proteins are built up from approximately twenty food elements called 'amino-acids', which are found more abundantly in animal protein than in vegetable protein. This means you have to eat a great deal more vegetable than animal food in order to get enough of these amino-acids. A great deal of the vegetable food goes to waste in this process and from the physiological point of view there is not much to be said in favor of life-long vegetarianism.

The economic side of the question, though, must be considered. Vegetable food is much cheaper than animal food. However, since only a small proportion of the vegetable protein is useful for body-building purposes, a consistent vegetarian, if he is to gain the necessary 70 grams of protein a day, has to consume a greater bulk of food than his digestive organs can comfortably deal with. In fairness, though, it must be pointed out that vegetarians claim they

need far less than 70 grams of protein a day.

Most nutrition experts today would recommend a balanced diet containing elements of all foods, largely because of our need for sufficient vitamins. Vitamins were first called 'accessory food factors' since it was discovered, in 1906, that most foods contain, besides carbohydrates, fats, minerals and water, these other substances necessary for health. The most common deficiencies in Western diets today are those of vitamins. The answer is variety in food. A well-balanced diet having sufficient amounts of milk, fruit, vegetables, eggs, and meat, fish or fowl (i.e. any good protein source) usually provides adequate minimum daily requirements of all the vitamins.

(Collected and abridged)

Questions:

- a. Why does 'vegetarianism on a long-term basis' cast negative impacts on our health?
 - b. How may the vegetarian fall short of required protein intake?
 - c. Why do most western diets lack required vitamins necessary for us?
 - d. Why is the choice of 'to be or not to be a vegetarian' crucial for a healthy living?
6. As an Executive Engineer of a private company (that monitors illegal land grabbing in low-lying and marshy areas surrounding Dhaka), you ordered for developing a software from a renowned software firm that can provide instant report on any kind of illegal occupancy in those places relying on real time satellite images. However, receiving the product, you noticed that the software cannot provide instant report of unauthorized possession in the aforementioned areas. Write a claim letter to the software provider, mentioning the inability of the software in meeting the expected need. (20)
7. Write a short essay on **ANY ONE** of the following: (20)
- (a) Water Bodies Surrounding Dhaka: Their Potentials in Easing City's Traffic Congestion
 - (b) Winter in Bangladesh: The Changes Brought by Covid-19
8. Describe the importance of **Interpretive Report** in improving an existing situation while reporting on a problem-solution topic. (20)

L-1/T-1/WRE

Date: 25/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
B. Sc. Engineering Examinations January 2020

Sub: **PHY 107** (Physical Optics, Waves & Oscillations and Heat & Thermodynamics)

Full Marks: 180

Time: 2 hours

The figures in the margin indicate full marks. Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

There are **FOUR** questions in this Section. Answer any **THREE**

1. (a) What is fringe width? By what factors it depends on? A transparent plate of thickness t is placed in the path of one of the interfering beams in an experiment using a monochromatic light of wavelength λ . Why monochromatic light is necessary in an interference experiment? If the refractive index of the material is μ ; find the optical path difference between interfering beams. (22)

(b) Green light of wavelength 5000 \AA from a narrow slit is incident on a double slit. If the overall separation of 8 fringes on a screen 200 cm away is 2 cm. find the slit separation. (08)

2. (a) If the Fraunhofer class of diffraction pattern produced by two parallel slits (each of width b) separated by a distance d and λ is the wavelength of incident light, write down the intensity distribution function for the Fraunhofer class of diffraction at a double slit. Explain each of the term of the expression of intensity distribution function. How does diffraction pattern change with d at the same value of b and λ ? Explain the grating spectrum. (22)

(b) Find the minimum number of lines in a grating which will just resolve the sodium lines in the first order spectrum. The wavelengths are 5892 \AA and 5895 \AA . (08)

3. (a) Explain Brewster's law. Let a crystal where the diagonal represents the Canada Balsam layer. If μ_O (the refractive index of O-ray) = 1.658, μ_E (the refractive index of E-ray) = 1.486 and μ_{layer} (the refractive index of layer) = 1.55. Show that O-ray is totally internally reflected from the Canada Balsam layer. (22)

(b) The refractive index for plastic is 1.25. Calculate the angle of refraction for a ray of light incident at polarizing angle. (08)

4. (a) Find an expression for temperature as measured by a Platinum resistance thermometer. (20)
- (b) The values of resistances of a platinum resistance thermometer are 6.64Ω and 6.80Ω at 0°C and 100°C respectively. When placed in a hot bath, the resistance is found to be 6.78Ω . Calculate the temperature of the hot bath on the gas scale. Assume $\delta = 1.5$ for a platinum wire. (10)

SECTION-B

There are **FOUR** questions in this Section. Answer any **THREE**

5. (a) Find an expression for average energy of a gas molecule by using Maxwell's law of distribution of energies. (20)
- (b) Calculate the average energy of a molecule of hydrogen at 300K . Given Boltzmann's constant $k = 1.38 \times 10^{-16} \text{ erg/K}$ and molecular weight of hydrogen $m = 3.34 \times 10^{-24} \text{ gm}$. (10)
6. (a) Two reversible engines A and B working between the same temperature limits T_1 (higher) and T_2 (lower). Prove that their efficiencies are equal. (20)
- (b) A Carnot engine whose temperature of the source is 400K takes 200 calories of heat at this temperature and reject 150 calories of heat in the sink. Calculate the efficiency of the engine. (10)
7. (a) Show that for a body executing simple harmonic motion, the total mechanical energy remains conserved. (20)
- (b) The amplitude of a simple harmonic oscillator is 10 cm . At what displacement is the kinetic energy $\frac{3}{4}$ th of the total energy of the oscillator? (10)
8. (a) Derive the differential equation of one dimensional wave motion by using the displacement equation $y = a \sin \frac{2\pi}{\lambda}(vt - x)$ (20)
- (b) A wave along a string is given by the relation $y = 0.02 \sin(30t - 4.0x)$, where x is in meters and t is in seconds. Find its frequency and wavelength. (10)

SECTION-A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) A function $f(x)$ is defined by, $f(x) = \begin{cases} 1+x^2; & \text{when } x \leq 0 \\ x; & \text{when } 0 < x < 1 \\ \frac{1}{x}; & \text{when } x \geq 1 \end{cases}$ (20)
- Discuss the continuity and differentiability of the function at $x = 1$ and also represent it graphically.
- (b) Evaluate the value of $\lim_{x \rightarrow 0} \left(\frac{2^x + 3^x}{2} \right)^{\frac{1}{x}}$. (10)
2. (a) If $y = (a \sin^{-1} x)^2$, then show that (15)
- $$(1 - b^2 x^2) y_{n+2} - (2n+1) b^2 x y_{n+1} - n^2 b^2 y_n = 0.$$
- (b) Find the maximum and minimum value of $u = \frac{4}{x} + \frac{16}{y}$ where $x + y = 2$. (15)
3. (a) Expand $f(x) = \frac{1}{1+x}$ in power of $(x-3)$ with Lagrange's form of remainder after n-terms. (15)
- (b) Verify Rolle's theorem for the function $f(x) = (x^2 - 2x)e^x$ in the interval $[0, 2]$. (15)
4. (a) Find the radius of curvature of the curve $\sqrt{x} + \sqrt{y} = 1$ at the intersection point of the line $y = x$ and the curve. (15)
- (b) Find the area of the triangle formed by the axes and tangent to the curve $\frac{2}{x^3} + \frac{2}{y^3} = b^3$. (15)

SECTION-B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Evaluate $\int \frac{\sin \frac{1}{x}}{3x^2} dx$ (15)

(b) Find reduction formula for $\int e^{ax} \cos^n x dx$ (15)

6. (a) Show that (15)

$$\frac{1}{1.2} + \frac{1}{2.3} + \frac{1}{3.4} + \dots + \frac{1}{n(n+1)} = \frac{n}{n+1}$$

Hence find $\lim_{n \rightarrow +\infty} \sum_{k=1}^n \frac{1}{k(k+1)}$.

(b) Evaluate (15)

$$\int_{\sqrt{2}}^2 \frac{dx}{x\sqrt{x^2-1}}$$

7. (a) Evaluate $\int_{-\infty}^{+\infty} \frac{e^{-t}}{1-e^{-2t}} dt$. (15)

(b) Prove that $\Gamma(x+1) = x\Gamma x$ for all $x > 0$. (15)

8. (a) Use a double integral in polar coordinates to find the area of the region enclosed by the cardioid $r = 1 - \cos \theta$. (15)

(b) Use a triple integral to find the volume of the solid bounded by the planes (15)

$$x + y + z = 1, \quad x = 0, \quad y = 0 \text{ and } z = 0.$$

Bangladesh University of Engineering and Technology, Dhaka
L-1/T-1 B.Sc Examinations of January 2020
Subject: Chem-115 (Chemistry-I)

Full Marks: 180

Time: 2 hours

Figure in the margin indicate the full marks

Use separate scripts for each section and upload in the LMS system separately

Section A(There are **FOUR** questions in the section. Answer any **THREE**)

- 1.a. Does the Bohr theory of the hydrogen atom differ from Schrodinger wave equation? Explain why or why not? 15
- b. Electron density concept is used to describe the position of an electron in the quantum mechanical approach. How does this happen? 15
- 2.a Write the Lewis structure for the following compounds and ion: (a) HCOOH (b) P₄ (c) NO⁺ 6
- b. Compare the solubility of ammonia and methanol in water. 12
- c. Explain the following order of the magnitude of repulsion on the basis of VSEPR model: lone pair-lone pair > lone pair-bonding pair > bonding pair-bonding pair. 12
- 3.a. Illustrate how the linear combination of atomic orbitals (LCAO) method gives rise to bonding and antibonding orbitals. 14
- b. Bond strength of N₂ molecule is greater than F₂ molecule—Explain it by using molecular orbital theory. 16
- 4.a. An element of alkali metals having a small ionic radius can be hydrated more than that of a bigger ionic radius. Validate this statement. 14
- b. Discuss how ion-exchange resins and polyphosphates can be used for the softening of water. 16

Section B

(There are FOUR questions in the section. Answer any THREE)

- 5.a. Arrange the following acids according to their ascending order of strength with justification: Phenol, Picric Acid, Nitro phenol. 15
- b. Discuss the application of Hard and Soft acids and bases (HSAB) principle in the following fields – 15
- (i) Predicting favorable equilibria
 - (ii) Ligand selection in metalloproteins and enzymes
- 6.a. The solubility of AgCl is 0.0014 gm at room temperature. Calculate its solubility product. 10
- b. How Henry's law is related to scuba diving? 10
- c. Discuss the following applications of solubility product principle. 10
- (i) Purification of common Salt
 - (ii) Determination of solubility of sparingly soluble salts
- 7.a. Apply the concept of osmosis and draw a diagram of the water desalination system with the operational principle. 15
- b. When a certain amount of solute is added to 100 g of water at 25°C, the vapour pressure reduces to one half of that for pure water. The vapour pressure of water is 23.76 mm Hg. Find the amount of salt added. 15
- 8.a. How colloids are different from true solutions and suspensions? Colloids show Brownian movement but true solutions and suspensions do not show – why? 15
- b. What are the differences between sol and gel? How optical properties of colloids can be used to distinguish between true solution and colloidal solution? 15