

SECTION – A

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

1. (a) Upon applying force F , the drum is about to move (Fig-1). Find the value of force F . (17)
- (b) The frame shown in the Fig-2 supports part of the roof of a small building. Knowing that the tension in the cable is 200 kN, determine the reaction at the fixed end D . (18)
2. (a) Find the resultant of the forces acting on a weightless frame AB as shown in the Fig.-3. (18)
- (b) Find the tension (T) at the cable of the frictionless pulley system shown in the Fig-4. Draw necessary free body diagrams to clarify your calculations. (17)
3. (a) Find the member forces at the truss members EC , FD , FB , and EF shown in the Fig-5. (18)
- (b) A 500-N horizontal force is applied to pin A of the frame shown in Fig-6. Determine the forces acting on the two vertical members of the frame. (17)
4. (a) A force Q is applied to a weightless body B as shown in Fig-7. Weight of the body A is also negligible. Determine the value of Q so that the body B is in impending motion downward. Given that, $f = 0.3$ (For all surfaces). (17)
- (b) Find the tension of the cable at each support as shown in the Fig-8. Also, find the length of the cable. Given that $w = 0.25$ N/m. (18)

SECTION – B

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

5. (a) Locate the centroid (\bar{x} , \bar{y}) of the shaded area shown in Figure 9. (12)
- (b) Determine the location of the centroid of the circular arc shown in Figure 10. (11)
- (c) Determine the location of the centroid of the half right circular cone shown in Figure 11. (12)

WRE 101

6. (a) A circular sea wall is shown in Figure 12. The sea wall is made of concrete. Determine the total weight of the wall if the concrete has a specific weight of 150 lb/ft^3 . (11)
- (b) The thin plate shown in Figure 13 has a mass per unit area of 10 kg/m^2 . Determine its mass moment of inertia about the z axis. (12)
- (c) Determine the moment of inertia for the shaded area shown in Figure 14 with respect to the x and y axes. (12)
7. (a) Using the method of virtual work, determine the magnitude of the couple M required to maintain the equilibrium of the mechanism shown in Figure 15. (8)
- (b) A 10-kg block is attached to the rim of a 300-mm-radius disk as shown in Figure 16. Knowing that spring BC is unstretched when $\theta = 0$, determine the position or positions of equilibrium, and state in each case whether the equilibrium is stable, unstable, or neutral. (16)
- (c) Car A is travelling at a constant 90 mi/h when it passes a parked police officer B , who gives chase when the car passes him (the officer). The officer accelerates at a constant rate until he reaches the speed of 105 mi/h . Thereafter, his speed remains constant. The police officer catches the car 3 mi from his starting point. Determine the initial acceleration of the police officer. (11)
8. (a) Load B is connected to a double pulley by one of the two inextensible cables shown in Figure 17. The motion of the pulley is controlled by cable C , which has a constant acceleration of 9 in./s^2 and an initial velocity of 12 in./s , both directed to the right. Determine (i) the number of revolutions executed by the pulley in 2 s , (ii) the velocity and change in position of the load B after 2 s , and (iii) the acceleration of point D on the rim of the inner pulley at $t = 0$. (18)
- (b) A sphere with a radius r and a weight W is released with no initial velocity on an incline and rolls without slipping (Figure 18). Determine (i) the minimum value of the coefficient of static friction compatible with the rolling motion, (ii) the velocity of the center G of the sphere after the sphere has rolled 10 ft , (iii) the velocity of G if the sphere were to move 10 ft down a frictionless 30° incline. (17)

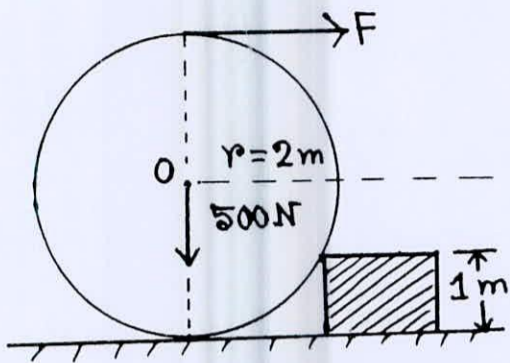


Fig-1 for Q-1(a)

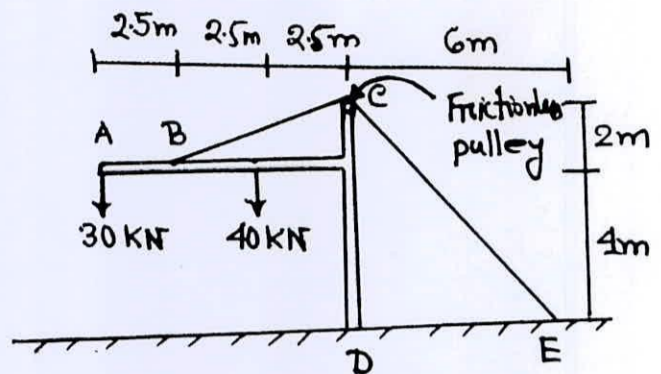


Fig-2 for Q-1(b)

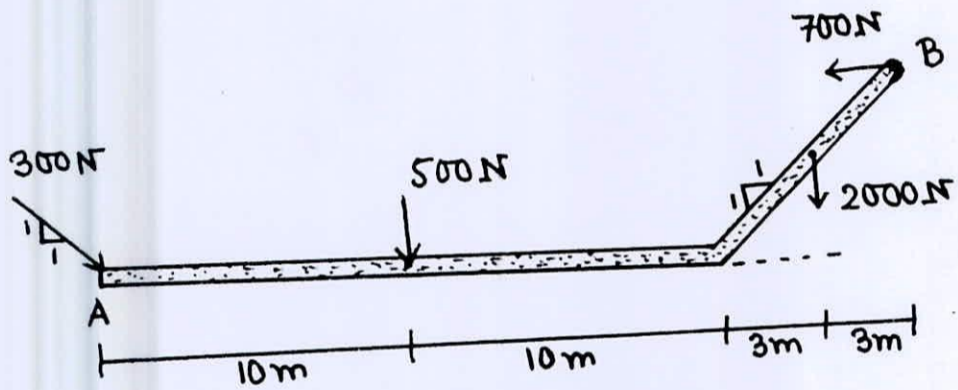


Fig-3 for Q-2(a)

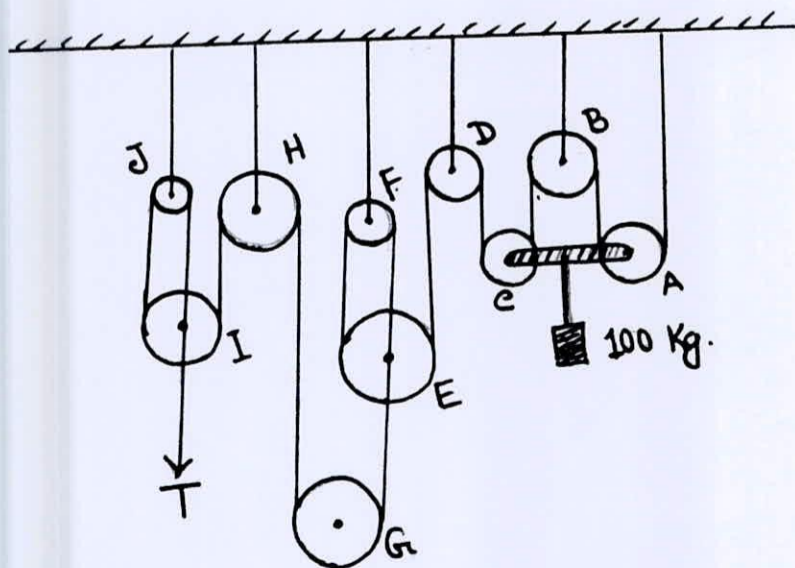


Fig-1 for Q-2(b)

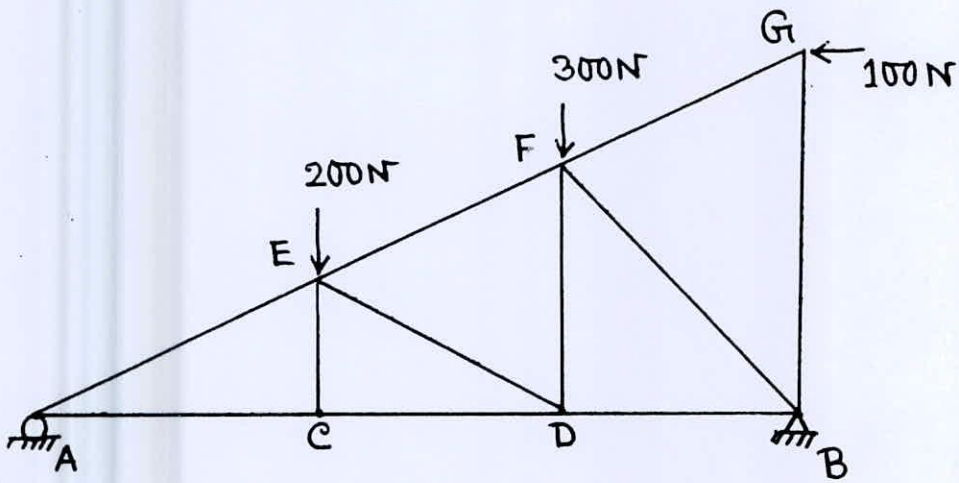


Fig-5 for Q-3(a)

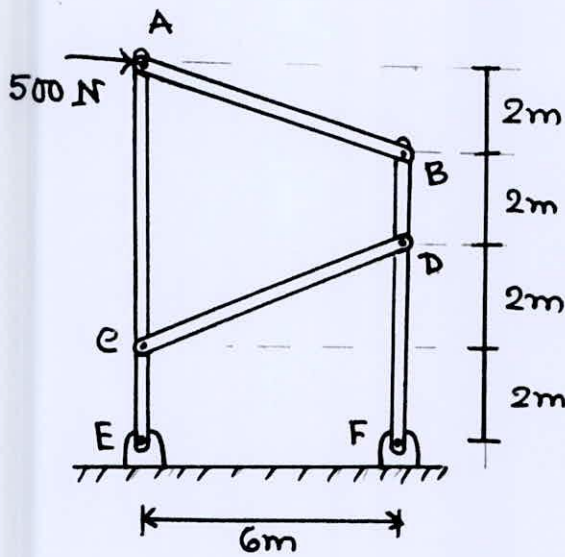


Fig-6 for Q-3(b)

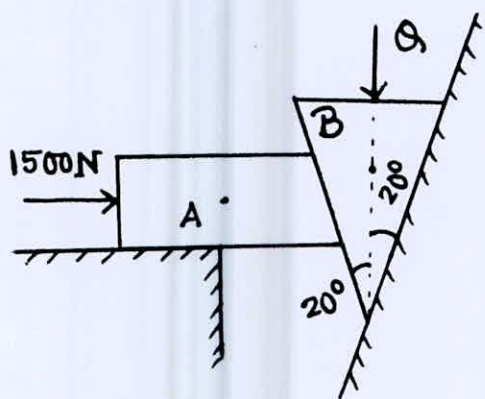


Fig-7 for Q-4(a)

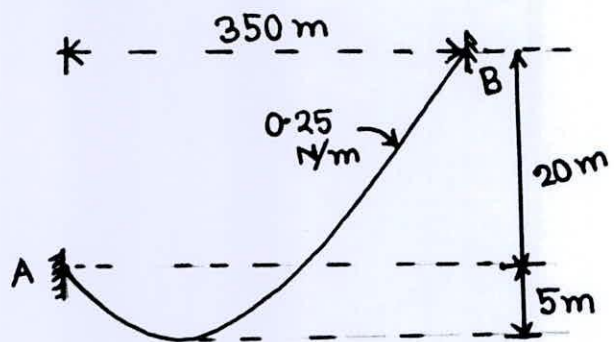


Fig-8 for Q-4(b)

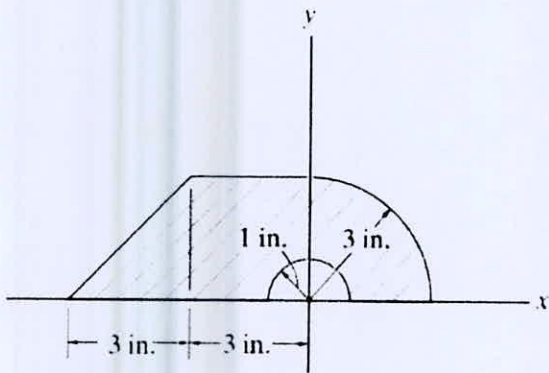


Figure no. 9 for Q. 5(a)

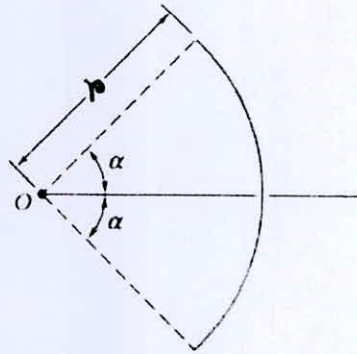


Figure no. 10 for Q. 5(b)

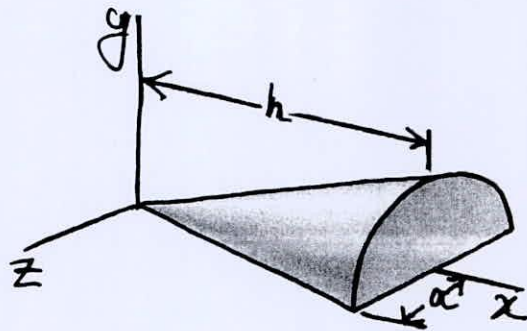


Figure no. 11 for Q. 5(c)

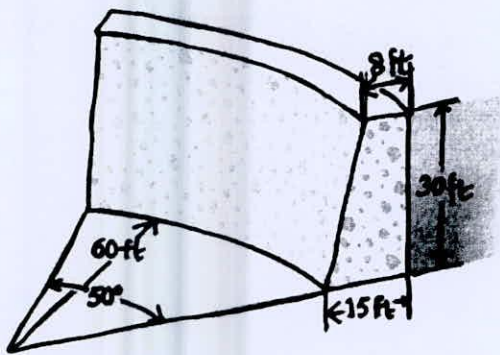


Figure no. 12 for Q. 6(a)

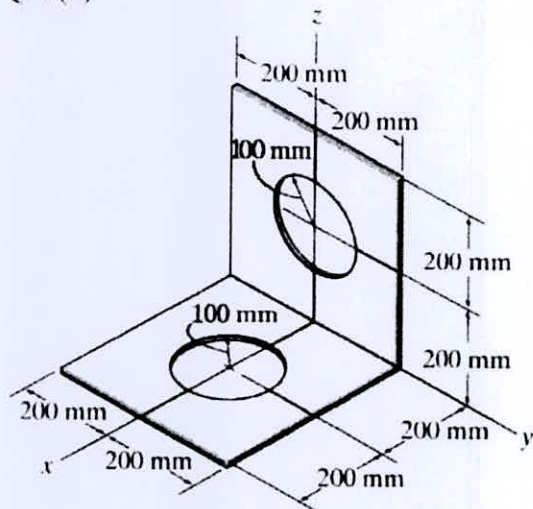


Figure no. 13 for Q. 6(b)

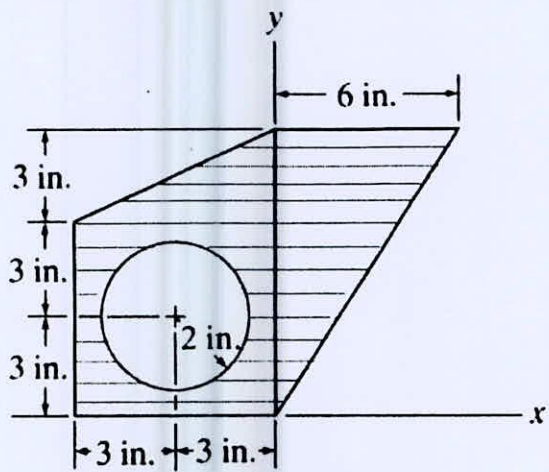


Figure no. 14 for Q. 6(c)

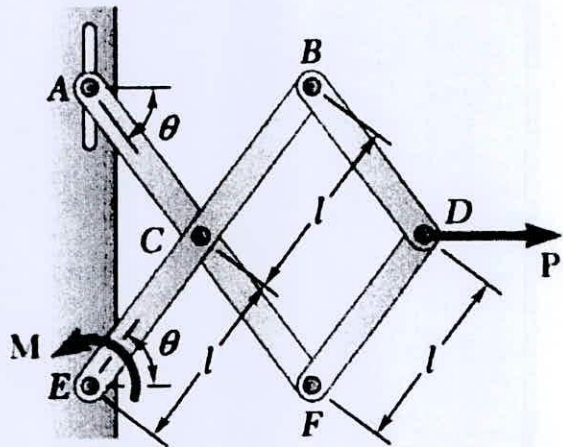


Figure no. 15 for Q. 7(a)

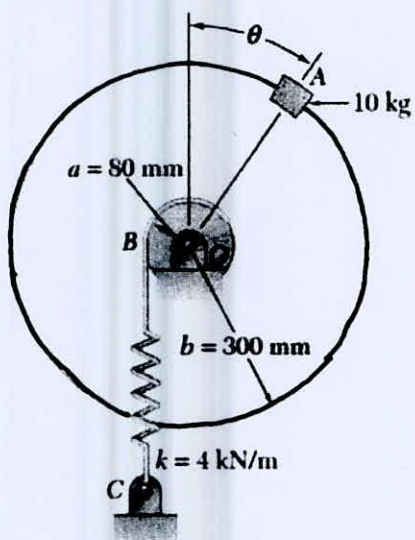


Figure no. 16 for Q. 7(b)

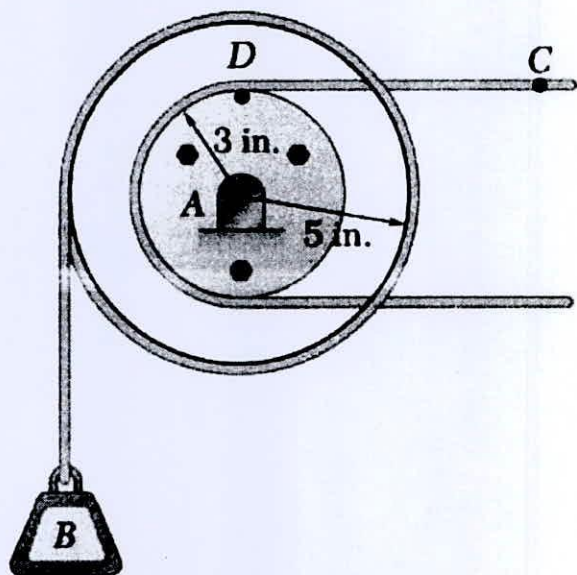


Figure no. 17 for Q. 8(a)

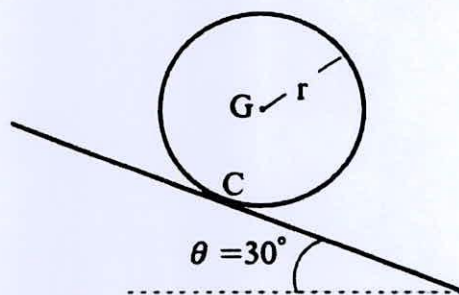


Figure no. 18 for Q. 8(b)

L-1/T-1/WRE

Date: 19/05/2022

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2020-2021

Sub: **PHY 107** (Physical optics, Waves and Oscillation, Heat and Thermodynamics)

Full Marks: 210

Time: 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks

SECTION – A

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

1. (a) What is meant by interference of light? Is there any loss of energy in the interference phenomenon? Explain it. What is fringe width? (10)
(b) Describe with necessary theory of Newton's rings experiment method for measuring the wavelength of monochromatic light. (15)
(c) In a Newton's rings experiment, the diameter of the 10th ring changes from 1.40 to 1.27 cm when a liquid is introduced between the lens and the plate. Calculate the refractive index of the liquid. (10)
2. (a) Explain the term – 'diffraction of light'. (5)
(b) Derive an expression of the intensity distribution function of the Fraunhofer class of diffraction due to a single slit. Explain the positions of maxima and minima. (20)
(c) Define resolving power of a grating. Calculate the minimum number of lines in a grating which will just resolve the sodium lines in the first order spectrum. The wavelengths are 5890 Å and 5890 Å. (10)
3. (a) What do you understand by polarization of light? (5)
(b) What is meant by double refraction? Explain the term-quarter and half-wave plates. What is specific rotation? (20)
(c) A solution of an optically active solute produces a rotation of 20° of the plane of polarization in a path length of 10 cm when the concentration is 20 g/litre. What is the concentration in a solution which produces a rotation of 30° in a path length of 5 cm. (10)
4. (a) Show the relation between the phase velocity and group velocity. (10)
(b) Discuss the formation of stationary waves analytically due to reflection at a rigid boundary. (20)

Contd P/2

PHY 107

Contd... Q. No. 4

(c) The equation of particle displacement of a stationary wave is

$$y = 2.4 \cos 3.5 \times \sin 4.5t \text{ (in cm).}$$

Find out the distance between a node and the next antinode.

(05)

SECTION – B

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

5. (a) What are Lissajous figures? On what factors does it depend?

(5)

(b) Derive a general expression for the combination of two simple harmonic motions acting at right angle to each other having a frequency ratio of 2:1. From the expression, find out the equation of a parabola.

(18)

(c) A simple harmonic motion is represented by the equation,

$$y = 12 \sin \left(\frac{2\pi t}{10} + \frac{\pi}{4} \right),$$

where y is measured in meters, t in seconds and the phase angle in radians. Calculate the followings:

- (i) the frequency,
- (ii) the time period,
- (iii) the maximum velocity, and
- (iv) the maximum acceleration.

6. (a) What are reverberation and reverberation time?

(5)

(b) What are the assumptions of Sabine's for reverberation? Derive expression of growth and decay of sound inside a room and find the expression for reverberation time.

(20)

(c) Calculate the reverberation time in a hall measuring $40 \times 100 \times 20 \text{ ft}^3$ with the following parameters: (i) 7500 sq.ft. of a plaster, $a_1 = 0.03$, (ii) 600 sq. ft. of wood and floor, $a_2 = 0.06$, (iii) 400 sq.ft. of glass, $a_3 = 0.025$, (iv) 600 seats, $a_4 = 0.30$, (v) audience of 500 persons, $a_5 = 4.3$ per person. Find the reverberation time in the absence of audience.

(10)

PHY 107

7. (a) Two reversible engines A and B working between the same two temperature limits T_1 (higher) and T_2 (lower). Prove that their efficiencies are equal. (10)
- (b) Show that the entropy remains constant in a reversible adiabatic process and increases in an irreversible process. (15)
- (c) A Carnot engine has an efficiency of 50%. On increasing the temperature of the sink reservoir by 100°C , the efficiency drops to 40%. By what amount should the source reservoir temperature be increased to restore the original efficiency? (10)
8. (a) Find an expression of average energy of a gas molecule according to Maxwell's law of distribution of velocities. (15)
- (b) Explain with the help of Callender and Griffith's bridge how a platinum resistance thermometer works. (20)
-

SECTION – A

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

Symbols used have their usual meaning. Assume reasonable values for any missing data.

1. (a) What are the causes of hardness of water? Explain why hard water is not suitable for boilers. (10)
- (b) With essential chemical reactions describe the soda-lime process for softening of water. (15)
- (c) A zeolite softener was completely exhausted and then regenerated by passing 200 L of NaCl solution containing 100 g/L of NaCl. How many liters of a sample of water of hardness 500 ppm can be softened by the softener? (10)

2. (a) How do colloidal particles acquire charge? Small amount of an electrolyte is essential for the stability of lyophobic sols-Explain. (10)
- (b) Define electrophoresis. How can you identify the nature of charge carried by the dispersed phase and the dispersion medium? (15)
- (c) Explain the term 'gel'. Outline some important properties of gels. (10)

3. (a) State and explain the law of lowering of vapor pressure. With suitable diagrams show how the vapor pressure of solution differs from that of the pure solvent. (10)
- (b) With help of clapeyron-clausius equation, show how the elevation of boiling point is related to the mole fraction of the solute. How can you use the relation to determine the molar mass of the salute? (15)
- (c) A solution of 12.5 g of urea in 170 g of water gave a boiling point elevation of 0.63 k. Calculate the molar mass of urea. (given: $K_b = 0.52 \text{ k/m}$). (10)

4. (a) With the help of the law of mass action, show expression for the equilibrium constant of a reaction. How does the expression differs from the thermodynamic equilibrium constant? (10)
- (b) Consider the reaction:

$$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) = 2\text{NH}_3(\text{g}) \quad \Delta H^\circ_{18^\circ\text{C}} = -22000 \text{ Cal.}$$
 Establish the relationship between the amount of ammonia formed in the reaction and the total pressure of the system. Explain the effect of temperature and pressure on the equilibrium. (15)

CHEM 115 /WRE**Contd... Q. No. 4**

(c) At 2155°C and 1 atmosphere pressure $\text{H}_2\text{O}(\text{g})$ is 1.18% decomposed into $\text{H}_2(\text{g})$ and $\text{O}_2(\text{g})$ in accordance with the equation



Calculate K_p for the process.

(10)**SECTION - B**

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

5. (a) Based on Bohr's calculations, establish the energy expression of the rotating electron in hydrogen. Explain the meaning of the negative sign in energy equation. **(6+5=11)**
- (b) Calculate the energies needed to remove an electron from the $n = 1$ state and the $n = 5$ state in the Li^{2+} ion. What is the wavelength (in nm) of the emitted photon in a transition from $n = 5$ to $n = 1$? The Rydberg constant for hydrogen-like ions is $(2.18 \times 10^{-18} \text{ J})Z^2$, where Z is the atomic number. **(6+6=12)**
- (c) Write down the general form of the Schrödinger equation and define each of the terms in it. Mention the importance of this equation. **(10+2=12)**
6. (a) Draw the molecular orbital for s - s overlap and axial overlap of p -orbitals. **(10)**
- (b) Write down the conditions of hybridization and show the directional characters of hybridization involving d orbitals. **(5+10=15)**
- (c) Describe the Davison and Germer experiment for the verification of wave nature of electrons. **(10)**
7. (a) Write down the main features of Linear Combination of Atomic Orbitals (LCAO method). **(10)**
- (b) Define Bond order and discuss the importance of Bond order. **(10)**
- (c) Name and draw the two common crystal structures adopted by metals. **(10)**
- (d) Differentiate between bonding and antibonding molecular orbitals. **(5)**
8. (a) Outline a Born-Haber cycle for the formation of an ionic compound (MCL). **(12)**
- (b) Approximate hydration number of Li^{2+} is 25.3 while it is 9.9 in case of Cs^+ - Establish the reason behind this trend. **(10)**
- (c) Define Cement. List the four main components of Hydraulic cement with their chemical formula. **(10)**
- (d) Categorize the allotropes of Phosphorus. **(3)**

SECTION – AThere are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Discuss the continuity and differentiability of the function (17)

$$f(x) = \begin{cases} 3 + 2x, & -\frac{3}{2} \leq x < 0 \\ 3 - 2x, & 0 \leq x < \frac{3}{2} \\ 3 + 2x, & x \geq \frac{3}{2} \end{cases}$$

at $x = 0$ and $x = \frac{3}{2}$. Also sketch the graph of $f(x)$.

- (b) Evaluate $\lim_{x \rightarrow 0} (\sin x)^x$ if $x > 0$. (5)

- (c) If $y^{\frac{1}{m}} + y^{-\frac{1}{m}} = 2x$, show that $(x^2 - 1)y_{n+2} + (2n + 1)xy_{n+1} + (n^2 - m^2)y_n = 0$. (13)

2. (a) Use Maclaurin's theorem to expand $f(x) = \tan x$ in powers of x upto x^5 . (10)

- (b) Find the points on the parabola $y^2 = 8x$ at which the curvature is $\frac{16}{125}$. (12)

- (c) Show that the curve $\left(\frac{x}{a}\right)^n + \left(\frac{y}{b}\right)^n = 2$ touches the straight line $\frac{x}{a} + \frac{y}{b} = 2$ at the point (a, b) whatever the value of n . (13)

3. (a) Assuming that the petrol burnt/hour in driving a motor boat varies as the cube of its velocity, show that the most economical speed going against a current of 'c' kg/hour is $\frac{3c}{2}$ kg/hour. (12)

- (b) Show that the asymptotes of the curve $(x^2 - y^2)y - 2ay^2 + 5x - 7 = 0$ form a triangle of area a square unit. (12)

- (c) Show that in the curve $by^2 = (x + a)^3$, the square of the subtangent varies as the subnormal. (11)

4. (a) Verify Rolle's theorem for the function $f(x) = x^2 + 5x - 6$ in the interval $(-6, 1)$. (11)

- (b) Find the pedal equation of the asteroid $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$. (13)

- (c) Find the centre of curvature for the curve $xy = 16$ at $(4, 4)$. (11)

MATH 131/WRE

SECTION – B

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

5. Work out the Integrals:

(i) $\int \frac{dx}{(2x+3)\sqrt{x^2+3x+2}}$. (12)

(ii) $\int \frac{dx}{x(a+bx^n)}$. (12)

(iii) $\int \frac{dx}{\sin(x-a)\sin(x-b)}$. (11)

6. (a) Establish a reduction formula for $\int \cos^n x dx$ and hence evaluate $\int \cos^6 x dx$. (12)

(b) Evaluate $\int_0^{\pi/2} \frac{x dx}{\sin x + \cos x}$. (12)

(c) Evaluate $\lim_{n \rightarrow \infty} \left\{ \left(1 + \frac{1}{n^2}\right)^{\frac{2}{n^2}} \left(1 + \frac{2^2}{n^2}\right)^{\frac{4}{n^2}} \left(1 + \frac{3^2}{n^2}\right)^{\frac{6}{n^2}} \dots \left(1 + \frac{n^2}{n^2}\right)^{\frac{2n}{n^2}} \right\}$ using definite integrals. (11)

7. (a) Show that $\beta(m, n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$ and use this relation to evaluate $\Gamma\left(\frac{1}{2}\right)$. (18)

(b) Find the area above the x-axis, included between the parabola $y^2 = ax$ and the circle $x^2 + y^2 = 2ax$. (17)

8. (a) Find the volume of solid generated when the region between the graphs of the equations $f(x) = 1 + x^2$ and $g(x) = x$ over the interval $[0, 2]$ is revolved about the x-axis. (18)

(b) Use triple integral to find the volume of tetrahedron formed by the plane $\frac{x}{3} + \frac{y}{2} + \frac{z}{4} = 1$ and the coordinate planes. (17)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-I/T-I B. Sc. Engineering Examinations 2020-2021

Sub : **HUM 111** (English)

Full Marks : 140

Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions including Q. No. 1 as compulsory.

Symbols have their usual meaning.

1. Read the following passage carefully and answer the questions that follow:

(30)

Beware of those who use the truth to deceive. When someone tells you something that is true, but leaves out important information that should be included, he can create a false impression. For example, someone might say, "I just won a hundred dollars on the lottery. It was great. I took that dollar ticket back to the store and turned it in for one hundred dollars!" This guy's a winner, right? Maybe or maybe not. We then discover that he bought two hundred tickets, and only one was a winner. He's really a big loser! He didn't say anything that was false, but he deliberately omitted important information. That's called a half-truth. Half-truths are not technically lies, but they are just as dishonest. Untrustworthy candidates in political campaigns often use this tactic. Let's say that during Governor Smith's last term, her state lost one million jobs and gained three million jobs. Then she seeks another term. One of her opponents runs and saying, an honest statement would have been, "During Governor Smith's term, the state had a net gain of two million jobs." Advertisers will sometimes use half-truths.

The purpose and or consequence of a half-truth is to make something that is really only a belief appear to be knowledge, or a truthful statement to represent the whole truth, or possibly lead to a false conclusion. According to the justified true belief theory of knowledge, in order to know that a given proposition is true, one must not only believe in the relevant true proposition, but one must also have a good reason for doing so. A half-truth deceive the recipient by presenting something believable and using those aspects of the statement that can be true as good reason to believe the statement is true in its entirety, or that the statement represents the whole truth. A person deceived by a half-truth considers the proposition to be knowledge and acts accordingly. It's against the law to make false claims so they try to mislead you with the truth. An ad might boast, "Nine out of ten doctors recommend Yucky Pills to cure nose pimples." It fails to mention that they only asked ten doctors and nine of them work for the Yucky Corporation. This kind of deception happens to often. It's sad fact of life: Lies are lies, and sometimes the truth can lie as well.

HUM 111

Answer the following questions:

- (a) How can we be aware from the half-truth?
- (ii) Why does the author express that half-truths are not technical lies?
- (iii) What can we know from the example of the Yucky Pill advertisement?
- (iv) What message does this passage convey to you?
- (v) As there is no title of the passage, give an appropriate title and justify your answer.
- (iv) Give the meanings of the following words as used in the passage:
Omit, deceive, consequence, relevant, mislead

2. (a) Suppose as a Deputy Engineer of Powertech Co. Ltd., you had ordered 150 Hydrological test kits after examining the samples sent by the supplier. When the consignment arrived, you found neither in quality nor in quantity of the Hydrological test kits weren't matched to the samples you had approved. Demanding their replacement, write a complain letter to the Managing Director of that company. (Provide other details from your own.) **(10)**
- (b) Give phonetic transcription of the following words: (any five) **(10)**
Ship, fool, say, hat, poor, take
3. (a) Write a dialogue between two classmates about the importance of industrial visit for enriching pragmatics knowledge. **(10)**
- (b) Write a short essay on any one of the following topics: **(10)**
(i) Sea-level Rise: A Global Crisis
(ii) Prospects of Water Resource Engineering in Bangladesh
4. (a) Transform the following sentences as directed: (Any five) **(10)**
(i) It started raining when I reached home. (Simple)
(ii) He is poor, but he is happy. (Complex)
(iii) Taking his breakfast, he rushed to his office. (Compound)
(iv) She was too poor to educate her children. (Complex)
(v) When his father saw it, he became very angry (Simple)
(vi) Though he is not sick, he feels weak. (Compound)
- (b) Write short notes on any two of the following: **(10)**
(i) Monophthong
(ii) Semantic gap of commercial correspondence
(iii) Front matters of a formal report.

HUM 111

SECTION – B

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

5. (a) Explain any one of the following with reference to the context: (8)
- (i) “If you’re going to stop a band playing every time someone has an accident, you’ll lead a very strenuous life.”
 - (ii) “She danced with enthusiasm, with passion, in a kind of cloud of happiness that came of all this.”
- (b) Answer any one of the following: (10)
- (i) Trace the development of Laura in “The Garden Party”.
 - (ii) How did Guy De Maupassant treat the theme of social class in “The Diamond Necless”? Discuss.
- (c) Answer any three of the following: (12)
- (i) How did Mr. and Mrs. Loisel manage the money to return the lost necklace?
 - (ii) Why did Mrs. Sheridan and Jose disagree to stop the garden party?
 - (iii) Comment on Mr. Scott and his family.
 - (iv) Why did the lawyer forsake the money?
 - (v) Do you support capital punishment? Why or why not?
6. Correct any ten of the following sentences: (20)
- (a) Jamil is senior from my brother.
 - (ii) They have decided to live in Siant Martin.
 - (iii) We considered the matter farther.
 - (iv) Kamal is one of the boys who is on time.
 - (v) He was a dark-complected man.
 - (vi) Sabina never sees none of her old friends anymore.
 - (vii) I hope he’ll succeed at his work.
 - (viii) Translate this passage to English.
 - (ix) Jabin talks as if she knows everything.
 - (x) She bought the same bag that me.
 - (xi) Robin was disappeared from the house.
 - (xii) The cinema likes me very much.
7. (a) Give the meaning of any ten of the following words: (10)
- Afluent, alleviate, synopsis, testify, tentative, sultry, reverse, promulgate, outrageous, ingredients, hamlet, dubious.
- (b) Make sentence with any ten of the following words: (10)
- Anguish, blend, clamorous, cogent, depict, elusive, feat, glossary, hazy, impromptu, intricate, postpone

HUM 111

8. (a) Write a précis of the following extract and give it a suitable title:

(20)

Walls and wall building have played a very important role in Chinese culture. These people, from the dim mists of prehistory have been wall-conscious; from the Neolithic period - when ramparts of pounded earth were used - to the Communist Revolution, walls were an essential part of any village. Not only towns and villages; the houses and the temples within them were somehow walled, and the houses also had no windows overlooking the street, thus giving the feeling of wandering around a huge maze. The name for "city" in Chinese (ch'eng) means wall, and over these walled cities, villages houses, and temples presides the god of walls and mounts, whose duties were, and still are, to protect and be responsible for the welfare of the inhabitants. Thus, a great and extremely laborious task such as constructing a wall, which was supposed to run throughout the country, must not have seemed such an absurdity.

However, it is indeed a common mistake to perceive the Great Wall as a single architectural structure, and it would also be erroneous to assume that it was built during a single dynasty. For the building of the wall spanned the various dynasties, and each of these dynasties somehow contributed to the refurbishing and the construction of a wall, whose foundations had been laid many centuries ago. It was during the fourth and third century B.C. that each warring state started building walls to protect their kingdoms, both against one another and against the northern nomads.

The role that the Great Wall played in the growth of Chinese economy was an important one. Throughout the centuries many settlements were established along the new border. The garrison troops were instructed to reclaim wasteland and to plant crops on it, roads and canals were built, to mention just a few of the work carried out. All these undertakings greatly helped to increase the country's trade and cultural exchanges with many remote areas and with the southern, central, and western parts of Asia - the formation of the Silk Route. Builders, garrisons, artisans, farmers, and peasants left behind a trail of objects, including inscribed tables, household articles, and written work, which have become extremely valuable archaeological evidence to the study of defence institutions of the Great Wall and the everyday life of these people who lived and died along the wall. (389 words)