BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2019-2020

Sub : **CE 101** (Analytic Mechanics)

Full Marks : 180 Time : 2 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION - A

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

1. (a) Two smooth spheres A and B remain in equilibrium as shown in Fig. 1. The sphere A is 60 mm in diameter and weighs 75 N. The sphere B is 120 mm in diameter and weighs 300 N. All the surfaces are smooth. Find the reactions at the contact points 1, 2, 3 and 4. **(12)**

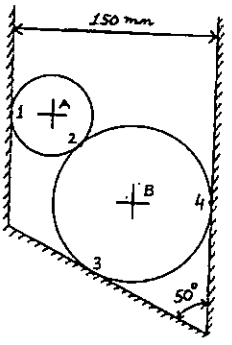


Fig. 1

(b) The vertical frame shown in Fig. 2 consists of two vertical members AE and BD, a horizontal member CD and an inclined member DE. All the members have been assumed to be weightless.

(i) Identify the two force member(s).

(ii) Calculate the components of pin reaction at A.

(iii) Determine the force in the two force member(s). **(18)**

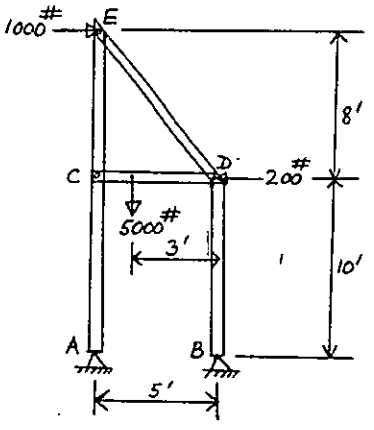


Fig. 2

2. (a) A bar of weight 700 N is hinged to a vertical wall at A and has been supported by a cable as shown in Fig. 3. Compute the tension in the cable BC and the components of pin reactions at A and C. **(16)**

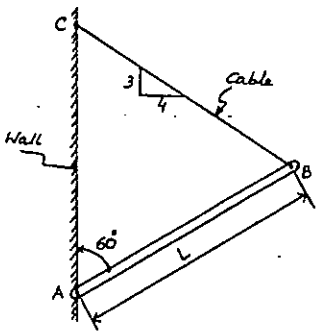


Fig. 3

(b) In Fig. 4, the bodies A and B weigh 400 N and 800 N, respectively. The coefficient of static friction for all surfaces is 0.3. The cord is parallel to the inclined plane CD. Calculate the value of the angle θ and tension in the cord when motion of the lower body B impends down the plane. **(14)**

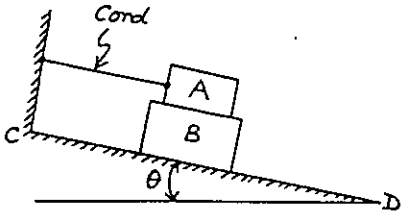


Fig. 4

3. (a) For the simply supported truss shown in Fig. 5, find the force in the members ac, cd, cf, eg and hi. **(15)**

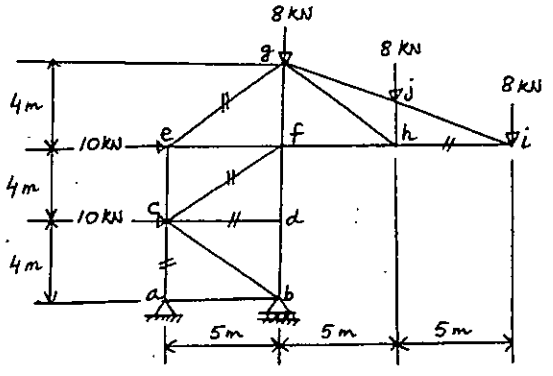


Fig. 5

(b) The body A in Fig. 6 weighs 150 lb. The coefficient of static friction between the body A and the inclined plane is 0.5. The coefficient of static friction between the rope and drum 1 is 0.4. The coefficient of static friction between the rope and drum 2 is 0.3. What value of W will cause motion of the body A to impend up the plane? **(15)**

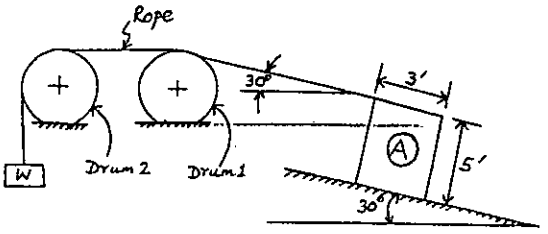


Fig. 6

4. (a) A cylindrical oil drum is pulled by a force P as shown in Fig. 7. The drum weighs 1700 N. The value of coefficient of static friction for all surfaces is 0.5. Calculate the magnitude of the force P when the drum just starts spinning. **(14)**

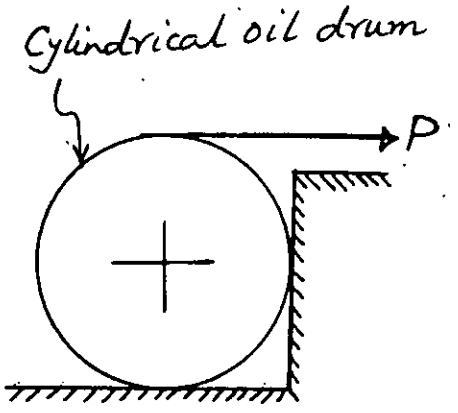


Fig. 7

(b) Fig.8 represents a grooved wheel. Using the theorem of Pappus and Guldinus, determine its volume. Verify your result using the formula for volume of a cylinder. **(16)**

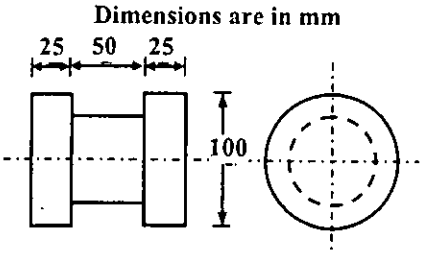
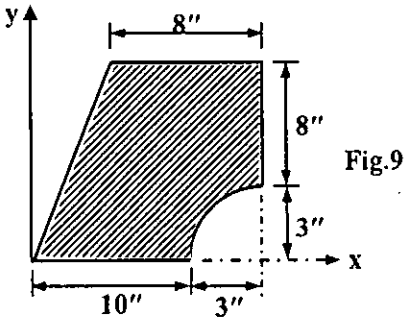
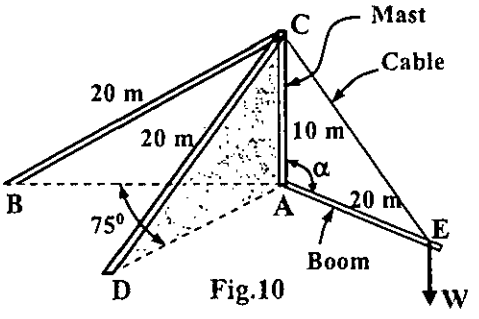
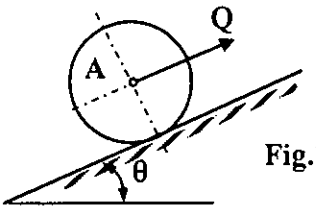


Fig.8

SECTION B: CE 101

There are **FOUR** questions in this section. Answer any **THREE** questions.
The figures in the margin indicate full marks.

NO.	QUESTIONS	MARKS
5.(a)	For the shaded area shown in **Fig. 9** determine I_x.  Fig.9	14
(b)	A derrick mast 10 m tall is supported by two stiff legs, **CB** and **CD**, each 20 m long **(Fig. 10)**. These legs are in vertical planes intersecting at the centerline of the mast and making an angle of 75^0 with each other. The load at the end of the 20 m boom **AE** is **W** = 25 kN. The plane of the boom is at right angles to the plane **ACD**. For $\alpha = 90^0$, find the force in the member **BC**.  Fig.10	16
6.(a)	A cable in the form of catenary is 400 ft long. How far apart may be the supports on the same level, if the maximum tension is not to exceed 400**w**, where '**w**' is the weight of cable in pounds per foot.	12
(b)	The body **A, Fig. 11**, is a 161 lb sphere, 12 inch in diameter. It is being rolled up the incline, where $\theta = 30^0$, by a constant force Q = 96.5 lb. Determine (a) the speed of its center of gravity after a displacement of 15 ft from rest (b) Frictional force between the plane and the sphere. Use impulse and momentum principles.  Fig.11	18

NO.	QUESTIONS	MARKS

7.(a) In **Fig. 12** **A** is a cylinder of weight $W_A = 300$ lb that has a central groove of 2 ft diameter. A weightless inextensible cord, wound about the groove, passes parallel to a 30^0 plane and over a smooth peg **D** and then holds a weight $W_B = 500$ lb. The friction is sufficient to cause the cylinder to roll. Determine, using the principles of impulse and momentum, the velocity of the body **B** after it moves 10 ft from rest. Given Radius of gyration, $\bar{k}_A = 1$ ft

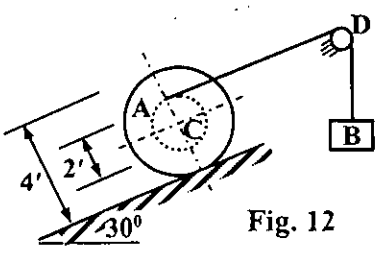


Fig. 12

15

(b) The hammer, shown in **Fig. 13**, consists of a cast iron head and wood handle. The iron head has 450 lb/ft^3 density, and its shape is a rectangular prism with a circular hole. The wood handle has 32 lb/ft^3 density, and its shape is a cylinder. Determine the mass moment of inertia about the z-axis and the corresponding radius of gyration.

15

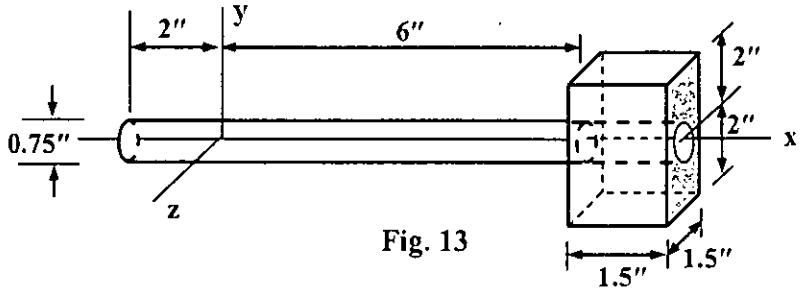


Fig. 13

8.(a) The weight of body **A** in **Fig. 14** is 1000 lb and the weight of body **B** is 2500 lb. The radius of gyration of body **B** about its centroidal axis is 2.5 ft. The pulley **C** is frictionless and weightless. Determine the speed of **B** after **A** has moved 15 ft from rest. Solve using the principles of work and kinetic energy.

15

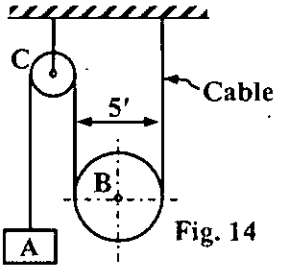


Fig. 14

(b) The crank **ABC** in **Fig. 15** is free to rotate about the frictionless pin at **B**. Determine, using virtual work principles, the magnitude of the horizontal force at **C** required to hold the crank in equilibrium. Given that **AB** = 2 m, **BC** = 1.5 m and **W** = 1.5 kN.

15

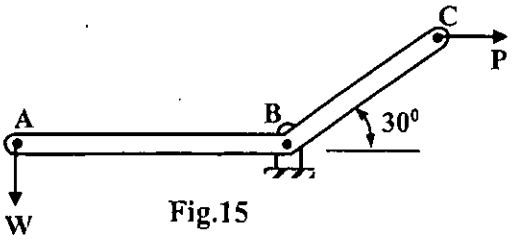


Fig.15

X

L-1/T-1/CE Date: 14/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

B. Sc. Engineering Examinations January 2020

Sub: **PHY 101** (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. i. We know that in simple harmonic motion the average potential energy equals to the average kinetic energy when the average is taken with respect to time over one period of the motion, and that each average equals $\frac{1}{4}kA^2$.

   ii. Prove that when the average is taken with respect to position over one cycle, the average potential energy equals $\frac{1}{6}kA^2$ and the average kinetic energy equals $\frac{1}{3}kA^2$.

   iii. Explain, why the two results in (i) and (ii) are different. [30]

2. (a) Explain your understanding about damped oscillations. Which type of damping motion should be set in door closer? Justify your answer. Discuss the effect of damping on the natural frequency of an oscillator. [10]

   (b) An object of mass 0.2 kg is hung from a spring whose spring constant is 80 N/m. The object is subjected to a resistive force given by $-bv$, where v is its velocity in meters per second.

   i. Set up differential equation of motion for free oscillations of the system.

   ii. If the damped frequency is $\frac{\sqrt{3}}{2}$ of the undamped frequency, what is the value of constant b. What is the quality factor of the system? [20]

3. (a) What are assumptions of Sabine's for reverberation? Explain your understanding about reverberation time and the acoustic requirements of a good auditorium. [10]

(b) A wave given by $y_1 = A\,Sin(\omega t - kx)$ is sent down in a string. Upon reflection it becomes $y_2 = \frac{A}{2} Sin(\omega t + kx)$. Find the resultant equation of these waves on the string. Identify the nature of each terms of the resultant equation. [20]

4. Draw a graph for the intensity distribution function formula due to the Fraunhofer class of diffraction at a single slit. Draw also $tan\beta = \beta$ graph and explain the intersections points to get the positions of the secondary maxima in the diffraction pattern, where $\beta = \frac{\pi b sin\theta}{\lambda}$ and b = the width of the slit, θ= the diffraction angle, λ= the wavelength of the incident light. How do you show that the intensity of the secondary maxima decreases along with the intersection points of $tan\beta = \beta$? Justify this interpretation with diffraction pattern. [30]

SECTION-B

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

5. (a) Draw schematically an optical diagram for Newton's rings experiment. Suppose you measured the diameters of the dark rings for various orders, varying from the m^{th} ring to the $(m+p)^{th}$ rings for the air medium and the liquid medium with the same setup of Newton's rings experiment using a monochromatic source. Why do you use monochromatic source instead of white light in this experiment? If μ is the refractive index of a liquid, how can you determine the refractive index of a liquid graphically? [20]

(b) The diameter of the 8^{th} ring changes from 1.35 cm to 1.25 cm when a liquid is introduced between the lens and the plate in the Newton's rings experiment. Calculate the refractive index of the liquid. [10]

6. (a) If crystal A act as a polarizer and crystal B act as an analyzer in figure-1, what are the role of A and B crystals to interpret the Malus' law. How will you orient the polarizer and the analyzer so that a beam of light is reduced to 0.5 of its original intensity? [20]

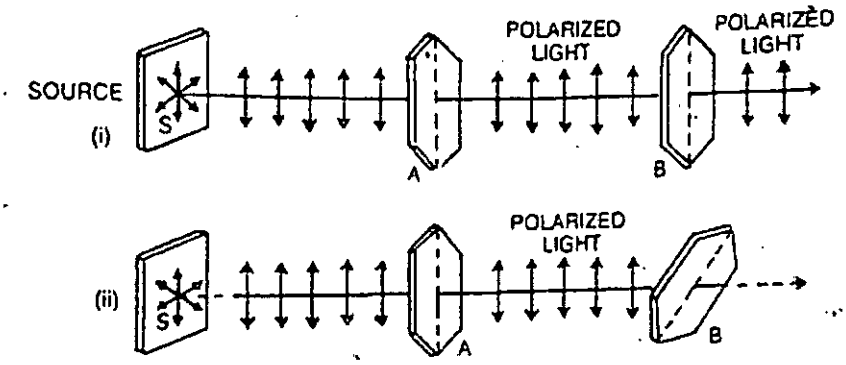


Figure 1

(b) How do you show that the refractive index of O-ray (μ_o) is less than that of the refractive index of E-ray (μ_e) everywhere except along the optic axis for quartz crystal? Why $\mu_o = \mu_e$ along the optic axis? [10]

7. (a) Two Carnot 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 has an efficiency of 55%. It operates between constant temperature reservoirs differing in temperature by 77°C. What are the temperatures of the two reservoirs? [10]

8. (a) State the law of equipartition of energy and find an expression for energy associated with each degree of freedom for a molecule. [20]

(b) The critical temperature and pressure of argon are 151K and 48 atmosphere, respectively. Calculate the radius of an argon atom. Given 1atmos = 1.013×10^5 Nm^{-2}. [10]

L-1/T-1/CE Date: 21/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B.Sc. Engineering Examination, January 2020

Sub: **HUM 355** (Sociology)

Full Marks: 120 Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 02 page(s) in this question paper.

SECTION – A

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

1. (a) 'Sociological imagination is an unusual type of creative thinking for understanding social relationships' –justify this statement with suitable example. (10)

   (b) Write the main properties of conflict perspective of sociology. (10)

2. (a) Discuss different types of social norms with examples. (10)

   (b) Explain counter culture and ethnocentrism with examples. (10)

3. (a) How does socialization shape human behavior? Write your answer highlighting the roles of different agents of socialization? (10)

   (b) Briefly discuss E. Goffman's dramaturgical approach to socialization. (10)

4. (a) Discuss the dysfunctional roles of media in modern society. (10)

   (b) Explain the gatekeeping functions of mass media. (10)

SECTION – B

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

5. (a) What are the different functions of the family? (10)

   (b) 'Families vary from culture to culture.' Analyze this. (10)

6. (a) What are the common features of restricted urbanization? (10)

(b) Briefly discuss the negative impacts of global warming. (10)

7. (a) What is birthrate, total fertility rate and death rate? (10)

(b) Why did Karl Marx criticize Malthus's views on population? (10)

8. Write short notes on any **two** of the following: (20)

a) Industrial revolution and new technology.

b) Juvenile Delinquency.

c) Capitalism.

L-1/T-1/CE Date: 21/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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

Sub: **HUM 375** (Government)

Full Marks: 120 Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 02 (Two) pages in this question paper.

SECTION – A

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

1. (a) Analyze the constituent elements of a state. (10)
   (b) Write the positive aspects of nationalism. (10)

2. (a) What are the various types of sovereignty? (10)
   (b) Explain the political rights of a citizen in a state. (10)

3. (a) Briefly discuss the importance of bureaucracy in a state. (10)
   (b) Write an analytical note on independence of judiciary. (10)

4. (a) Briefly describe the functions of the Executive in a state. (10)
   (b) Examine four major differences between democracy and dictatorship. (10)

SECTION – B

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

5. (a) Define socialism. Discuss the key features of socialism. (10)
   (b) Describe the different types of e-government. (10)

6. (a) Analyze the main characteristics of the constitution of Bangladesh. (10)
   (b) Briefly discuss the constitutional body – Election Commission (EC). (10)

7. (a) Explain the salient features of the foreign policy of Bangladesh. (10)

   (b) Write down any two principal organs of the United Nations Organization. (10)

8. (a) Describe the role of NGOs in Bangladesh. (10)

   (b) Briefly discuss the significance of the Language Movement. (10)

L-1/T-1/CE Date: 18/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2019-2020

Sub: **MATH 137** (Differential & Integral Calculus, Matrices)

Full Marks: 180 Time: 2 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

Symbols used have their usual meanings

SECTION -A

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

1. (a) Suppose (15)

$$f(x) = \begin{cases} p(x) & for \quad -\infty < x \leq -2 \\ q(x) & for \quad -2 < x \leq 0 \\ r(x) & for \quad 0 < x < \infty \end{cases}$$

where

$y = p(x)$ is obtained by translating the graph of $y = |x|$, 2 units left.

$y = q(x)$ is generated by translating the graph of $y = x^3$, 1 unit upward.

$y = r(x)$ is a trigonometric function which is always bounded and produces value 0 at $x = 0$.

Sketch $f(x)$ and check the continuity and differentiability at $x = -2$.

(b) Evaluate the following (15)

$$\lim_{x \to \frac{\pi}{2}^-} (\tan x)^{\frac{\pi}{2}-x}$$

2. (a) Expand $f(x) = \sin(m \sin^{-1} x)$ in the power of x with at least 4 non-zero term. (15)

(b) State Euler's theorem. If $u = \sin^{-1}\left\{\frac{x+y}{\sqrt{x}+\sqrt{y}}\right\}$, then determine the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$. (15)

3. (a) A closed rectangular container with a square base is to have a volume of 2250 inch^3. The material for the top and bottom of the container will cost \$3 per inch^2, and the material for the sides will cost \$4 per inch^2. Find the dimensions of the container of least cost. (15)

(b) Find a condition on p, q, r so that the curves (15)

$\left(\frac{x}{r}\right)^{\frac{2}{3}} + \left(\frac{y}{r}\right)^{\frac{2}{3}} = 1$ and $\frac{x^2}{p^2} + \frac{y^2}{q^2} = 1$ may touch each other.

4. Evaluate the following integrals:

(a) $\int \frac{dx}{1+2x^2+x^4}$ (15)

(b) $\int (\sin x \cos x)^2 dx$ (15)

SECTION -B

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

5. Evaluate the following:

(a) $\int_0^1 \cot^{-1}(\sqrt{x})dx$; (15)

(b) $\int_0^{\frac{1}{a}} \frac{\ln(1+ax)}{(1+a^2x^2)}dx$ (15)

6. (a) Evaluate $\int_0^a \int_{-\sqrt{ax-x^2}}^{\sqrt{ax-x^2}} \int_{-\sqrt{ax}}^{\sqrt{ax}} dzdydx$. (15)

(b) Find the value of $\int_0^1 \frac{dx}{(1-x^n)^{\frac{1}{n}}}$ (15)

7. (a) Find non singular matrices P, Q such that PAQ is in normal form, where (15)

$$A=\begin{bmatrix}1 & 1 & 2\\ 1 & 2 & 3\\ 0 & -1 & -1\end{bmatrix}$$

(b) Use only elementary row transformation to reduce A to I, hence find the inverse of (15)

$$A=\begin{bmatrix}3 & -3 & 4\\ 2 & -3 & 4\\ 0 & -1 & 1\end{bmatrix}$$

8. (a) Solve the following system by converting it to matrix form: (15)

$$3x-y-z=k-2$$
$$2x+y-2z=k-2$$
$$5x-5y+2z=2k+1$$
$$kx-ky+z=3$$

where k = last digit in your student ID number and k = 10 when last digit is equal to zero in your student ID number.

(b) Using Cayley-Hamilton theorem, find inverse of the matrix (15)

$$A=\begin{bmatrix}1 & 2 & -2\\ 1 & 1 & 1\\ 1 & 3 & -1\end{bmatrix}$$

OK.

L-1/T-1/CE Date:25/01/2021

Bangladesh University of Engineering and Technology, Dhaka

L1/T1 B.Sc Engineering Examinations, January 2020

Subject: Chem 103 (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**)

1a. The gold numbers of A, B, C, and D are 0.005, 0.05, 0.5, and 5, respectively. Which of these has the greatest protective action? Explain your answer. 20

b. How can you prove that colloidal particles are electrically charged? 10

2a. Why the chemical changes that occur in different sections of a rotary kiln are different? Predict the chemical changes that will occur inside a rotary kiln using the usual raw materials for portland cement manufacture. 20

b. Explain the differences between a primary galvanic cell that is not rechargeable and a storage cell that is rechargeable. 10

3a. What is zeolite? Discuss the principle of softening hard water using permutit or zeolite process. Why brine is passed after a certain interval during the softening of water by permutit process? 20

b. Arsenic(III) sulfide forms a sol with a negative charge. Which of the following ionic substances should be most effective in coagulating the sol and why? KCl, $MgCl_2$, $Al_2(SO_4)_3$ and Na_3PO_4 10

4a. If 20.0 mL of 0.10 M $Ba(NO_3)_2$ are added to 50.0 mL of 0.10 M Na_2CO_3, will $BaCO_3$ precipitate? (Use Appendix 1 if necessary) 20

b. Which of the following solutions can act as a buffer? (i) KCN/HCN, (ii) $Na_2SO_4/NaHSO_4$, (iii) NH_3/ NH_4NO_3, (iv) NaI/HI. 10

Section B

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

5a. Write down Schrödinger wave equation and explain each term in it. What are the conditions for an acceptable solution of Schrödinger wave equation? 10

b. The work function of potassium is 3.68×10^{-19} J. (i) What is the minimum frequency of light needed to eject electrons from the metal? (ii) Calculate the kinetic energy of the ejected electrons when light of frequency equal to 9.62×10^{14} /s is used for irradiation. 10

c. Write down the equation that expresses wave-particle dual properties of light. Calculate the energy (in joules) of (i) a photon with a wavelength of 5.00×10^{4} nm (infrared region) and (ii) a photon with a wavelength of 5.00×10^{-2} nm (X ray region). 10

6a. Draw the Lewis structure and predict the geometry of the following compounds using VSEPR model: XeF_4, I_3^-, N_2O, ClF_3, BrF_5 15

c. Explain the formation of acetylene molecule with the help of Valence Bond Theory. 15

7a. Show that Raoult's law is a special case of Henry's law. 8

b. Derive a relationship between the elevation in boiling point of a solution and the mole fraction of the solute from thermodynamic consideration. 12

c. 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 in moles. 10

8a. $F_2 + Cl_2 \rightarrow 2FCl$ 8

Bond energies of F_2 and Cl_2 are 36.6 and 580 kcal/mole, respectively. Heat liberated in the reaction is 26.6 kcal. Find the bond energy of F–Cl bond.

b. When carbon is burnt with limited amounts of oxygen gas (O_2), carbon monoxide (CO) is the main product. $2C\ (s) + O_2\ (g) \rightarrow 2CO\ (g), \Delta H = -221.0$ kJ 12

When carbon is burnt in excess amounts of oxygen gas (O_2), carbon dioxide (CO_2) is the main product. $2C\ (s) + O_2\ (g) \rightarrow CO_2\ (g), \quad \Delta H = -393.5$ kJ

Use these information to calculate the enthalpy change per mole of CO for the reaction of CO with O_2 to give CO_2.

c. Show the bond formation of CO using Molecular Orbital Theory. 10

Appendix 1 | Solubility Products of Some Slightly Soluble Ionic Compounds at 25°C

Compound	K_{sp}	Compound	K_{sp}
Aluminum hydroxide [$Al(OH)_3$]	1.8×10^{-33}	Lead(II) chromate ($PbCrO_4$)	2.0×10^{-14}
Barium carbonate ($BaCO_3$)	8.1×10^{-9}	Lead(II) fluoride (PbF_2)	4.1×10^{-8}
Barium fluoride (BaF_2)	1.7×10^{-6}	Lead(II) iodide (PbI_2)	1.4×10^{-8}
Barium sulfate ($BaSO_4$)	1.1×10^{-10}	Lead(II) sulfide (PbS)	3.4×10^{-28}
Bismuth sulfide (Bi_2S_3)	1.6×10^{-72}	Magnesium carbonate ($MgCO_3$)	4.0×10^{-5}
Cadmium sulfide (CdS)	8.0×10^{-28}	Magnesium hydroxide [$Mg(OH)_2$]	1.2×10^{-11}
Calcium carbonate ($CaCO_3$)	8.7×10^{-9}	Manganese(II) sulfide (MnS)	3.0×10^{-14}
Calcium fluoride (CaF_2)	4.0×10^{-11}	Mercury(I) chloride (Hg_2Cl_2)	3.5×10^{-18}
Calcium hydroxide [$Ca(OH)_2$]	8.0×10^{-6}	Mercury(II) sulfide (HgS)	4.0×10^{-54}
Calcium phosphate [$Ca_3(PO_4)_2$]	1.2×10^{-26}	Nickel(II) sulfide (NiS)	1.4×10^{-24}
Chromium(III) hydroxide [$Cr(OH)_3$]	3.0×10^{-29}	Silver bromide (AgBr)	7.7×10^{-13}
Cobalt(II) sulfide (CoS)	4.0×10^{-21}	Silver carbonate (Ag_2CO_3)	8.1×10^{-12}
Copper(I) bromide (CuBr)	4.2×10^{-8}	Silver chloride (AgCl)	1.6×10^{-10}
Copper(I) iodide (CuI)	5.1×10^{-12}	Silver iodide (AgI)	8.3×10^{-17}
Copper(II) hydroxide [$Cu(OH)_2$]	2.2×10^{-20}	Silver sulfate (Ag_2SO_4)	1.4×10^{-5}
Copper(II) sulfide (CuS)	6.0×10^{-37}	Silver sulfide (Ag_2S)	6.0×10^{-51}
Iron(II) hydroxide [$Fe(OH)_2$]	1.6×10^{-14}	Strontium carbonate ($SrCO_3$)	1.6×10^{-9}
Iron(III) hydroxide [$Fe(OH)_3$]	1.1×10^{-36}	Strontium sulfate ($SrSO_4$)	3.8×10^{-7}
Iron(II) sulfide (FeS)	6.0×10^{-19}	Tin(II) sulfide (SnS)	1.0×10^{-26}
Lead(II) carbonate ($PbCO_3$)	3.3×10^{-14}	Zinc hydroxide [$Zn(OH)_2$]	1.8×10^{-14}
Lead(II) chloride ($PbCl_2$)	2.4×10^{-4}	Zinc sulfide (ZnS)	3.0×10^{-23}