University of Dhaka
Department of Computer Science and Engineering
1st Year 1st Semester B.Sc. Examination, 2020
CHE – 1104, Chemistry

Total Marks: 70 Time: 2 Hours

(Answer any 3 (Three) of the following Questions)

1. a) Bohr described the hydrogen atom as an electron orbiting a hydrogen nucleus. Although certain aspects of his theory are still valid, his theory agreed quantitatively with experiment only in the case of the hydrogen atom. In what way does quantum mechanics change Bohr's original picture of the hydrogen atom? 3.33

   b) What is the difference between a $2p_x$ and a $2p_y$ orbital? 2

   c) According to Heisenberg uncertainty principle, $\Delta x\, \Delta p \geq {}^{h}/_{4\pi}$. What do Δx and Δp stand for? What is the significance of the sign'≥' here? 3

   d) Indicate the total number of (i) *p* electrons in N ($Z = 7$); (ii) *s* electrons in Si ($Z = 14$); and (iii) 3*d* electrons in S ($Z = 16$). 3

   e) *Henry Moseley discovered a correlation between atomic number and the frequency of X rays generated by bombarding an element with high-energy electrons.* Mention how did it help to establish modern periodic law? 3

   f) Justify your choice: 2+2

   (i) Which of the following atoms should have a larger first ionization energy: N or P?

   (ii) Which of the following atoms should have a smaller second ionization energy: Na or Mg?

   g) Match each set of characteristics on the left column with an element in the right column. 2

(i) A reactive nonmetal; the atom has a large negative electron affinity	Sodium (Na)
(ii) A soft metal; the atom has low ionization energy	Antimony (Sb)
(iii) A metalloid that forms an oxide of formula R_2O_3	Argon (Ar)
(iv) A chemically unreactive gas	Chlorine (Cl2)

   h) *Lithium and magenisum have similarity in chemical behavior*. Explain. 3

2. a) Sodium chloride is a brittle solid with a high melting point (801°C) that conducts electricity in the molten state and in aqueous solution. While carbon tetrachloride is a colorless liquid with a very low melting point (-23°C) and low boiling point (76 ^{o}C) that does not conduct electricity in the liquid state or in aqueous solution.

   (i) What type of bonding is there in NaCl and CCl_4? Show how octet rule is applied in the formation of bonding in NaCl and CCl_4. 1+2

   (ii) Justify the differences in mentioned properties of NaCl and CCl_4. 3

   (iii) What is wrong with or ambiguous about if one states "four molecules of NaCl"? 3

   b) List the types of intermolecular forces that exist between molecules (or basic units) in each of the following species: (i) benzene, (ii) CH_3Cl, (iii) NaCl. 3

   c) *The police often use a device to test drivers suspected of being drunk.* What is the general name of such a device? What is the chemical basis of this device? Show appropriate reactions. 3

   d) Balance the following redox reaction: 3

   $Fe^{2+} + H_2O_2 \rightarrow Fe^{3+} + H_2O$ (acidic medium)

   e) Which of the following solutions can be classified as buffer systems? 3

   (i) KH_2PO_4/H_3PO_4, (ii) $NaClO_4/HClO_4$. Explain your answer.

f) Identify the oxidizing agent and the reducing agent in the following reaction: 2.33

$C_2H_2(g) + H_2(g) \rightarrow C_2H_6(g)$

3. a) Draw distribution curve for molecular velocities of H_2 and O_2 gases at a particular temperature (300K). Locate the most probable velocities in these curves. Mention the key differences with appropriate reasoning. 2+1 +2

b) (i) A real gas is introduced into a flask of volume V. Is the corrected volume of the gas greater or less than V? 2+2

(ii) Ammonia has a larger *a* value than neon does. What can you conclude about the relative strength of the attractive forces between molecules of ammonia and between atoms of neon?

c) (i) How many equilibria are there in the phase diagram of water? Draw the phase diagram and indicate all the equilibria on the diagram. 2+3

(ii) Also indicate the different regions of the diagram and calculate the degree of freedom in each of them, along with in the equilibrium region.

d) A 0.5 mole sample of He(g) and a 0.5 mole sample of Ne(g) are placed separately in two 10.0 L rigid containers at 25 °C. Each container has a pinhole opening. Which of the gases, He(g) or Ne(g), will escape faster through the pinhole and why? 3

e) Determine whether the following statements are correct or incorrect. If incorrect, correct them: 3

(i) All spontaneous processes release heat.

(ii) The entropy of the universe is decreasing to a minimum.

(iii) Both ΔH_{sys} and ΔH_{surr} become zero at equilibrium.

f) *Hess's law of constant heat summation is an indirect approach to determine the standard enthalpy of reaction*. Explain. 3.33

4. a) Write down the rate expressions in different forms and rate equation for the reaction- 2+ 1.33

$$aA+B = C+dD$$

b) The reaction 2A→B is second order with a rate constant of 51/*M* min at 24°C. 4
(i) Starting with $[A]_0 = 0.0092\ M$, how long will it take for $[A]_t = 3.7 \times 10^{-3}\ M$?

(ii) Calculate the half-life of the reaction.

c) Why the equilibrium yield of NH_3 in the reaction 3+2

$$N_2(g)+3H_2(g) \rightleftharpoons 2NH_3\ (g),\ \Delta H=-92\ kJmol^{-1}$$

decreases if the reaction temperature is varied. Draw the potential energy diagram for the reaction.

d) You are given three sugar solutions: saturated, unsaturated and supersatured. How can you distinguish them using a crystal of sugar? Is iodine (I_2) more soluble in water or in carbon disulfide (CS_2)? 2+2

e) Using schematic diagram, differentiate osmosis from reverse osmosis. Which one may be used for desalination of water? 3+1

f) A cucumber placed in concentrated brine (salt water) shrivels into a pickle. Explain. 3

5. a) A voltaic cell is constructed with an Ag/Ag^+ half-cell and a Pb/Pb^{2+} half-cell. Given, standard reduction potentials of Ag/Ag^+ and Pb/Pb^{2+} electrodes are 0.80 V and -0.13 V respectively.

(i) Write the balanced half-reactions and the overall reaction for this cell. 3

(ii) Draw a tentative diagram for the cell, label the electrodes and show the directions of electron flow in the circuit and of cation and anion flow in the salt bridge. 3.33

b) Explain: *"D- Glucose is an aldose"*. 3

c) Describe the difference between a voltaic cell and an electrolytic cell. 3

d) Complete the following table. State whether the cell reaction is spontaneous, nonspontaneous, or at equilibrium. 3

E	**ΔG**	**Cell Reaction**
>0		
	>0	
=0		

e) *Cellulose is a natural polymer, but nylon is a synthetic one.* Justify. 3

f) What is 'denaturation of protein'? If untreated, a fever of 104 ^{o}F or higher may lead to brain damage; why? 2+2

g) What are the sugars present in DNA and RNA? 1

University of Dhaka
Department of Computer Science and Engineering
1st Year 1st Semester B.Sc. Examination, 2020
CSE – 1101, Fundamentals of Computers and Computing

Total Marks: 70 Time: 2 Hours

(Answer any 3 (Three) of the following Questions)

1. a) Draw a flowchart that will guide us to sort three integers in non-decreasing order. 8

   b) Write a C program that takes two timestamps (given as **YYYY:MM:DD-hh:mm:ss**) A and B (A is strictly earlier than B) as input and find the differences of time between A and B in hours. 8

Sample Input	**Sample Output**
2020:05:05-00:00:03 2020:05:06-00:00:03	24
2020:05:05-00:00:03 2020:05:05-01:15:03	1.25

   c) Suppose that you are given four circles as a pair of (center, radius): $((cx_i, cy_i), r_i)$ and $i \in \{1,2,3,4\}$. Design a flow chart or write a C program to identify which pair of circles intersect each other. Note that if two circles only touch each other then it will also be counted as an intersection. 7.33

2. a) Consider two hexadecimal numbers A = $(BED0CA)_{16}$ and B = $(F0F0BA)_{16}$. Find the result of A×B without using any other base as intermediary steps. Note that only writing the answer or using other bases as intermediary steps will not carry any marks. 6

   b) A float array $x[50][30]$ is declared in a C program and the starting memory address is assigned as 6666 by the operating system. Now, find the memory address of the element $x[44][16]$. 5

   c) Consider the following single-precision floating point numbers and represent those according to IEEE-754 standard. Final result should be written in hexadecimal (Base-16) form. 4+4

   - 85.R [Here, R is your exam roll]
   - R.125 [Here, R is your exam roll]

   d) Suppose that a number system, called *BaseBase*, has only four digits: 1, 3, 5, and 7. Find what will be the $(10)_{10}$ equivalent in *BaseBase* system. 4.33

3. a) Describe swapping and virtual memory technique to run more programs than fit in main memory at once. 4

   b) Suppose, you have one desktop computer, one laptop, and a mobile phone; all these devices are connected to the Internet via a router. The desktop computer is connected to the router through an ethernet cable. The other two devices are connected using wifi signal using some credentials (wifi name and security key). Your router is wired-connected to your ISP provider's machine. Your ISP provider has a single public IP address and using that IP, they provide internet service to multiple customers like you.

   i) Explain suitable network topology/topologies involved in the architecture with logical arguments. 8

   ii) What are the possible protocols and procedures involved in the entire system that you know of? 3.33

   c) State at least two functionalities each of the following layers in seven layer OSI model 8

   i) Data Link Layer
   ii) Transport Layer
   iii) Network Layer
   iv) Presentation Layer

4. a) Suppose that Bangla, Hindi, English, and Russian language have 50, 46, 26, and 33 alphabets, respectively. In addition, we need 105 more symbols to express our feelings in written form. Find the minimum length of bit-string that can represent all the necessary symbols uniquely. 5

b) Consider the Machine Instructions for some Machine Language below.

Opcode	Operand	Descriptions
0	000	RESET all the register values to 0
1	RXY	LOAD the value XY to the register no R.
2	RXY	LOAD the value from memory address XY to the register no R
3	RXY	STORE the value to the memory address XY from the register no R
4	RST	ADD the integer values from register no S and T and STORE the result into the register no R
5	RST	ADD the float values from register no S and T and STORE the result into the register no R
6	RST	GET the integer values from register no S and T and STORE the AND result into the register no R
7	RST	GET the integer values from register no S and T and STORE the OR result into the register no R
8	RS0	GET the integer value from register no S and STORE the NOT (Complement) result into the register no R
9	RST	GET the integer values from register no S and T and STORE the XOR result into the register no R
A	RSX	GET the integer values from register no S and STORE the X bit RIGHT shifted result into the register no R
B	RSX	GET the integer values from register no S and STORE the X bit LEFT shifted result into the register no R
C	000	HALT the program

Write a valid sequence of machine instructions to compute the values of both the expressions and that stores the result in Register no 0. 6+6

- $2 \times 18 - 64 + 8 - 3$
- $(1 << 3) - 7 + (127 >> 3) - 3 \times 2$

Note that the very first and the very last instructions of each sequence should be 0000 and C000, respectively.

c) Write a comparative study among Machine Language, Assembly Language and Higher Level Language. 6.33

5. a) Explain a comparative study of different types of ROM's. 5

b) Draw a block diagram of the memory hierarchy of a computer system having 1 TB HDD, 16 GB DRAM and a processor of 1.93 GHz with L1(2 MB), L2(4MB) and L3(32 MB) cache memory. 5

c) Explain the working principle of 'Liquid Crystal Display' monitors. 5

d) Explain bitwise, assignment and logical operators in C with example. 5

e) Suppose that your mouse is not working when you are busy with some important works. Moreover, the mouse will not work until you restart your system. How you can complete your work without restarting the system. 3.33

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1st Year 1st Semester B.Sc. Examination, 2020
CSE – 1102, Discrete Mathematics

Total Marks: 70 Time: 2 Hours

(Answer any 3 (Three) of the following Questions)

1. a) Prove that all functions are relations but all relations are not functions. 4

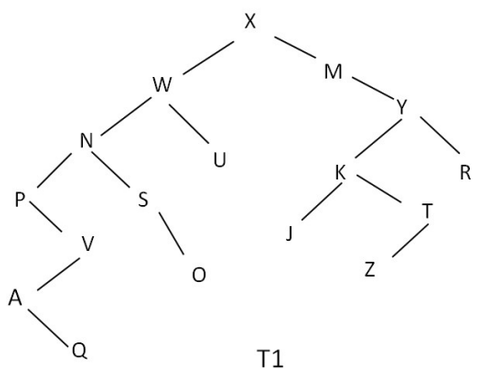
   b) Distinguish between one-one and onto functions. 5

   c) Find transitive closure of the relation $R = \{(a,b),(b,c),(c,d),(d,a)\}$ defined on $S = \{a,b,c,d\}$. 4

   d) Consider the function $f(x) = x^2$ $(f: Z \to Z)$. Is it invertible? Explain your answer. 3.33

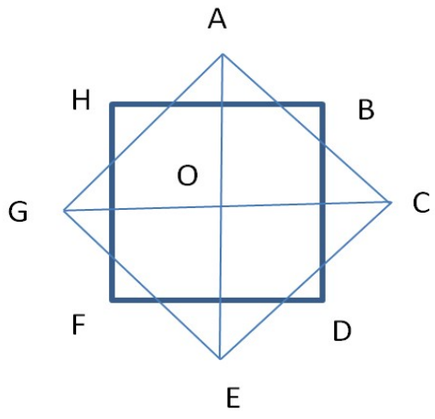
   e) Determine whether the relation $R = \{(a,b) | a \equiv b \pmod 3\}$ has equivalence relation on the set $\{0, 1, 2, 3, 4, 5\}$. 5

   f) Traverse the tree T1 (**Fig. 1**) in in-order way. 2



T1

Fig. 1



G3

Fig. 2

2. a) If exist, find the Euler circuit and the Euler path of K_5. 4.33

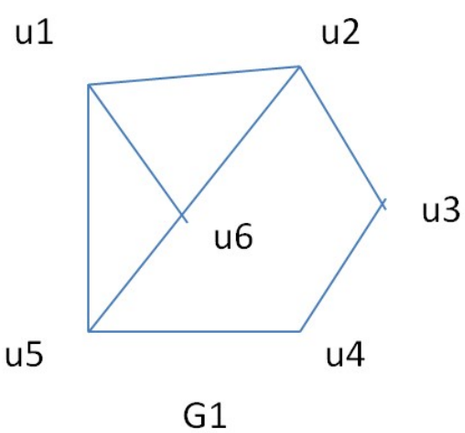
   b) Draw the planar representation of $K_{2,4}$. 2.5

   c) Find the Hamiltonian circuit in Q_3. 2.5

   d) Find the number of vertices and edges of $K_{m.n}$. 3

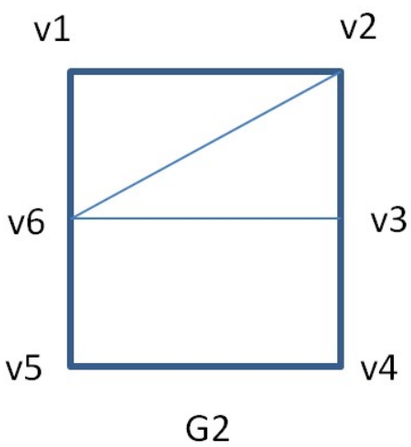
   e) Are the graphs G1 (**Fig. 3**) and G2 (**Fig. 4**) isomorphic to each other? 7

   f) Derive chromatic number of G3 (**Fig. 2**) using the Welch-Powel algorithm. 4



G1

Fig. 3



G2

Fig. 4

3. a) "1+1 = 3 if and only if monkeys can fly." What kind of proposition is it? Find out its truth value. 2.33

b) Write down the contrapositive of the proposition: "If monkeys can fly then 1+1=3." 2

c) Let $F(x, y)$ be the statement "x can fool y," where the domain consists of all people in the world. Use quantifiers to express each of these statements: 7

i) Everybody can fool Fred.
ii) Evelyn can fool everybody.
iii) There is no one who can fool everybody.
iv) No one can fool both Fred and Jerry.

d) For the following argument explain which rules of inferences are used for each step : 5
"All movies produced by Roman Polanski are wonderful. Roman Polanski produced a movie about black magic. So, there is a wonderful movie about black magic."

e) Consider a set S = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}. A1 = {1, 4, 6}, A2 = {2, 3, 10}, A3 = {9, 10}, A4 = {4, 7, 8} are subsets of S. Are these subsets a partition of S? Explain your answer. 3

f) Prove $A \cup (B \cup C) = (A \cup B) \cup C$ using rules of set identities; where A, B, C are three sets. 4

4. a) Solve the following congruence equations: 8

i) $9x \equiv 1 \pmod{16}$.
ii) $9x \equiv 1 \pmod{15}$.
iii) $9x \equiv 5 \pmod{15}$.
iv) $9x \equiv 6 \pmod{15}$.

b) Using Chinese Remainder theorem, find the smallest positive integer x such that when x is divided by 3 it yields a remainder 2, when x is divided by 5 it yields a remainder 1, and when x is divided by 11 it yields a remainder 7. 6

c) Using mathematical induction, prove that $2^n > n^2$ if n is an integer greater than 4. 4.33

d) Let P(n) be the statement that a postage of n takas can be formed using just 3 tk and 5 tk stamps. Prove P(n) using strong induction for $n \geq 8$. 5

5. a) In how many ways can a photographer at a wedding arrange six people in a row, including the bride and the groom, if 7

i) Bride and groom must be together
ii) Bride and groom must not be together
iii) The bride is positioned somewhere to the left of the groom.

b) How many cards must be selected from a standard deck of 52 cards to guarantee that at least three cards of the same suit are chosen? How many cards must be selected to guarantee that at least 3 hearts get selected? 4

c) Suppose that the number of bacteria in a colony triples every hour. 4

i) Set up a recurrence relation for the number of bacteria after n hours have elapsed.
ii) If 100 bacteria are used to begin a new colony, how many bacteria will be in the colony in 10 hours.

d) A survey of households in Bangladesh reveals that 90% have TV set, 98% have mobile phone and 94% have both TV set and mobile phone. What percentage of households in Bangladesh has neither a TV nor a mobile phone? 4

e) How many bit strings of length seven either start with a 1 bit or end with the one bit 0. 4.33

University of Dhaka
Department of Computer Science and Engineering
1st Year 1st Semester B.Sc. Examination, 2020
EEE – 1103, Electrical Circuits

Total Marks: 70 Time: 2 Hours

(Answer any 3 (Three) of the following Questions)

1. a) Explain the temperature effect on the resistance of conductors, semiconductors, and insulators. 3.33

   b) The voltage drop across a transistor network is 12 V. If the total resistance is 5.6 kΩ, what is the current level? What is the power delivered? How much energy is dissipated in 5 h? 3

   c) For the network in **Fig. 1**: 7
      i) Find the total resistance R_T.
      ii) Find the source current I_s and currents I_2, I_3 and I_5.
      iii) Find voltages V_2 and V_4.

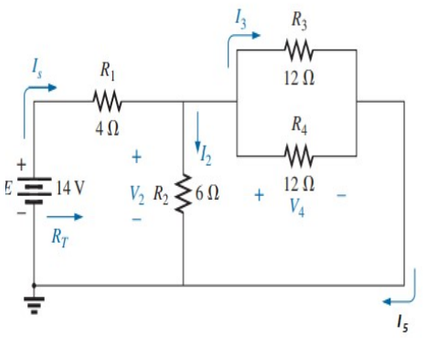


Fig. 1

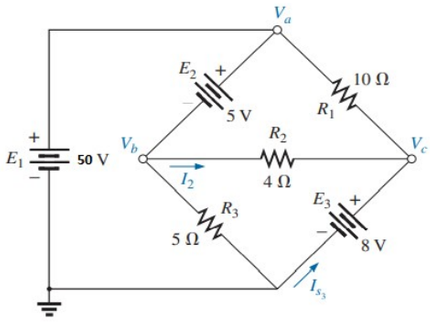


Fig. 2

   d) For the network in **Fig. 2**: 10
      i) Determine voltages V_a, V_b , V_c, V_{ac} and V_{bc} .
      ii) Find current I_1, I_2, and I_{s3} .

2. a) Illustrate with an example, the voltage drop and current through the open circuit and close circuit portion of a network. 2.33

   b) For the network in **Fig. 3**: 6
      i) Determine the open-circuit voltage V_L.
      ii) If the 2.2 kΩ resistor is short circuited, what is the new value of V_L?
      iii) Determine V_L if the 4.7 kΩ resistor is replaced by an open circuit.

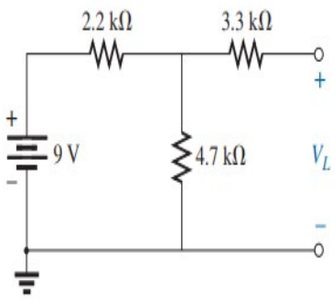


Fig. 3

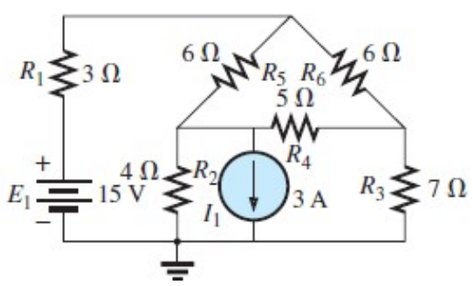


Fig. 4

   c) Summarize the Duality Principle between series and parallel configurations among network elements. 5

   d) For the network in **Fig. 4**: 5+5
      i) Write the nodal equations and solve for the nodal voltages.
      ii) Find current through and voltage across R_4 using mesh analysis.

3. a) What is super-mesh current? Illustrate using an example network. 5.33

b) For the following bridge network in **Fig. 5**: 10

i) Write the Mesh equations and determine the current through R_4 and R_5.

ii) Is the bridge balanced?

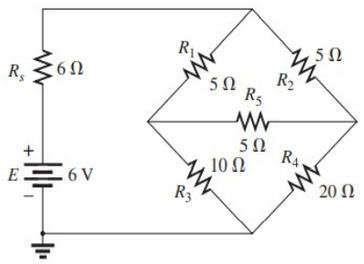


Fig. 5

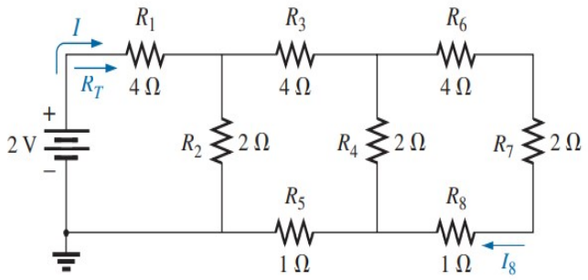


Fig. 6

c) For the ladder network in **Fig. 6**: Calculate R_T, I_5, V_4 and I_8. 8

4. a) State Maximum Power Transfer Theorem. What is the advantage of using the Maximum Power Transfer theorem? 3.33

b) Using the principle of superposition theorem, find the current through the 2Ω resistor of the network in **Fig. 7**. 10

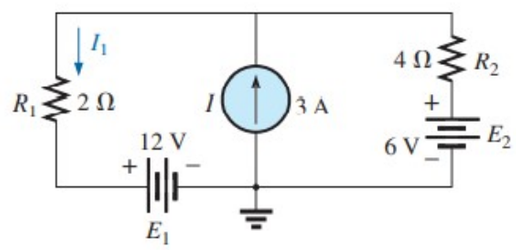


Fig. 7

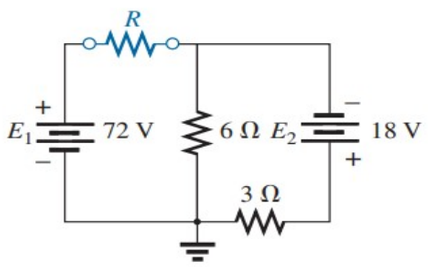


Fig. 8

c) State Thévenin Theorem. Find the Thévenin equivalent circuit for the network external to the resistor R for the network in **Fig. 8**. 10

5. a) Find the phase relationship between the following waveforms: 4

i) **i = 10 sin(ωt + 60°)** ii) **i = - sin(ωt + 30°)**

v = 15 sin(ωt - 20°) **v = 3 sin(ωt + 10°)**

b) For the network in **Fig. 9**: 4+4

i) Using Superposition theorem, find the current through and voltage across the resistor R. +1

ii) Using Millman's theorem, find the current through and voltage across the resistor R.

iii) Find the maximum power to R.

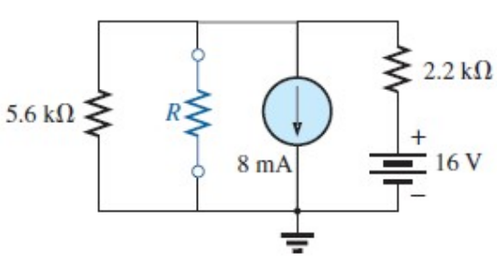


Fig. 9

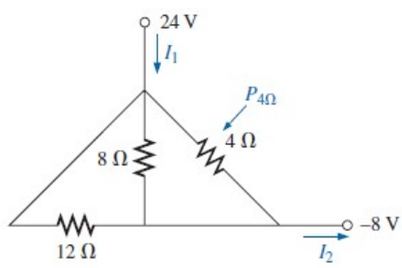


Fig. 10

c) Find the unknown quantities for the network in **Fig. 10** using the information provided. 4.33

d) Using substitution theorem, draw three equivalent branches for the branch *a-b* of the network in **Fig. 11**. 6

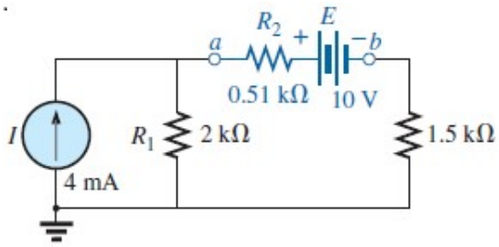


Fig. 11

University of Dhaka
Department of Computer Science and Engineering
1st Year 1st Semester B.Sc. Examination, 2020
MATH – 1105, Differential and Integral Calculus

Total Marks: 70 Time: 2 Hours

(Answer any 3 (Three) of the following Questions)

1. a) (i) Sketch the graph of the functions $f(x) = \log_p x$ and $g(x) = \log_q x$ when $p > q$. Use a solid line for one and a dotted line for the other. Mark the x and y intersection points, if they exist, with their coordinates. 11

(ii) Find the equations of reverse functions of f and g.

(iii) Draw, in the same graph, the inverse functions.

(iv) Mention the domain, range, horizontal and vertical asymptote lines (if applicable).

b) Suppose $f(x) = m_1x + b_1$, $g(x) = m_2x + b_2$, where m_1, m_2, b_1 and b_2 are constants. Is $f(g(x))$ a linear function? If yes, what is its slope? If not, is it a polynomial, and if yes, of what degree? 5.33

c) Give precise (i.e., δ - ε) definition of 3.5+ 3.5

(i) $\lim_{x \to +\infty} f(x) = L$ (ii) $\lim_{x \to a} f(x) = -\infty$

Mention an example of each case.

2. a) Calculate the limits of the following quantities. You must mention the appropriate limit laws used in your derivation. 3.5+ 3.5

(i) $\lim_{x \to -\infty} \frac{4x^2 - x}{5x^3 - 8}$ (ii) $\lim_{x \to 0^+} \left(\frac{1}{x} - \frac{1}{\sin x}\right)$

b) Prove, from the basic definition of a derivative, that 6.33

$$\frac{d\,[f(x)g(x)]}{dx} = f(x)\frac{d\,[g(x)]}{dx} + g(x)\frac{d[f(x)]}{dx}.$$

You must mention appropriate limit laws and derivative laws used in your derivation unless they are obvious.

c) Answer to the following questions: 5+5

(i) Find $\frac{dw}{dt}$ where $w = \sin x$, $x = 4y^3 + y$, and $y = t^4$

(ii) Given $3x^2 - 4y^2 = 10$, find $\frac{d^2y}{dx^2}$.

3. a) Evaluate the following integrals (**Any 4**) 4x5

(i) $\int_0^1 \tan^{-1}x$ (ii) $\int \sin^4 x \cos^5 x\, dx$ (iii) $\int \frac{x}{\sqrt{3 - 2x - x^2}}\, dx$

(iv) $\int \frac{2x + 4}{x^3 - 2x^2}\, dx$ (v) $\int \sqrt{\frac{1 - x}{1 + x}}\, dx$

b) What is the difference between the following terms: Definite integral, Indefinite integral and Anti-derivative. 3.33

4. a) We know that if $f(x) \geq g(x)$ for $a \leq x \leq b$, then $\int_a^b f(x)\ dx \geq \int_a^b g(x)\ dx$. 5.33

Now prove that if $m \leq f(x) \leq M$ for $a \leq x \leq b$, then:

$m(b - a) \leq \int_a^b f(x)\ dx \leq M(b - a)$.

b) How can we determine the average value of a continuous function on an interval $[a, b]$ using a definite integral? Explain the derivation using a graphical illustration. 9

c) Apply L'Hospitals rule to evaluate : 3

$$\lim_{x \to 0} \frac{\tan x - x}{x^3}$$

d) Suppose that a population y grows according to the logistic model given below: 6

$$y = \frac{L}{1 + Ae^{-kt}},$$

where y is the population at time t ($t \geq 0$) and A, k, and L are positive constants. At what rate is y increasing at time $t = 0$?

5. a) Find the area of the region bounded above by $y = e^x$, bounded below by $y = ln\ x$, and bounded on the sides by $x = 0$ and $x = 1$. 7.33

b) Find the volume of the solid created by rotating the region bounded by $y = x^3$, $y = 4$, and $x = 0$ about the y axis. 8

c) The region enclosed by the curves $y = x$ and $y = x^2$ is rotated about the line $x = -2$. Find the volume of the solid obtained by rotating the region. 8