

Xavier College of Interdisciplinary Studies**Luminous College of Advanced Studies
(Managed by Hrit Academy)****Basundhara, Kanti Marg, Kathmandu**

BALLB | Dashain Vacation Assignment | 2026

Dear Students,

As you prepare for the upcoming vacation, please review the instructions below to ensure your assignments are completed correctly and presented professionally.

✂ Guidelines for Assignment Submission:

- Answer all questions thoroughly in your own words & and original observations. Plagiarism or copied work are strictly prohibited. AI tools, if used, should support learning rather than replace your own work.
- Complete the entire assignment by hand or computer typed on standard A4-sized paper.
- Include neat, properly labeled diagrams and flowcharts where necessary. Please use a pencil and ruler to draw all visual aids.
- Collect authentic information through observation, participation, short interviews, or personal experience as required by the assignments.
- Submit a well-organized report supported by relevant evidence, such as photographs, interview notes, sample documents, tables, or screenshots where appropriate maintaining ethical standards:
- Ensure the first page clearly displays the following details:
 - Your Full Name
 - Faculty
 - Subject Name
 - Assignment Title / Topic
- **Page Assembly:** Arrange all pages sequentially and bind or staple them securely.
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Wishing you a productive and enjoyable vacation!

BALLB | Dashain Vacation Assignment | 2026**Subject: Political Thought**

Write a paper to complete during the Dashain vacation. The paper must connect classical Western political thought to those you have already discussed in earlier classes. From Plato and Aristotle to John Locke, Jean-Jacques Rousseau, Montesquieu, John Stuart Mill, and Karl Marx, Western political philosophers have developed different theories concerning the state, sovereignty, political authority, citizenship, liberty, equality, and social transformation. These ideas provide important analytical tools for understanding contemporary Nepali politics. Compare this Western political thought with Nepal's contemporary political system, constitutional democracy, federalism, political parties, corruption, social inclusion, and youth-led demands for political accountability. The essay is expected to be written in an academic style, with comparative analysis and references suitable for BALLB students, **following the attached format.**

Western Political Thought:

A Comparative Analysis with Contemporary Nepali Politics

Submitted by: [Student's Name]

Program: Bachelor of Arts and Bachelor of Laws (BALLB)

Subject: Political Thought

Institution: [Name of College]

Submitted to: [Name of Teacher]

Occasion: Dashain Festival Vacation Assignment

Date: [Submission Date]

Length of the paper: {3000 words}

Subject Teacher: Dr. Khimlal Devkota

BALLB | Dashain Vacation Assignment | 2026

Subject: Jurisprudence

Read this essay on Hart- Fuller debate and answer the questions below:

LawTeacher. (n.d.). Hart and fuller debate on law and morality. LawTeacher.net.
<https://www.lawteacher.net/free-law-essays/judicial-law/hart-and-fuller-debate-9262.php#citethis>



Questions

1. What do you mean by morality? Distinguish between law and morality.
2. Discuss H.L.A Hart's view on relationship between law and morality in 1000 words.
3. What was grudge informer case about? Do you think it as proper to convict the woman? Discuss the validity of Hitler's law on the standard of Fuller's eight principles of inner morality of law in 1000 words.
4. Do you support Fuller's view about morality of law? Discuss the strength and weakness of Fuller's concept of morality of law.

Subject Teacher: Dr. Rewati Raj Tripathee

BALLB | Dashain Vacation Assignment | 2026**Subject: Economics**

Attempt all ten questions. Each is a critical-answer question: do not merely reproduce notes; explain, compare, evaluate and justify. Suggested length: 400-500 words per answer. Use diagrams, tables and real examples from Nepal wherever relevant. Cite your sources (textbooks, articles, reports, web links). Answers must be original; copied work will not be accepted.

Questions

Q1. Economists have defined economics differently. Critically examine the definitions given by Adam Smith, Alfred Marshall, Lionel Robbins, Paul Samuelson and Green. (*Hint: state the central idea of each definition: wealth, welfare, scarcity and choice, growth and dynamic view, and the position of Green as discussed in class. Point out strengths and limitations, then conclude which definition best suits a developing country like Nepal.*)

Q2. "Robbins' definition is wider but Marshall's definition is more humane." Do you agree? Justify your view. (*Hint: compare the wealth, welfare, scarcity and growth approaches; discuss the criticisms of Marshall such as materialism and the exclusion of non-welfare activities; discuss the criticisms of Robbins such as being neutral between ends and ignoring welfare; give a reasoned conclusion.*)

Q3. Discuss the scope and subject matter of economics. Is economics a science or an art, positive or normative? Explain with suitable examples. (*Hint: consumption, production, exchange, distribution and public finance; scientific method and its limits in social science; positive and normative statements with two Nepalese examples each; relevance of economic reasoning to law and policy.*)

Q4. Explain the uses and importance of studying economics. How is a basic understanding of economics useful for a student of law in Nepal? (*Hint: importance for the individual, business, government and society; understanding of taxation, regulation, property, contracts and labour laws; link with national planning and development; economic analysis of legal decisions.*)

Q5. Distinguish between microeconomics and macroeconomics. Are they truly independent of each other? Support your answer with examples from the Nepalese economy.

(Hint: differences in subject matter, tools and scope; micro examples such as price of an item and consumer choice; macro examples such as inflation, unemployment, GDP and remittance; interdependence and the paradox of thrift; draw a comparison table.)

Q6. Scarcity and choice are the root of every economic problem. Critically explain this statement. **Field task:** observe the buying behaviour of one household or one local market during Dashain-Tihar and show how scarcity and choice operate.

(Hint: unlimited wants versus limited resources; types of wants and the scale of preference; scarcity versus shortage; role of income, price and time constraints; ordering of purchases by a household during festivals; whether scarcity disappears for the rich.)

Q7. What are the basic economic problems of every society? Explain how a mixed economy like Nepal attempts to solve them. *(Hint: what to produce, how to produce, for whom to produce, and the problems of efficiency and growth; contrast market, command and mixed systems; role of the state, private sector and cooperatives as provided in the Constitution of Nepal; evaluate the success of the Nepalese approach.)*

Q8. Define opportunity cost. Why is it considered the real cost of any choice? Task: identify one decision you made during the vacation and calculate or explain its opportunity cost.

(Hint: next best alternative forgone; money cost versus real cost; implicit and explicit costs; constant versus increasing opportunity cost; a simple numerical illustration; application in personal, business and government decisions.)

Q9. What is a Production Possibility Frontier (PPF)? Explain its assumptions and shape with a diagram. What causes it to shift? *(Hint: construct a hypothetical schedule of two goods, for example agriculture and manufacturing or hydropower and tourism; show attainable, unattainable and inefficient points; reason for the concave shape (law of increasing opportunity cost); effect of technology, resource discovery, education or earthquake and conflict damage on the curve.)*

Q10. Using the concept of PPF, discuss how scarcity, choice and opportunity cost are linked. Illustrate with a point on, inside and outside the curve. *(Hint: unemployment or underutilisation of resources inside the curve; efficient allocation on the curve; the need for economic growth to reach beyond it; movement along versus shift of the curve; capital goods versus consumer goods and long-run growth.)*

Q11. Case study: The Government of Nepal has a limited budget and must choose between building a new hospital and constructing a rural road. Analyse this decision using the concepts of scarcity, choice, opportunity cost, PPF and the basic economic problems. *(Hint: identify the scarce resources; state the opportunity cost of each option; show the trade-off on a PPF; consider efficiency, equity and long-term growth; discuss the micro and macro aspects; give your own reasoned recommendation, noting the legal and constitutional duties of the state.)*

Subject Teacher: Ramesh Raj Adhikari

BALLB | Dashain Vacation Assignment | 2026**Subject: Sociology**

Attempt all the questions of First unit test Question Set. Answer all questions thoroughly in your own words & and original observations. Plagiarism or copied work are strictly prohibited. AI tools, if used, should support learning rather than replace your own work.

Subject Teacher: Narayani Devkota

Subject: Legal Nepali - I

नेपाली भाषा: “उद्भवदेखी आजसम्म” शीर्षकमा १२०० देखि १५०० शब्द सम्मको प्रबन्धलेख तयार पार्नुहोस्।

Subject Teacher: Rabindra Bhattarai

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BBA | Dashain Vacation Assignment | 2026**Subject: Business Communication****Theme: Business Communication During Festivals**

Task: Observe how businesses, shops, service providers, or community organizations communicate with customers and stakeholders during Dashain and Tihar. Analyze the effectiveness of their communication practices.

Practical activities

Students must complete the following tasks:

1. Observe a business or service organization. Visit a local shop, supermarket, cooperative, bank, hotel, or other accessible organization. Observe how it communicates with customers during the festive season.
2. Conduct a short interview. Interview an owner, manager, employee, or customer with permission—to learn about festive offers, customer service, communication challenges, and customer feedback.
3. Collect communication samples. Examine two or three authentic examples, such as promotional posters, social media posts, discount notices, customer messages, or public announcements.
4. Analyze communication effectiveness. Identify the audience, purpose, channel, message clarity, tone, feedback mechanisms, and possible barriers to effective communication.
5. Create a business communication product. Design one improved promotional message, customer notice, festive email, or social media advertisement for the selected business.

Expected submission

Prepare a brief report on it, including:

1. Title page and introduction to the selected business.
2. Objectives and methods of observation or interview.
3. Description of actual communication practices.
4. Analysis using concepts studied in Business Communication.
5. Samples of existing communication materials, where permission allows.
6. One improved business communication product.
7. Personal reflection: What did you learn about communication in a real business environment?
8. Conclusion and recommendations.

Subject Teacher: Kusum Waiba

BBA | Dashain Vacation Assignment | 2026**Subject: Mathematics**

Attempt all questions. Show complete steps, especially for determinant expansion, matrix inversion, and row operations. Cramer's rule applies when the coefficient determinant is non-zero; otherwise, use row-reduction/Gauss-Jordan to classify the system as having no solution or infinitely many solutions.

Section A: Knowledge (1 mark each)

1. Define the determinant of a square matrix.
2. Write the formula for the determinant of $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$.
3. Define the minor of an element of a 3×3 determinant.
4. Define the cofactor of an element of a determinant.
5. State Sarrus' rule for evaluating a 3×3 determinant.
6. Define the adjoint of a square matrix A .
7. Define a singular matrix.
8. State the condition for a square matrix A to be invertible.
9. Write the condition for the system $AX = B$ to have a unique solution.
10. State the condition under which Cramer's rule cannot be used directly.

Section B: Understanding (3 marks each)

11. Find the minors and cofactors of every element of the first row of the determinant:
 $\begin{vmatrix} 2 & -1 & 3 \\ 4 & 0 & 5 \\ 1 & 2 & -2 \end{vmatrix}$.
12. Evaluate the following determinant using Sarrus' rule:
 $\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 10 \end{vmatrix}$.
13. If $A = \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix}$, find A^T , $|A|$, and $\text{adj}(A)$.
14. Find the inverse of $A = \begin{bmatrix} 3 & 5 \\ 2 & 4 \end{bmatrix}$.
15. Determine whether the following matrix is singular or non-singular:
 $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 3 & 7 & 10 \end{bmatrix}$.
16. Without solving completely, determine whether the following system has a unique solution, no solution, or infinitely many solutions:
 $x + 2y = 4$; $2x + 4y = 8$. Justify your answer.
17. For what value of k does the following system have no solution?
 $2x + 3y = 5$; $4x + ky = 10$.

Section C: Higher Abilities (5 marks each)

18. Evaluate the determinant by Laplace expansion along the first row:
 $\begin{vmatrix} 2 & -1 & 4 \\ 3 & 0 & 5 \\ 1 & 2 & -3 \end{vmatrix}$.

19. Solve the following system using Cramer's rule:

$$2x + 3y - z = 5; x - y + 2z = 6; 3x + 2y + z = 10.$$

20. A shop sells three items: pens, notebooks, and calculators. In one day, it sells 10 pens, 15

notebooks, and 5 calculators for Rs. 4,250. On another day, it sells 8 pens, 12 notebooks, and 7

calculators for Rs. 4,300. On a third day, it sells 12 pens, 10 notebooks, and 4 calculators for Rs.

3,700.

Let the prices of a pen, notebook, and calculator be Rs. x , Rs. y , and Rs. z , respectively.

(a) Form a system of linear equations.

(b) Solve the system using the inverse matrix method.

(c) Verify your answer using the Gauss–Jordan method.

(d) Interpret the values of x , y , and z in the commercial context.

Submission Instructions

- Write your name, class, section, roll number, and subject clearly on the first page.
- Use separate sheets for rough work; attach only neat final solutions.
- Draw a box around each final answer.
- Submit the completed homework on the first day after the Dashain vacation.

Subject Teacher: Uddhav Itani

BBA | Dashain Vacation Assignment | 2026**Subject: IT for Business*****Assignment 1: History of Computers***

Prepare a comprehensive report on the history and evolution of computers. Your report should cover the major eras and generations of computers, important computing devices, their inventors, key features, technological advancements, and contributions to the development of modern computers.

Students are encouraged to include relevant pictures, historical facts, timelines, and creative illustrations to make their reports informative and attractive.

Assignment 2: Case Study of a Multinational Organization

Prepare a case study of a multinational organization of your choice, explaining how it has implemented and utilized Information Technology (IT) and Information Systems (IS) to expand its business and improve operational efficiency and effectiveness.

Your case study should include a brief introduction to the organization, the IT and IS technologies it uses, their applications in business operations and decision-making, and their contributions to business growth and performance. Also discuss the challenges the organization faces in implementing and managing these technologies.

Subject Teacher: Joshesh Kumar Singh

BBA | Dashain Vacation Assignment | 2026**Subject: Economics****Questions**

Q1. Define microeconomics and explain its nature and scope. Is microeconomics a positive science, a normative science, or both? Discuss. (*Hint: individual units such as consumers, firms and markets; theory of demand, production, cost, product pricing, factor pricing and welfare; positive and normative statements with examples; brief contrast with macroeconomics.*)

Q2. Explain the uses and importance of microeconomics for a business student and for a manager. Also point out its limitations. (*Hint: pricing and output decisions, resource allocation, cost control, understanding consumer behaviour, forecasting demand, basis for government policy such as taxes and subsidies; limitations such as unrealistic assumptions, ignoring the whole economy, and the fallacy of composition.*)

Q3. State the law of demand and explain it with a demand schedule and a demand curve. Why does the demand curve slope downward? Field task: during Dashain-Tihar, note the price and approximate demand of one festive item (for example flowers, fruits, sel roti ingredients, goat meat or clothing) in a local market and examine whether the law holds. (*Hint: inverse relationship between price and quantity demanded, ceteris paribus; assumptions; reasons for the downward slope: income effect, substitution effect, law of diminishing marginal utility, new and old buyers; record your observations in a small table and state the limitations of your data.*)

Q4. What are the determinants of demand? Explain each with examples from Nepal, with special reference to festive seasons. (*Hint: own price, price of related goods (substitutes and complements), income (normal and inferior goods), tastes and preferences, expectations, population and its composition, seasonal and festival effects, remittance, credit availability and government policy; classify each as a cause of movement or shift.*)

Q5. Critically examine the exceptions to the law of demand. Are they genuine exceptions or only apparent ones? (*Hint: Giffen goods, Veblen or conspicuous goods, snob effect, expectation of future price changes, ignorance and the price-quality belief, necessities and emergencies; explain why the demand curve slopes upward in each case, and give a reasoned conclusion on the general validity of the law.*)

Q6. What is a demand function? Distinguish between individual demand and market demand. Given the function $Q_d = 120 - 4P$, prepare a demand schedule for $P = 5, 10, 15, 20$ and 25 , draw the demand curve and interpret the intercept and slope. (*Hint: general form $Q_d = f(P, P_r, Y, T, E)$; linear form $Q_d = a - bP$; compute quantities and find the price at which demand becomes zero; slope = $-b$; market demand as the horizontal sum of individual demands; explain what happens to the equation when income rises.*)

BBA | Dashain Vacation Assignment | 2026**Subject: Economics****Questions**

Q7. Distinguish clearly between a movement along the demand curve and a shift of the demand curve. Illustrate each with diagrams and Nepalese examples. (*Hint: extension and contraction caused only by a change in own price; increase and decrease (rightward and leftward shift) caused by other determinants; separate diagrams; explain why a change in the price of a good never shifts its own demand curve; show the difference in tabular form.*)

Q8. Case study: Before Dashain, many households receive a festival bonus and remittance inflow rises. At the same time, the price of tomatoes falls, the price of mutton rises, and a popular smartphone brand announces a discount scheme. Analyse each situation using demand theory. (*Hint: for each event decide whether it is a movement or a shift; identify the determinant involved, the direction of change and the type of good (normal, inferior, substitute or complement); sketch a small diagram for every case; comment on how sellers may respond.*)

Q9. "The law of demand holds true only when other things remain constant." Critically discuss the role and the weakness of the ceteris paribus assumption in demand analysis. (*Hint: meaning of ceteris paribus; why economists isolate one variable at a time; real-life situations in which many factors change together; difficulty of testing the law empirically; how the assumption is relaxed in multivariate demand functions; your view on its usefulness.*)

Q10. Mini project: Select one product commonly consumed in Nepal and prepare a short demand analysis of 2-3 pages covering its law of demand, main determinants, demand function (assumed or estimated), demand curve, and one example each of a movement and a shift. (*Hint: choose an easily observable product such as milk, mobile data, rice, petrol or momo; collect simple price-quantity data from a shop, family or online source; present a table and diagram; explain any exception that may apply; conclude with a business implication for a seller of the product.*)

Subject Teacher: Ramesh Raj Adhikari

Subject: Foundations of Management

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Subject Teacher: Shiba Lal Sharma

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B.Sc. CSIT | Dashain Vacation Assignment | 2026

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| B.Sc. CSIT | Dashain Vacation Assignment | 2026**Subject: Physics**

1. Explain how the law of conservation of mechanical energy applies to a freely falling object. Draw a simple diagram showing the changes in kinetic and potential energy.
2. Prepare a short report on the importance of Newton's laws and conservation laws in modern technology. Include at least three examples related to vehicles, sensors, computer hardware, or other technological systems. Add relevant diagrams or pictures where appropriate.

Subject Teacher: Narayan Banjade**Subject: Computer Concept and Programming**

1. Define a computer and explain its major characteristics. Also, describe the five generations of computers with their key technologies.
2. Draw a block diagram of a computer system and explain the functions of its major components, including the CPU, memory unit, input unit, and output unit.
3. Differentiate between primary memory and secondary memory with suitable examples. Also, explain the memory hierarchy by arranging different memory types from fastest to slowest.
4. Explain the differences between LAN, MAN, and WAN with suitable examples. Also, differentiate between peer-to-peer and client-server network architectures.
5. Explain the functions of input devices, output devices, storage devices, and communication devices. Give at least two examples of each category.
6. Describe the major phases of program development, from problem definition and analysis to maintenance. Explain why each phase is important.
7. Define an algorithm, flowchart, and pseudocode. Explain their differences and describe how they help in solving programming problems.
8. Write an algorithm and draw a flowchart to calculate the sum, difference, product, and quotient of two user-input numbers. Your solution must handle division by zero appropriately.
9. Write pseudocode to accept a student's marks in three subjects, calculate the total and average, and determine whether the student has passed or failed. Assume the student must score at least 40 marks in each subject to pass.
10. Write an algorithm and pseudocode to display all even numbers from 2 up to a positive integer N. Then briefly explain the three basic program control structures and describe the procedural, object-oriented, functional, and declarative programming models with suitable examples.

Subject Teacher: Dipak Aryal

B.Sc. CSIT | Dashain Vacation Assignment | 2026**Subject: Technical Communication English**

Theme: Technology, Digital Communication and User Experience During Festivals

Task: Investigate how modern technology (e.g., digital payments/eSewa/Khalti, IoT decorative lighting, logistics apps, crowd management tools, or e-commerce) impacts festival management during Dashain & Tihar.

Practical activities

1. Observe real-world technology use. Examine how people use digital payment services, online shopping platforms, mobile applications, digital invitations, online booking services, or communication tools during the vacation.
2. Identify a technical communication problem. For example, users may have difficulty understanding digital payment instructions, navigating an application, recognizing transaction status, or following online safety guidance
3. Gather user perspectives. Ask two or three willing users about their experience, difficulties, and suggestions. Avoid collecting passwords, account details, financial information, or other sensitive data.
4. Develop a technical communication resource. Prepare a user guide, step-by-step instruction sheet, troubleshooting guide, FAQ document, or brief technical presentation addressing the identified problem.
5. Test and improve the document. Ask one or two users to follow your instructions. Record where they encounter confusion and revise your document for clarity, accuracy, sequence, and usability.

Expected submission

1. Prepare a brief report on it, including Title page and introduction to the selected technology or service.
2. Objectives and methods of observation or user feedback.
3. Description of the identified communication problem.
4. Analysis of the target audience and its technical needs.
5. The technical document created, with relevant screenshots, diagrams, or illustrations.
6. Feedback from users and revisions made.
7. Personal reflection on the importance of clear technical communication.
8. Conclusion and recommendations.

Subject Teacher: Kusum Waiba

B.Sc. CSIT | Dashain Vacation Assignment | 2026**Subject: Digital Logic****Theme: Number System and Computer Codes**

1. What is number system? Describe the application areas of different digit
1. number system.
2. Differentiate between Weighted and Non-weighted number system.
3. Convert as instructed:
 - a. (10111.1001)₂ into Octal
 - b. (100001000101101)₂ into Hexadecimal
 - c. (11101.10110)₂ into Decimal
 - d. (2043.112)₈ into Binary
 - e. (4762)₈ into Decimal
 - f. (01102.2365)₈ into Hexadecimal
 - g. (9053.672)₁₀ into Hexadecimal
 - h. (406)₁₀ into Binary
 - i. (3456.7891)₁₀ into Octal
 - j. (ABC.DEF)₁₆ into Decimal
 - k. (1014.010)₁₆ into Binary
 - l. (BA8.7FD)₁₆ into Octal
 - m. (10110+1011-10111)₂
 - n. (10110*101)₂
 - o. (1001011011 / 10)₂
 - p. (110010 + 101110)₂ / (10001 – 1010)₂
4. What do you mean by complements and its type?
5. Subtract (1011011)₂ from (11011)₂ using 1's and 2's complement methods.
6. Given P = 107 and Q = 66, represent them in binary and perform P – Q using 1's and 2's complement methods.
7. Using 9's and 10's complement methods, perform B – A. A = 1235 and B = 5679.
8. Subtract 5566 from 1212 using 9's and 10's complement methods.
9. Perform X – Y. The value of X is 30 and the result of the 9's complement method is 150. Find the value of Y.
10. Perform BCD addition:
 - a. 101101 and 110100
 - b. 25 and 63
11. What is Reflected Binary Code? Convert following binary code to reflected code:
 - a. 110101
 - b. 1011011
12. Convert following gray code to Binary code:
 - a. 111010
 - b. 100101
13. What is Excess – 3 codes? Explain with example.
14. How parity works in error detection method? Explain with example.
15. Explain BCD Adder Circuit.
16. Explain some of the error detection and correction techniques used in modern digital system.

Subject Teacher: Sujan Joshi

B.Sc. CSIT | Dashain Vacation Assignment | 2026**Subject: Mathematics-I****Section A: Knowledge and Recall***Questions 1–5*

- Define the following mathematical terms.
 - Limit of a function
 - Continuity of a function at a point
 - Discontinuity
 - Derivative of a function
 - Linearization of a function
- State the conditions for a function $f(x)$ to be continuous at $x = a$. Also, explain the difference between removable and non-removable discontinuities with one example of each.
- State the following theorems and write their mathematical conditions. (6 marks)
 - Rolle's theorem
 - Lagrange's mean value theorem
 - Cauchy's mean value theorem
- Evaluate the following limits. (4 marks)
 - $\lim_{x \rightarrow 2} (x^2 - 4)/(x - 2)$
 - $\lim_{x \rightarrow \infty} (3x^2 + 2x - 1)/(x^2 - 4)$
 - $\lim_{x \rightarrow 0} \sin(3x)/x$
 - $\lim_{x \rightarrow \infty} (2x + 1)/(x^2 + 3)$
- Differentiate the following functions. (5 marks)
 - $y = 3x^3 - 5x^2 + 7x - 2$
 - $y = (x^2 + 1)(x^3 - 2x)$
 - $y = (x^2 + 1)/(x - 1)$
 - $y = e^2 \sin x$
 - $y = \ln(x^2 + 1)$

Section B: Understanding and Application of Concepts*Questions 6–12*

- Determine the values of a and b for which the following function is continuous at every real number. $f(x) = x^2 + ax + b$, for $x < 1$; $f(1) = 3$; $f(x) = 2x + a - b$, for $x > 1$.
- Find and classify the discontinuities of the function. Identify any removable discontinuity and determine whether the function has any vertical asymptotes. Justify your answer.
 $f(x) = (x^2 - 4)/(x^2 - x - 2)$.
- Find the equations of the asymptotes of the following functions.
 - $y = (2x + 3)/(x - 1)$
 - $y = (x^2 + 1)/(x - 2)$
 - $y = (3x^2 - 1)/(x^2 + 2)$
- Use the definition of the derivative to find $f'(x)$ for the function below. Verify your result by using the standard differentiation rules. $f(x) = x^2 + 3x$.

10. Find the first and second derivatives of the following function. Hence, calculate $y'(0)$ and $y''(0)$. $y = x^3 e^x$.

11. Find the linearization of the function $f(x) = \sqrt{x+4}$ at $x = 5$.

a. Determine the linear approximation $L(x)$.

b. Use it to estimate $\sqrt{8.9}$.

c. Compare the estimated value with the actual value using a calculator and comment on the accuracy.

12. Verify Rolle's theorem for the function $f(x) = x^2 - 4x + 3$ on the interval $[1, 3]$.

a. Check whether all the conditions of the theorem are satisfied.

b. Find the value(s) of c guaranteed by the theorem.

c. Explain the geometrical meaning of the result.

Section C: Higher-Order Thinking and Problem Solving

Questions 13–17

13. Apply Lagrange's mean value theorem to the function $f(x) = x^2 - 2x$ on $[0, 3]$.

a. Verify the conditions of the theorem.

b. Find the value(s) of $c \in (0, 3)$.

c. Interpret the result geometrically by comparing the secant and tangent slopes.

14. Verify Cauchy's mean value theorem for $f(x) = x^2$ and $g(x) = x + 1$ on $[0, 2]$.

a. Verify the required conditions.

b. Find the value(s) of $c \in (0, 2)$ satisfying:

$$(f(2) - f(0))g'(c) = (g(2) - g(0))f'(c).$$

c. Explain how Cauchy's mean value theorem generalizes Lagrange's mean value theorem.

15. Find the Maclaurin expansion of $f(x) = e^x$ up to the term containing x^3 .

a. Derive the expansion using Maclaurin's theorem.

b. Use the expansion to approximate $e^{0.2}$.

c. Compare your approximation with the calculator value and determine the absolute error.

16. Find the Taylor polynomial of degree 3 for $f(x) = \ln x$ about $x = 1$.

a. Calculate the required derivatives.

b. Construct the Taylor polynomial.

c. Use the polynomial to approximate $\ln(1.2)$.

d. Explain why the approximation is expected to be more accurate when x is close to 1.

17. A particle moves along a straight line, and its displacement after t seconds is given below, where displacement is measured in metres.

$$s(t) = t^3 - 6t^2 + 9t + 2.$$

a. Find the velocity function $v(t)$.

b. Find the acceleration function $a(t)$.

c. Determine when the particle is momentarily at rest for $t \geq 0$.

d. Find the acceleration at each time when the particle is momentarily at rest.

e. Explain the physical meaning of the first and second derivatives in this situation.

Section D: Critical Thinking and Real-Life Applications*Questions 18–20*

18. A rectangular garden is to be constructed beside a straight wall. Only three sides need fencing, and 40 metres of fencing are available. (7 marks)

Let x be the width perpendicular to the wall and y be the length parallel to the wall.

- Express y in terms of x .
- Form an expression for the area A of the garden.
- Use differentiation to determine the dimensions that maximize the area.
- Verify that your result gives a maximum area and calculate the maximum area.

19. A company estimates its production cost using the function below, where x is the number of units produced and $C(x)$ is the cost in monetary units. (7 marks)

$$C(x) = 0.02x^2 + 5x + 200.$$

- Find the marginal cost $C'(x)$.
- Find the marginal cost when $x = 50$.
- Use linearization at $x = 50$ to estimate the cost of producing 51 units.
- Calculate the actual cost of producing 51 units and compare it with your estimate.
- Explain why marginal cost is useful in production planning.

20. Investigate the following function using the concepts of limits, continuity, derivatives and asymptotes. (8 marks)

$$f(x) = (x^2 - 1)/(x - 1), x \neq 1.$$

- Simplify the function and state its domain.
- Evaluate $\lim_{x \rightarrow 1} f(x)$.
- Determine whether the function is continuous at $x = 1$. If not, classify the discontinuity.
- Find $f'(x)$ for $x \neq 1$.
- Sketch the graph and identify any asymptotes or holes.
- Explain how the limit exists even though the function is not defined at $x = 1$.

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