Problem 1 (30%)

Aurora Fine Art Gallery (AFAG) specializes in contemporary paintings and sculptures by emerging Asian and European artists. AFAG pursues a product differentiation strategy, emphasizing curatorial expertise, artist reputation building, private previews, and customized client services.

During 20X4, AFAG served three major customers—Customer A (Private Collector), Customer B (Corporate Buyer), and Customer C (Interior Design Studio)—who together accounted for a substantial portion of gallery revenue. Management is concerned that revenue rankings may not align with profitability rankings and has asked for a comprehensive profitability and strategic analysis.

AFAG uses an activity-based customer profitability system. Costs are classified at the customer level; gallery-sustaining costs (e.g., owner salary, brand advertising) are not allocated.

Exhibit 1 — 20X4 Sales-Mix Planning Benchmarks

AFAG prepared a static budget for 20X4 using the following budgeted revenue mix (based on total revenue dollars):

Confirmed static-budget revenue mix	A	B	C
Budgeted mix % of total revenue	40%	35%	25%

Budgeted total revenue for 20X4: $1,200,000

Exhibit 2 — 20X4 Sales and Cost of Artwork Information by Customer

Item	Customer A	Customer B	Customer C
Number of artworks purchased	8	15	22
Average selling price per artwork	$45,000	$28,000	$18,000
Average cost of artwork per unit	$25,000	$19,000	$14,000

Exhibit 3 — 20X4 Customer-Level Activities and Cost-Driver Rates

Activity (Customer-Level)	Cost Driver	Rate
Sales order processing	Number of purchase orders	$300 per order
Curatorial consulting & private viewings	Number of client visits	$1,200 per visit
Customized logistics & installation	Number of installations	$2,500 per installation
After-sale client service	Number of artworks sold	$400 per artwork

Exhibit 4 — 20X4 Customer Consumption of Cost Drivers

Cost Driver	Customer A	Customer B	Customer C
Purchase orders	6	12	18
Client visits	10	6	4
Installations	8	10	14
Artworks sold	8	15	22

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Required:

1. Rank the three customers from most profitable to least profitable based on customer-specific operating income. (5%)
2. Compute the sales-mix variance of revenue attributable to Customer A. (5%)
3. Compute the annual change in AFAG operating income if Customer C is dropped. (5%)
4. Calculate the growth (5%), price-recovery (5%), and productivity components (5%) that explain the change in operating income from 20X3 to 20X4, providing the following information in Exhibit 5:

Exhibit 5

Panel A: Sales and cost of artwork data

Item	20X3	20X4
Artworks sold (units)	40	*Compute from Exhibit 2*
Average selling price per artwork	$25,000	*Compute from Exhibit 2*
Average cost per artwork	$18,000	*Compute from Exhibit 2*

Panel B: Customer-service operating costs (capacity-based, fixed within year)

Resource area	Capacity driver	Capacity supplied	Total cost (Year)
Curatorial/relationship team	client visits capacity	25 visits (20X3)	$60,000 (20X3)
		28 visits (20X4)	$67,200 (20X4)
Installation team (logistics & install)	installations capacity	30 installs (20X3)	$75,000 (20X3)
		32 installs (20X4)	$80,000 (20X4)

Panel C: Actual activity usage

Activity usage	20X3 actual	20X4 actual
Client visits used	22	20
Installations used	27	32

Problem 2 (20%)

NeuraCore Technologies, Inc. (NTI) manufactures customized AI accelerator modules under job-order production. Manufacturing is organized into two production departments: Department M (Module Assembly) and Department T (Testing and Burn-in). NTI completes a single job, Job Q-91, during June 20X7; assume there is no beginning or ending work in process. Both direct labor-hours (DLH) and machine-hours (MH) are measured in both departments.

Job Q-91 was expected to produce 1,950 but produced 1,300 finished modules during June 20X7 (completed and transferred out). There was no beginning or ending work in process.

Under NTI's traditional job-order costing system, overhead in Department M is applied solely using DLH, whereas overhead in Department T is applied solely using MH. In contrast, under NTI's proposed activity-based costing (ABC) system, variable and fixed overhead are accumulated into activity pools and assigned using DLH, MH, and setups as cost drivers, as specified below.

Data for the Traditional Job-Order Costing System

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Budgeted annual totals (used to compute predetermined rates)

Department M has budgeted variable MOH of $2,000,000, budgeted fixed MOH of $1,500,000, budgeted DLH of 50,000, and budgeted MH of 20,000.
Department T has budgeted variable MOH of $3,200,000, budgeted fixed MOH of $2,400,000, budgeted DLH of 15,000, and budgeted MH of 80,000.

June 20X7 data (Job Q-91 only)

For Department M, actual DLH are 4,800 and budged DLH are 7,800; actual MH are 2,200 and budged MH are 3,900. Actual variable MOH incurred is $205,000 and actual fixed MOH incurred is $145,000.
For Department T, actual DLH are 1,200 and budged DLH are 2,100; actual MH are 9,600 and budged MH are 12,600. Actual variable MOH incurred is $410,000 and actual fixed MOH incurred is $310,000.

<u>Data for the ABC System</u>

Under ABC, NTI decomposes overhead into variable and fixed activity pools. The redesign preserves the same totals of (i) variable MOH, (ii) fixed MOH, (iii) budgeted DLH and MH, and (iv) actual and standard-allowed DLH and MH. After a costing study, NTI identifies the following manufacturing overhead activities and their budgeted amounts:

Assembly support: Variable $1,400,000, fixed $1,600,000, and driven by direct labor-hours.

Machine operation: Variable $3,300,000, fixed $1,400,000, and driven by machine-hours

Batch setups: Variable $500,000, fixed $900,000, and driven by number of setups

Budgeted DLH and MH for ABC are the same as those in the traditional costing system, and budgeted setups for ABC pools are 1,000 setups.

June 20X7 Job Q-91: Activity Drivers and Overhead Incurred

Cost-driver measurement under ABC:

"Direct labor-hours (DLH)" used for the Assembly support pool equals total DLH across both departments for Job Q-91.

"Machine-hours (MH)" used for the Machine operation pool equals total MH across both departments for Job Q-91.

"Setups" used for the Batch setups pool equals the number of setups for Job Q-91.

For Job Q-91 in June 20X7, the number of setups is 42 compared with budgeted 60 setups allowed for actual finished modules. Actual manufacturing overhead incurred under ABC equals that incurred under the traditional system. Specifically, actual variable overhead totals $ 615,000, comprising Assembly support $ 173,856, Machine operation $372,548, and Setup supplies $68,596. Actual fixed overhead totals $455,000, comprising Assembly sustaining capacity $189,000, Machine sustaining capacity $158,667, and Setup capacity $107,333.

Required:

For Job Q-91, compute each variance under Traditional and under ABC, then report the difference to help NTI understand whether and how ABC improves the cost allocation:
(ABC variance) – (Traditional variance)

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Computation and rounding conventions: Compute all predetermined overhead rates and ABC activity rates to four decimal places, use full precision (no intermediate rounding) when calculating variances, and report each VMOH/FMOH variance and each (ABC – Traditional) difference rounded to the nearest dollar.

1. VMOH spending variance difference (ABC – Traditional). **(5%)**
2. VMOH efficiency variance difference (ABC – Traditional). **(5%)**
3. FMOH spending variance difference (ABC – Traditional). **(5%)**
4. FMOH production-volume variance difference (ABC – Traditional). **(5%)**

Problem 3 (20%)

Precision Parts Inc. (PPI) manufactures high-tolerance aerospace components. For profit planning and budgeting purposes, PPI uses variable costing method to account for its inventoriable costs. Recently, PPI has seen an uptick in scrap and rework costs. Marco Chen, the management accountant, is tasked with optimizing the quality control process. Marco wants to build a decision tree to predict whether a part will be Defective or Functional based on production data.

Marco has pulled a sample of 105 production runs. In this sample, 62 runs resulted in Functional parts and 43 runs resulted in Defective parts.

After investigating manufacturing quality controls, Marco find that Machine Temperature and Operator Experience could be predictors of defective products. Marco is evaluating two potential splits for the root node of his decision tree:

Split A (Machine Temp): Is the temperature greater than 200°C?
Split B (Operator Experience): Does the operator have experience greater than 5 years?

Among 105 sample production runs, the two splits show the following results:

Split A: 55 runs were Hot (>200°C). Of these, 42 were Defective and 13 was Functional. The remaining 50 runs were Cool, and all 50 were Functional.

Split B: 62 runs were by Experienced operators. Of these, 33 were Functional and 29 were Defective. The remaining 43 runs were by Junior operators. Of these, 31 were Functional and 12 was Defective.

Required: (Round your answer to the nearest thousandth)

1. To help Marco find the optimal split, calculate the information gain for Split A **(5%)** and that for Split B **(5%)**.
2. Precision Parts Inc. (PPI) has just secured a contract to produce 8 units of the Aero-Fin, a complex component for a new commercial jet. The operations manager is wondering whether PPI should use the Incremental Unit-Time Learning Model or the Cumulative Average-Time Learning Model for assessing the labor requirements. Marco Chen is preparing the budget for the first year of production. Because the Aero-Fin is highly specialized, the production process is labor-intensive, and Marco expects significant labor efficiencies as the team gains experience.

   The production of the first unit took exactly 1,200 labor hours. Based on historical data from similar projects, Marco believes a 85% learning rate is applicable. PPI uses a standard costing system. Variable manufacturing overhead (VMOH) is applied based on direct labor hours. Fixed overhead is allocated based on units produced. Financial and production data are summarized as below:

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Direct Materials	$11,500 per unit
Direct Labor Rate	$43.50 per hour
Variable Manufacturing Overhead	$26.20 per direct labor hour
Total Annual Fixed Overhead	$83.80 per unit
Selling Price	$147,500 per unit

Using variable costing method, calculate the budgeted gross profits for the 8 units of Aero-Fins, comparing the results when labor hours are assessed under the Incremental Unit-Time Learning Model **(5%)** versus the Cumulative Average-Time Learning Model **(5%)**.

$1^{\ln 0.85/\ln 2}=1.0000$ $6^{\ln 0.85/\ln 2}=0.6570$

$2^{\ln 0.85/\ln 2}=0.8500$ $7^{\ln 0.85/\ln 2}=0.6337$

$3^{\ln 0.85/\ln 2}=0.7729$ $8^{\ln 0.85/\ln 2}=0.6141$

$4^{\ln 0.85/\ln 2}=0.7225$ $9^{\ln 0.85/\ln 2}=0.5974$

$5^{\ln 0.85/\ln 2}=0.6857$ $10^{\ln 0.85/\ln 2}=0.5828$

Problem 4 (20%)

Global Dynamics Inc. (GDI) is a multinational technology firm. Recently, two of its business units—GDI-Electronics in Tokyo and GDI-Logistics in Hamburg—reported the following distinctive managerial problems.

GDI-Electronics (Tokyo, Japan): GDI-Electronics manufactures the Z-Core Microchip. The Tokyo plant currently has a capacity of 200,000 machine-hours. Each Z-Core requires 2 machine-hours to produce, and the contribution margin is $50 per unit. Currently, the plant produces and sells 80,000 good chips.

However, quality problem results in 25% of the good output are identified as defective and must be reworked. Reworking 1 chip takes 1 machine-hour. Variable rework costs (including materials and labor) is $40 per unit. Fixed rework costs (allocated overhead) is $20 per unit.

To solve this quality problem, the engineering team proposes an Ultra-Precision system upgrade. This system would eliminate all defects (100% quality) and maintain current production speeds. The upgrade costs $2,500,000 per year. Current market demand for Z-Core chips is 120,000 units per year. If the upgrade is implemented, the improved quality is expected to attract the market demand to fill all GDI-Electronics' available machine capacity.

GDI-Logistics (Hamburg, Germany): GDI-Logistics acts as a central investment center responsible for the distribution of components to GDI's European assembly plants. GDI-Logistics manages the inventory for the E-Sensor, a critical component used in German automotive manufacturing. The Hamburg facility operates 50 weeks per year.

E-Sensor's annual demand is 100,000 units. Ordering cost is $500 per order (includes customs, handling, and shipping). Annual carrying cost is $4.00 per unit (includes climate-controlled storage and insurance). Lead time is 2 weeks to receive an order from the supplier. Stockout cost occurs when the sensor is out of stock and GDI-Logistics must use air-freight and pay an additional cost of $10 per unit.

GDI-Logistics faces the inventory management problem. While the average weekly demand is 2,000 units (100,000/50 weeks), the actual weekly demand varies according to the following probability distribution:

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Total Demand for 1 Week	Probability
1,600 units	0.05
1,800 units	0.20
2,000 units	0.50
2,200 units	0.20
2,400 units	0.05

Requirement:

1. GDI-Electronics is considering the Ultra-Precision system upgrade. Assuming the upgrade attracts market demand to fill all available machine capacity, calculate the change in profit resulting from the implementation of this system. **(10%)**.
2. GDI-Logistics is addressing an inventory management challenge. Using EOQ model, calculate the optimal order quantity for E-Sensors **(5%)** and the total annual relevant costs at the EOQ level **(5%)**.

Problem 5 (10%)

GreenTextiles Corp., a commercial fabric manufacturer, operates a high-volume dyeing and finishing plant. To meet its commitment to reduce carbon emissions by 40% by 2030, the company is evaluating the replacement of its current industrial boiler system.

The current standard boiler was purchased 4 years ago. On January 1, 2026, management is considering replacing it with an efficient eco-electric boiler. The new machine uses significantly less energy and qualifies for Green Energy tax credits.

Related information is summarized as below:

	Old Machine (Standard)	New Machine (Eco-Electric)
Initial purchase cost	$400,000	$650,000
Original useful life	10 Years	6 Years
Remaining useful life (Jan 1, 2026)	6 Years	6 Years
Current book value (Jan 1, 2026)	$240,000	N/A
Current market value (Jan 1, 2026)	$120,000	N/A
Expected annual energy costs	$180,000	$70,000
Annual maintenance costs	$45,000	$30,000
Terminal disposal value	$20,000	$80,000
Depreciation method (Tax purposes)	Straight-line	Straight-line

GreenTextiles is subject to a 30% income tax rate and utilizes an after-tax required rate of return (WACC) of 12%. The eco-electric machine qualifies for a sustainability bonus, consisting of a one-time $50,000 green investment tax credit, deducted directly from taxes owed, in the year of purchase. Assume all cash flows occur at year-end, except for the initial investment. Any gains or losses on the disposal of assets are treated as ordinary tax items

Required: Compute net present value (NPV) to decide whether GreenTextiles should replace the old standard machine with the new eco-electric machine **(10%)**.

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