Name:

**Question 1 (9 marks)**

A car dealer wants to forecast quarterly sales for each quarter of 2022, based on the data shown below:

| Year | Quarter | Sales | | | |
|---|---|---|---|---|---|
| 2018 | 1 | 225 | | | |
| | 2 | 272 | | | |
| | 3 | 233 | | | |
| | 4 | 372 | | | |
| 2019 | 1 | 215 | | | |
| | 2 | 260 | | | |
| | 3 | 220 | | | |
| | 4 | 358 | | | |
| 2020 | 1 | 210 | | | |
| | 2 | 252 | | | |
| | 3 | 212 | | | |
| | 4 | 360 | | | |
| 2021 | 1 | 200 | | | |
| | 2 | 250 | | | |
| | 3 | 210 | | | |
| | 4 | 340 | | | |

a. Determine quarterly seasonal relatives using the centered moving average method.

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b. Deseasonalize the sales.

| Year | Quarter | Sales | |
|---|---|---|---|
| 2018 | 1 | 225 | |
| | 2 | 272 | |
| | 3 | 233 | |
| | 4 | 372 | |
| 2019 | 1 | 215 | |
| | 2 | 260 | |
| | 3 | 220 | |
| | 4 | 358 | |

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**Question 2 (8 marks)**

The following data are quarterly sales of engine oil (in thousands of gallons) in the Montreal region.

| Year | Q1 | Q2 | Q3 | Q4 |
|---|---|---|---|---|
| **2018** | 11.5 | 19.2 | 17.4 | 12.7 |
| **2019** | 11.9 | 15.1 | 17.4 | 12.1 |
| **2020** | 10.6 | 19.1 | 13.9 | 11.5 |
| **2021** | 10.2 | 6.2 | 5.6 | |

The CMA method provided the following seasonal relatives:

| Quarter | Q1 | Q2 | Q3 | Q4 |
|---|---|---|---|---|
| **Seasonal relative** | 0.858 | 1.184 | 1.098 | 0.860 |

The linear trend is observed and the following linear trend equation is obtained based on the deseasonalized data:

$$Y_t = 17.2 - 0.535\, t$$

Extend the model to forecast the sales of engine oil in 2022.

Name:

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**Question 3 (9 marks)**

A medical supply distributor imports N95 masks from a supplier in Asia. The monthly demand is stable and is 120,000 boxes per month. A box costs $7 including shipping but placing an order costs $450. Holding cost is $1.2 per box per year.

The distributor can also produce the masks in her warehouse – up to 200,000 boxes per month. The manufacturing cost per box is $5.0 and the inventory holding cost is $0.72 per box per year. Production setup cost is $800 per production run. Currently, the warehouse has a capacity to accommodate a maximum of 10,000 boxes in the inventory; however, the warehouse can easily extend this capacity to 80,000 boxes (by leasing another warehouse) at a cost of $1,200 per year. Propose the most economical recommendation with justification.

Name:

Name:

**Question 4 (7 marks)**

A store sells 1000 tennis balls every three months. Currently store orders 2000 units each time an order is placed. At this order quantity, store can buy the tennis balls at $0.60 per unit. It costs $50 to place an order and the annual inventory-carrying cost is estimated to be 25 percent of the purchasing cost. The quantity discounts offered by the supplier are listed below:

| Order Quantity | Discount |
|---|---|
| **Up to 750** | **-** |
| **751 -1500** | **10%** |
| **1500 or more** | **20%** |

Review the current ordering policy and recommend a new policy if needed. *Report total costs for the current policy as well as for the recommended policy – if applicable.*

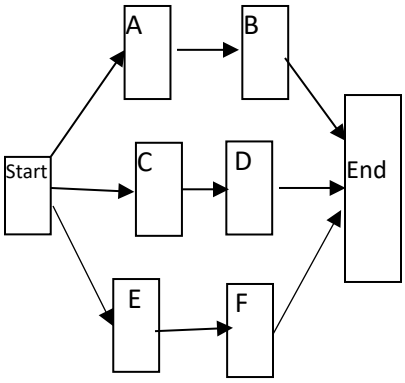
Name:

Name:

**Question 5 (8 marks)**

The following project has three independent paths as shown in the project network diagram. The deadline to complete this project is 46 days.

| Activity | Optimistic Time (days) | Most Likely Time (days) | Pessimistic Time (days) | Expected Time (days) | Variance of Activity |
|---|---|---|---|---|---|
| A | 10 | 16 | 28 | | |
| B | 20 | 28 | 42 | | |
| C | 18 | 30 | 42 | | |
| D | 15 | 15 | 15 | | |
| E | 1 | 2 | 3 | | |
| F | 42 | 45 | 48 | | |




a) What is the probability that this project will be delayed?

b) What is the probability that activity F alone will take between 44 and 46 days?

Name:

**Question 6 (9 marks)**

A project manager has compiled a list of major activities that will be required to install a new computer system. The duration of each activity can be reduced by a maximum of two weeks. The crashing cost for each week is provided in the table below:

| | | | Crashing Costs | |
|---|---|---|---|---|
| **Activity** | **Immediate predecessor(s)** | **Normal Duration (weeks)** | **1st Week** | **2nd Week** |
| **A** | - | 5 | $8 | $15 |
| **B** | A | 6 | 7 | 22 |
| **C** | B, E | 3 | 17 | 25 |
| **D** | - | 3 | 9 | 21 |
| **E** | D | 7 | 8 | 8 |
| **F** | - | 5 | 10 | 21 |
| **G** | F | 5 | 15 | 23 |
| **H** | E, G | 5 | 12 | 24 |
| **End** | C, H | | | |

**a)** Determine the minimum-cost crashing if the goal is to shorten the project by three weeks.

Name:

Name:

**b)** Assume the project manager **does not want to crash more than two activities**. Which activity will you pick in order to reduce the project duration as much as possible (in the most economical way)? Compute the new project duration and crashing cost.

Name: