

# Exam CFESDM

**Date:** Wednesday, April 28, 2021

## INSTRUCTIONS TO CANDIDATES

### General Instructions

1. This examination has 6 questions numbered 1 through 6 with a total of 100 points.

The points for each question are indicated at the beginning of the question. All questions pertain to the Case Study.

2. While every attempt is made to avoid defective questions, sometimes they do occur. If you believe a question is defective, the supervisor or proctor cannot give you any guidance beyond the instructions provided in this document.

### Written-Answer Instructions

1. Each question part or subpart should be answered either in the Word document or the Excel file as directed. Graders will only look at work in the indicated file.
  - a) In the Word document, answers should be entered in the box marked ANSWER. The box will expand as lines of text are added. There is no need to use special characters or subscripts (though they may be used). For example,  $\beta_1$  can be typed as beta\_1 (and ^ used to indicate a superscript).
  - b) In the Excel document formulas should be entered. Performing calculations on scratch paper or with a calculator and then entering the answer in the cell will not earn full credit. Formatting of cells or rounding is not required for credit.
  - c) Individual exams may provide additional directions that apply throughout the exam or to individual items.
2. The answer should be confined to the question as set.
3. Prior to uploading your Word and Excel files, each file should be saved and renamed with your five-digit candidate number in the filename.
4. The Word and Excel files that contain your answers must be uploaded before time expires.

*Recognized by the Canadian Institute of Actuaries.*

## Navigation Instructions

Open the Navigation Pane to jump to questions.

Press Ctrl+F, or click View > Navigation Pane:

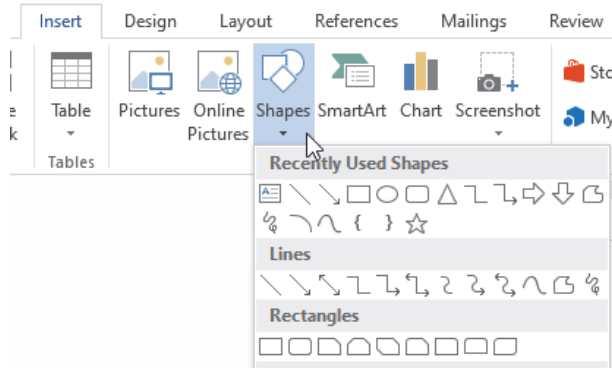


## **CASE STUDY INSTRUCTIONS**

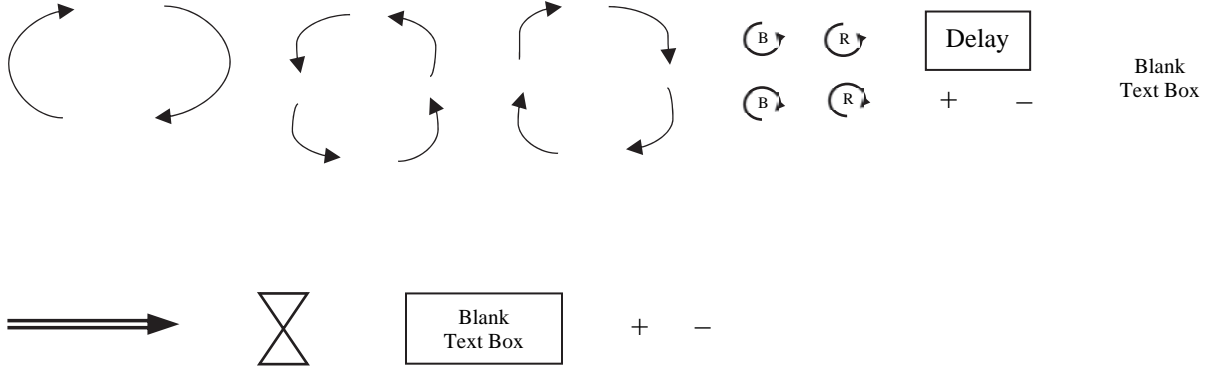
**The case study will be used as a basis for some examination questions. Be sure to answer the question asked by referring to the case study. For example, when asked for advantages of a particular plan design to a company referenced in the case study, your response should be limited to that company. Other advantages should not be listed, as they are extraneous to the question and will result in no additional credit. Further, if they conflict with the applicable advantages, no credit will be given.**

## Drawing Models in a CBT Setting

The following shapes are commonly used when modelling dynamic process and complex systems, such as those in *Business Dynamics* (Sterman, John D., 2000). Not all shapes may be needed, nor should this be considered an exhaustive list of possible shapes. Candidates may copy, paste, and manipulate shapes to answer questions where a sketch is required. For reference, candidates can also insert a variety of shapes using either Microsoft Excel or Microsoft Word under the insert menu:



*Selected shapes used in Business Dynamics:*



*Question 1 pertains to the Case Study.  
Each question should be answered independently.*

**1.**

(23 points)

- (a) (1.5 points) Describe the basic modes of behavior in dynamic systems.

ANSWER:

- (b) (1 point) List two benefits and one limitation of causal loop systems.

ANSWER:

Information on Blue Jay Air can be found in Section 2 of the case study.

- (c) John Feather wants to create a plan for BJA that would be followed in the event of a global pandemic. He plans to first model the expected spread of the disease using a few key assumptions:

- There will be a second wave: a rise of infections after they have initially diminished (i.e., after the first wave).
- Some infected individuals may die due to the pandemic.
- Those who recover may become infected again after a delay.

- (i) (3.5 points) Draw a stock and flow diagram to illustrate the relationship between the population, the infection rate, the recovery rate, and the death rate.

ANSWER:

- (ii) (0.5 points) Explain what the model predicts at the start of a wave.

ANSWER:

## 1. Continued

- (iii) (0.5 points) Explain what the model predicts near the end of a wave.

ANSWER:

- (iv) (1 point) Recommend a mode of behavior to model the cumulative number of cases in a given country from the start to the end of the first wave. Justify your answer.

ANSWER:

- (v) (1 point) Describe the shape of the curve used to model the cumulative number of cases in a given country from the start to end of the pandemic using the modes of behavior.

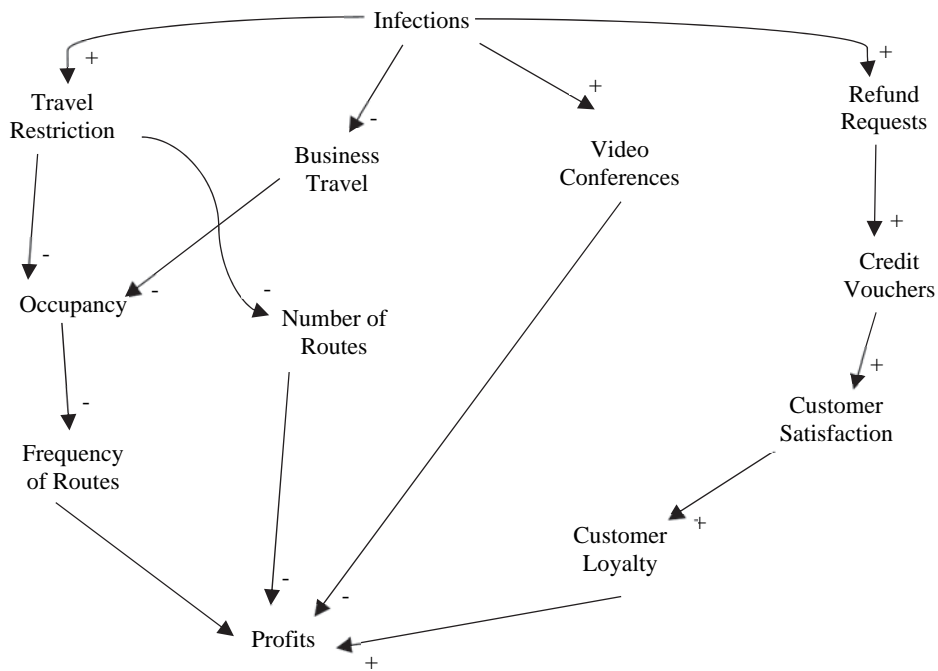
ANSWER:

# 1. Continued

John Feather makes the following assumptions about how the pandemic will affect demand for travel:

- Travel, regardless of reason or method, is expected to decrease. Blue Jay Air average flight occupancy (percent of seats available sold) will drop from 85% to 40%.
- Three US states where Blue Jay Air operates daily flights now require a 14-day quarantine for all incoming passengers.
- Blue Jay Air is required to take each passenger's temperature, give hand sanitizer and a mask to each passenger and flight crew member and disinfect the planes between each flight.
- There will be no action from competing airlines with respect to changing refund policies when customers cancel travel. BJA will also make no change.

John Feather prepared the causal loop system below, to illustrate the impact of a pandemic on BJA's profits, particularly with respect to business travel.



(d) (1 point) Identify two specific errors within the causal loop drafted by John.

ANSWER:

## 1. Continued

- (e) (2 points) Recommend two improvements, other than error correction, to the causal loop drafted by John. Justify your answer.

ANSWER:

- (f) (5 points) The following are three of Porter's Five Forces:

- A. Bargaining Power of Buyers
- B. Threat of Substitute Products
- C. Rivalry Among Existing Competitors

- (i) Identify where the global pandemic is represented in the Five Forces model.

ANSWER:

- (ii) Explain the effect of the global pandemic on each of the forces (A – C), with respect to BJA.

ANSWER:

- (iii) Critique the causal loop drafted by John, including his assumptions, with respect to consistency with each of the forces (A – C).

ANSWER:

John insists that in the event of a pandemic BJA would keep the current policy to offer a credit voucher valid for the next six months for cancellations. His objective is to minimize cash outflows from the company. The BJA board views this as a very conservative approach, and they would like another option to consider.

- (g) (2 points) Describe two biases exhibited by John Feather. Justify your answer.

ANSWER:



# 1. Continued

BJA is considering a different approach for customers cancelling travel in the event of a pandemic:

- Customers must first complete a survey about travelling after the pandemic. There are pictures of desirable travel locations embedded in the survey.
- Customers then choose between a cash refund or a voucher.
  - The cash refund is for 100% of the ticket price. Customers choosing this option will need to fill out a two-page form and mail it to BJA. It will take six to eight weeks to process.
  - The voucher is for 115% of the ticket price, but expires two years from the date of issue. No additional paper work is required and the voucher is immediately available to book future travel.
- An email communication will be sent out to customers to confirm the completed transaction, regardless of which option is chosen.

(h) (4 points)

(i) Explain the difference between System 1 and System 2 thinking.

ANSWER:

(ii) Explain how System 1 thinking is used in the proposed approach. Justify your answer.

ANSWER:

(iii) Explain how System 2 thinking is used in the proposed approach. Justify your answer.

ANSWER:

(iv) Explain an improvement to the proposed approach that could bypass both systems.

ANSWER:

**Question 2 pertains to the Case Study.  
Each question should be answered independently.**

**2.**

*(12 points)*

- (a) *(1.5 points)* Explain the difference between management science models and active management in the investment management industry with respect to each of the following:

- (i) Selection of assets

ANSWER:

- (ii) Consideration of risks

ANSWER:

Information on Darwin Life can be found in Section 7 of the Case Study.

- (b) *(3 points)* Describe two techniques of management science Darwin Life can use to assist with its business operations, specifically as it pertains to managing investments. Justify your answer.

ANSWER:

## 2. Continued

Darwin is considering making a change to its investment strategy. Funds would be invested in Bonds, Mortgages, and Alternatives.

Asset	Expected Rate of Return	Variance	Risk Rating	Avg Duration
Bonds	2.0%	0.25%	2	12
Mortgages	7.0%	9.0%	4	5
Alternatives	16.0%	25.0%	8	2

	Correlation Matrix		
Asset	Bonds	Mortgages	Alternatives
Bonds	1	0.5	-0.5
Mortgages	0.5	1	-0.25
Alternatives	-0.5	-0.25	1

- Risk-free rate of return is 0.0%.
  - Darwin's duration mismatch tolerance is 1.5 years. The duration of the underlying liabilities is 7.
  - The risk rating of the portfolio must be no more than 3.5.
  - Darwin must expect to earn a rate of return of at least 5%.
- (c) You have been asked to maximize the Sharpe ratio of the asset portfolio using only nonlinear optimization.

$$\text{Sharpe Ratio} := \frac{E[R_a - R_b]}{\sigma_a}$$

where...

- $R_a$  is the rate of return of the portfolio.
- $R_b$  is the risk-free rate of return.
- $\sigma_a$  is the standard deviation of the portfolio rate of return in excess of the risk-free rate of return.

- (i) (2 points) State the objective function.

ANSWER:
---------

## 2. Continued

- (ii) (2.5 points) State all of the unique constraints necessary to implement the above investment strategy.

ANSWER:

- (iii) (2 points) Compare and contrast linear optimization and nonlinear optimization as approaches for maximizing the Sharpe ratio.

ANSWER:

- (iv) (1 point) Propose an approach that uses the results of both linear optimization and nonlinear optimization to maximize the Sharpe ratio. Justify your answer.

ANSWER:

**Question 3 pertains to the Case Study.**  
**Each question should be answered independently.**

### 3.

(15 points) Information on Frenz can be found in Section 4 of the Case Study.

Some of the parts of this question require calculations and require you to show your work. If you are completing this work in a Microsoft Excel workbook, please include it as part of your submission.

The following information is given regarding Frenz' North American operations in 2020:

- Number of stores: 50
- Total Sales (\$000): 81,548
- Total Overhead (\$000): 8,826
- Overhead is allocated to each store following the approach detailed by Kitty Dunn.

X and Y are two stores located in North America. Sales information about these two stores are as follows:

Store	Coffee Sales (\$000)	Non-Coffee Sales (\$000)	Total Sales (\$000)
X	800	1,000	1,800
Y	1,000	500	1,500

Both stores have the following non-overhead expense metrics:

Type of Expense	
Cost of Sales	13% of total store sales
Store operating expenses	60% of total store sales
Depreciation	7% of total store sales
General and Administrative Expenses	1.5% of total store sales

(a) (2 points) Calculate the following values (i-iii) for each store, X and Y, using the existing overhead allocation method:

(i) 2020 Overhead allocation

ANSWER:

### 3. Continued

(ii) 2020 Pre-tax profit

ANSWER:

(iii) 2020 Pre-tax profit margin

ANSWER:

Show your work.

(b) (2 points) Calculate the following values (i-iii) for each store, X and Y, using the allocation method proposed by Jeff Bemowski, assuming overhead is shared equally by all stores:

(i) 2020 Overhead allocation

ANSWER:

(ii) 2020 Pre-tax profit

ANSWER:

(iii) 2020 Pre-tax profit margin

ANSWER:

Show your work.

(c) (3 points) Compare and contrast how Frenz' head office, Store X, and Store Y would perceive each of the two proposed overhead allocation methods. Justify your answer.

ANSWER:

### 3. Continued

Frenz has opened a new store, Z, in a new, competitive market. Initial sales targets for store Z are quite low compared to established stores, but Frenz' objective is to not make newer stores look like they are under-performing compared to existing stores.

(d) (2 points)

- (i) Explain whether an insulating or non-insulating allocation approach is better to achieve Frenz' objective. Justify your answer.

ANSWER:

- (ii) Recommend which of the two proposed overhead allocation methods should be used to meet Frenz' objective.

ANSWER:

Frenz is considering using different cost pools for new and existing stores to allocate overhead at a lower rate to new stores.

- (e) (2 points) Recommend whether or not a distinct cost pool is appropriate for new stores. Justify your answer.

ANSWER:

### 3. Continued

Decisions regarding overhead allocation are communicated to each store manager by Kitty. Each store manager will raise their concerns to Kitty directly.

(f) (2 points)

- (i) Identify the communication network model used to communicate decisions regarding overhead allocation.

ANSWER:

- (ii) Describe an organizational barrier to effective communication when using this model to communicate overhead allocation. Justify your answer.

ANSWER:

Frenz is considering introducing the loyalty rewards program described in Section 4.4 of the Case Study as part of its Digital Strategy.

(g) (2 points)

- (i) Describe two cognitive biases that may limit the success of the rewards program. Justify your answer.

ANSWER:

- (ii) Recommend actions Frenz can take to combat each bias described in (i). Justify your answer.

ANSWER:



*Question 4 pertains to the Case Study.  
Each question should be answered independently.*

**4.**

(10 points) Information on Frenz can be found in Section 4 of the Case Study.

Some of the parts of this question require calculations and require you to show your work. If you are completing this work in a Microsoft Excel workbook, please include it as part of your submission.

Frenz would like to enter into a vertical complementary alliance with a popular coffee bean producer as its primary bean supplier. The alliance would require the supplier to have a dedicated facility for Frenz's beans.

The supplier's preliminary analysis indicates the following:

- The supplier's marginal monthly production costs for a dedicated facility is \$25,000.
- The supplier will produce 1,000 units of coffee beans per month.
- Frenz's demand for beans is 750 units per month. They have negotiated a discounted fixed price of \$30/unit with the supplier. The supplier will sell surplus coffee bean production to other commodity markets.
- The monthly demand for coffee beans by other commodity markets is uncertain and follows the discrete probability distribution in the table below:

<b>Demand for Surplus Coffee Beans (units per month)</b>	<b>Probability</b>
0	0.5
250	0.3
500	0.2

- The supplier is able to vacuum pack any unsold beans so they can be sold in a future period. There is no additional inventory cost for storing unsold beans.
- The market price for coffee beans for any given month follows a Normal distribution with mean of \$35/unit and standard deviation of \$10/unit.

#### 4. Continued

The supplier wants to simulate earnings projections over the next 10 months. You are given one set of random uniform numbers and one set of Standard Normal random variables (Z):

Month	Random Number Set 1 (Market Demand for Coffee Beans)	Z, Standard Normal random variable (Market Price of Coffee Beans)
1	0.65	-1.00
2	0.25	0.75
3	0.15	0.00
4	0.85	-1.50
5	0.75	1.00
6	0.95	2.00
7	0.55	-1.75
8	0.45	0.25
9	0.05	-0.75
10	0.35	-0.50

(a) (6 points)

- (i) Design a model to project the supplier's earnings from the dedicated facility.

ANSWER:

- (ii) Calculate projected earnings over the next 10 months using the random numbers provided. Show your work.

ANSWER:

(b) (2 points) Recommend two metrics the bean producer could use to evaluate earnings risk from the dedicated facility. Justify your answer.

ANSWER:

(c) (2 points) Describe two considerations as to whether or not Frenz should proceed with the alliance. Justify your answer.

ANSWER:

**Question 5 pertains to the Case Study.**  
**Each question should be answered independently.**

**5.**

(21 points) Information on Frenz can be found in section 4 of the case study.

Some of the parts of this question require calculations and require you to show your work. If you are completing this work in a Microsoft Excel workbook, please include it as part of your submission.

XYZ is a European-based company that owns restaurant chains operating across Europe and the Americas. A survey revealed that the company's coffee offerings are consistently rated as poor in all markets. XYZ is considering acquiring a coffee chain to replace its existing in-restaurant coffee offerings. King Coffee and Frenz are both being considered. You are an analyst working at XYZ.

- (a) (1.5 points) Compare and contrast discounted cash flow valuation and relative valuation.

ANSWER:

- (b) (1.5 points) Calculate the Price-to-Book Equity multiple for Frenz at the end of 2018, 2019 and 2020. Show your work.

ANSWER:

Another analyst at XYZ has been asked to quickly determine whether or not Frenz is over-valued. They plan to compare the Price-to-Book Equity metrics you just calculated against the average Price-to-Book Equity for the entire restaurant industry in 2015.

- (c) (1 point) Describe two shortfalls of the approach the analyst at XYZ plans to use.

ANSWER:

## 5. Continued

(d) (2 points)

- (i) Explain why XYZ should use value multiples rather than equity multiples to value an acquisition target in general.

ANSWER:

- (ii) Explain why XYZ should use value multiples rather than equity multiples to value Frenz specifically, in addition to the points from (i).

ANSWER:

Assume the market value of Frenz's debt is equal to the book value of Frenz's debt.

(e) (2 points)

- (i) Calculate Frenz's 2020 Firm Value.

ANSWER:

- (ii) Calculate Frenz's 2020 Enterprise Value (EV).

ANSWER:

- (iii) Calculate Frenz's 2020 EV / EBIT ratio.

ANSWER:

Show your work.

## 5. Continued

The EV / EBIT ratio for King Coffee at the end of 2020 is 25.8. Your colleague remarks “this ratio is all we need to look at to be sure that Frenz is undervalued compared to King Coffee”.

- (f) (3 points) Critique your colleague’s statement.

ANSWER:

XYZ is looking for alternatives to acquiring an existing firm. Food services is considered a Standard-Cycle market.

- (g) (4 points)

- (i) (2 points) Compare and contrast reasons for acquisition versus reasons to form a strategic alliance in a Standard-Cycle market.

ANSWER:

- (ii) (2 points) Recommend if XYZ should pursue an acquisition or an alliance to achieve its objective. Justify your answer.

ANSWER:

## 5. Continued

Your colleague overheard XYZ's CEO say that any company meeting all criteria for either acquisition or an alliance will be contacted by XYZ. Your colleague concluded that since neither King nor Frenz meets all of the criteria for either acquisition or an alliance, then neither will be contacted by XYZ.

(h) (3 points)

(i) (1 point) Define deductive reasoning.

ANSWER:

(ii) (2 points) Explain the fallacy in your colleague's statement.

ANSWER:

Through your analysis of the premium coffee segment, you believe there is a risk that there will not be sufficient supply of premium coffee beans to support demand.

(i) (3 points)

(i) (1 point) Define inductive reasoning.

ANSWER:

(ii) (2 points) Sketch an inductive argument to communicate your concern with at least three supporting ideas.

ANSWER:

**Question 6 pertains to the Case Study.**  
**Each question should be answered independently.**

**6.**

(19 points) Information on Blue Jay Tire (BJT) can be found in section 3 of the case study.

Some of the parts of this question require calculations and require you to show your work. If you are completing this work in a Microsoft Excel workbook, please include it as part of your submission.

CCC Tire Stores order tires from BJT. You are given the following information about one CCC Tire Store.

	Tires sold per week	Desired inventory	Current inventory	Inventory adjustment time
RU42WR	280	940	800	5 days
RU42WD	130	200	250	5 days

Following are four reasons why stocks are critical in generating a dynamic system:

- I. Stocks characterize the state of the system and provide the basis for action.
- II. Stocks provide systems with inertia and memory.
- III. Stocks are the source of delays.
- IV. Stocks decouple rates of flow and create a disequilibrium dynamic.

- (a) (2 points) Explain CCC Tire Stores' stock structure based on the four reasons above (I – IV).

ANSWER:

- (b) (2 points) Calculate CCC's acquisition rate for RU42WR and RU42WD assuming there is no time delay. Show your work.

ANSWER:

## 6. Continued

CCC Tire Stores has opened a new store outside of Arizona. The new store is far from BJT's warehouse, so a delay between order and acquisition is expected. The new store's co-managers, Abby and Benny, want to investigate how the existence of a supply line of unfilled orders will affect their stock structure.

- (c) (0.5 points) State the purpose of a supply chain.

ANSWER:

Abby and Benny collect the following information to model the supply chain:

	Storage cost (per tire per day)	Net profit (per tire)	Expected acquisition lag	Supply line adjustment time	Number of tires on order
RU42WR	\$2	\$35	3 days	5 days	400
RU42WD	\$1	\$40	3 days	5 days	50

Abby says: "We should consider the expected acquisition lag and the desired acquisition rate in our calculation."

Benny says: "Desired acquisition rate? Lag? What? Those sound too difficult to determine! Let's just use the rule of thumb and use the average number of tires sold per week instead."

- (d) (3.5 points)
- (i) (1.5 points) Explain why Benny's rule of thumb method is suboptimal in this case.

ANSWER:

- (ii) (2 points) Calculate the order rates for RU42WR and RU42WD using Abby's approach. Show your work.

ANSWER:



## 6. Continued

Abby and Benny are considering a new supplier, Red Finch Tire (RFT). RFT is a nationwide tire manufacturer with warehouses in many cities. RFT produces two types of tires, FT1 and FT2, which are close substitutes for RU42WR and RU42WD respectively. The following is information about RFT:

	Storage cost (per tire per day)	Net profit (per tire)	Expected acquisition lag	Supply line adjustment time
FT1	\$2	\$30	1 day	7 days
FT2	\$1	\$40	1 day	5 days

CCC is considering using the new store as a pilot model for all stores.

(e) (3 points)

- (i) (1 point) Compare the bargaining power of CCC (as a buyer) with respect to BJT and RFT.

ANSWER:

- (ii) (2 points) Recommend whether the new CCC store should switch its supplier under each of the following scenarios (A – D). Justify your answers.

- A. Customer demand is forecasted to be more volatile in the next three years.
- B. The new store invests in a larger warehouse, and halves its storage cost per tire.
- C. The new store implements a pre-order service where customers order tires online every Monday and the tire will be guaranteed for customer pick-up the next day.
- D. CCC rebrands itself as a tire wholesaler.

ANSWER:

## 6. Continued

Abby and Benny share their analysis of RFT with BJT leadership, who then shares it with the BJT-USA leadership team. The BJT-USA leadership team is angered by the news that they may sell fewer tires to CCC.

(f) (5 points)

- (i) (2 points) Describe two structural factors that contribute to conflict between CCC and BJT-USA. Justify your answer.

ANSWER:

BJT Leadership directs CCC to destroy the analysis and continue using BJT-USA as the sole supplier or the new store will be closed.

- (ii) (1 point) Explain the type of power used by BJT Leadership.

ANSWER:

- (iii) (2 points) Recommend a political tactic that could be used by Abby and Benny in response to BJT Leadership's decision. Justify your answer.

ANSWER:

## 6. Continued

Tire production is a non-specialized manufacturing process and is an oligopoly with 80% of the market share controlled by BJT and RFT. However, distribution of tires is quite fragmented with many small to large shops selling them in large volumes. CCC is considering purchasing a small tire producer to replace its existing tire supplier.

(g) (3 points)

- (i) Evaluate the tire industry with respect to exposure to vertical market failure.

ANSWER:

- (ii) Recommend whether or not CCC should purchase the small tire producer. Justify your answer.

ANSWER:

**\*\*END OF EXAMINATION\*\***