Answer **all** questions.

Question 1: The Nitrogen Fertilizers Crisis

Table 1: Employment and consumption data on fertilisers

	2015	2016	2017	2018	2019
Number of workers employed in US fertilizers industry	19 133	19 580	20 058	20 837	22 179
Fertilizers consumed in US (in million tons)	22.46	23.14	23.44	21.68	22.40
Fertilizers consumed globally (in million tons)	213.27	215.13	217.42	213.77	215.37

Sources: IBISWorld *and ourworldindata.org*

Extract 1: The US fertilizer production industry

Fertilizers are critical input for crop production and represent a major variable cost for several US crops. Farmers represent the end users in the fertilizers' supply chain, and the prices they pay for fertilizers depend on several factors including local demand, product type, retailer mark-ups, and transportation costs.

The US fertilizers sector has undergone substantial changes. Between the 1980s and mid-2000s, the combination of lower fertilizers demand and higher input costs for fertilizers production caused the fertilizers sector to contract from 59 to 22 production facilities. The assumption is that highly concentrated industries are synonymous with market power, which can be detrimental to the society. Whether that will happen in reality rely on many factors, one of which is the level of government regulation in the fertilizers market.

Source: Choices and the Agricultural & Applied Economics Association*, 2020*

Extract 2: USDA announces plan to support US farmers

The US Department of Agriculture (USDA) will support American farmers by increasing the fertilizers production so as to address its rising costs. It is offering a $250 million new grant to encourage greater production of fertilizers.

Additionally, to address growing competition concerns in the agricultural supply chain, USDA will launch a public inquiry, seeking information regarding agricultural fertilizers and the impact of concentration and market power on agriculture farmers. The inquiry aims to enhance fairness and competition across America's economy.

"Concentrated market structures and potentially anti-competitive practices leave America's farmers, businesses, and consumers facing higher costs, fewer choices and less control about where to buy and sell, and reduced innovation—ultimately making it harder for those who grow our food to survive," said Agriculture Secretary of the United States.

Source: US Department of Agriculture*, 11 March 2022*

Extract 3: Fertilizer costs: what is driving the increase?

Significant increase in the cost of fertilizers over the past year has caused a lot of concern among farmers in the United States. Given that the cost of fertilizers now account for approximately 15-20% of total costs for corn production, fertilizer prices and its availability are a major concern for farmers planning for the 2022 growing season. Farmers in some areas are reporting prices more than 300% higher than last winter, and delivery times seems to be anyone's guess. The price increase was driven by strong domestic and global demand for crops, low fertilizers inventories, and very slow adjustments in production by the US fertilizers industry.

As fertilizers are global commodity, its prices can be influenced by various market factors beyond the control of US producers. Countries that import fertilisers are also exporters of the raw materials needed to produce these fertilisers. Hence, this means that fertilizers prices are more volatile as it is subjected to both the cost of factor inputs as well as the production costs of the country producing it. Another factor is that two-thirds of global fertilizers demand is driven primarily by the production of crops, of which corn, wheat, and soybeans constitute about 36% of that total demand. So, as large producers of corn, soybeans, and wheat, the US is a large consumer of fertilizers.

Trades disputes and disruptions have also played a big role in fertilizers availability and cost. The US have restricted imports of selected factor inputs such as potash from Belarus. Potash is an essential raw material used to produce fertilisers, and Belarus is a country which contributes to about 20% of the global production of potash. The uncertainty of Russian actions against Ukraine creates further volatility since Russia is also one of the top global exporters of all three fertilizers raw materials — nitrogen, phosphate, and potash.

Price of fertilizers in the US can also be influenced by internal factors such as increased domestic transport costs due to labour shortages in the freight industry which the fertilizers industry relies on for transportation. Domestic weather conditions like hurricanes, ice storms, as well as infrastructure breakdowns, have caused several production and distribution disruptions.

Source: Institute of Agriculture and Natural Resources*, 8 February 2022*

Question 1: The Nitrogen Fertilizers Crisis

Suggested Mark Scheme:

(a) With reference to Table 1, identify the difference in the trend of number of workers employed in the US fertilizers industry and the consumption of fertilizers in the US from 2016 to 2019. State one possible reason for the difference. [2]

Suggested Response:

- From 2016 to 2019, number of workers employed is generally increasing while the consumption of fertilizer in the US was decreasing [1m]
- The increase in number of workers employed could be a result of US requiring more factor inputs to producing a larger share for export to the global market although domestic demand for fertilizer was decreasing [1m]

Mark Scheme:
1 difference in the trend of the two stated variables – 1m
1 reason to account for the difference – 1m

(b) (i) With reference to Extract 1, explain how the lower demand for fertilizers and higher input costs could cause firms to exit the US fertilizers industry. [4]

Suggested Response:

- A fall in demand results in a fall in the market price. The existing firms in the fertilizer industry would have to charge a lower price than before. As such, existing firms' average revenue (AR) would fall.
- A higher input costs implies that a firm's average costs (AC) would increase
- In the long run, the firm's AR could be lower than its AC. Firms exit the industry because of earning subnormal profit

Alternative response

- A fall in demand results in a fall in the market price. The existing firms in the fertilizer industry would have to charge a lower price than before. As such, existing firms' average revenue (AR) would fall.
- A higher input costs implies that a firm's average variable costs (AVC) would increase
- In the short run, a firm is unable to cover fixed costs and part of their variable costs if AR < AVC (or total revenue < total variable costs). Firms would then choose to shut down to minimize losses.

Mark Scheme:
Explain impact on average revenue – 1m
Explain impact on AC – 1m
Explain exit/shutdown decision – 2m

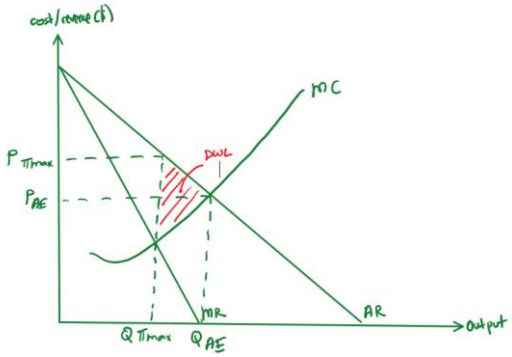
(ii) Explain how market dominance could lead to an inefficient allocation of resources in the US fertilizers market. [6]

Suggested Response:

- Efficient allocation of resources is achieved where MB = MC i.e. P = MC given that price reflects MB. Therefore, social welfare is maximised if the firm produce the good up to Q_{AE} where P = MC.
- However, market dominance implies that a firm is a price setter i.e. the firm has the power to set price by restricting output. For example, a profit maximizing firm would

produce up $Q_{\pi max}$ where MC = MR. At this point, the profit maximizing price $P_{\pi max}$ is greater than MC.

- Society incurs a deadweight loss as a result of the firm not producing the amount $Q_{\pi max}$ to Q_{AE}. This is because the marginal benefit to society is larger than the marginal cost to society of producing additional unts of fertilizer from $Q_{\pi max}$ to Q_{AE}
- Therefore, market dominance could lead to inefficient allocation of resources in the US fertilizers market.



Mark Scheme:

Knowledge, Application, Understanding, Analysis		
L2	• Accurate and clear explanation of inefficient allocation of resources arising from market dominance • An analytical response that can: ○ Establish point of allocative efficiency ○ Explain why a firm with market power can deviate from allocative efficiency ○ Explain implications of deviating away from allocative efficiency	**4 - 6**
L1	• Smattering of points • Several concept flaws	**1 – 3**

(c) Discuss how improving the level of competition in the US market for fertilizers can affect dynamic efficiency. [8]

Suggested Response:

Body Paragraph 1/Requirement 1: Improve dynamic efficiency

- Improving the level of competition would increase the threat of competition
- The profits of incumbent firms may be eroded by the entry of new firms
- Assuming profit-maximising objective, incumbent firms may attempt to safeguard their profits by becoming less complacent and working towards dynamic efficiency.
- Firms may engage in both product and process innovation
- Product innovation allows a firm to experience an increase in AR
- Process innovation allows a firm to experience a fall in AC
- An increase in AR and a fall in AC would help the firm to retain its profits in light of competition.

Body Paragraph 2/Requirement 2: Does not improve dynamic efficiency

- Improve the level of competition would result in a fall in level of profit

- The average revenue of firms would fall as the market share is split among many more firms
- Moreover, the fall in output by each individual firm would mean that the firms may not be able to exploit internal economies of scale as much as before; thus a firm's average cost would increase.
- Consequently, AR falls while AC increases; thus, profit falls.
- The fall in profits reduces a firm's capacity to engage in product and process innovation.

Conclusion:

- The overall impact on dynamic efficiency depends on how the government intends to improve the level of competition in the US market for fertilizers. The government may choose to promote competition by financially supporting innovative practices. Such a policy would minimize the concern of how a loss of market share could reduce a firm's capacity to be dynamic efficient. However, if the government promote competition by simply deregulating the market; then firms may be less able to engage in process and product innovation although they may be less complacent.

Knowledge, Application, Understanding, Analysis		

L2	• Breadth
	  ○ Explains how dynamic efficiency may and may not be achieved
	• Depth
	  ○ Rigorous and relevant economic analysis used in explanation
		4 - 6

L1	• Smattering of points • Several concept flaws	**1 – 3**

Evaluation		
E2	• For an answer that builds on appropriate analysis to evaluate critically and arrives at well reasoning judgements and/or decisions	**2**
E1	• Unsupported evaluative statement(s) • Unsubstantiated / generic conclusion • Statements supported with very weak/incorrect/unrealistic/illogical reasoning (therefore making the judgement unconvincing)	**1**

(d) Discuss whether demand or supply factors have a greater impact on the price of fertilizers in the US. [10]

Suggested Response

Body Paragraph 2/Requirement 2: Impact of supply factor on price of fertilizers

- **Fall in supply of fertiliser** could explain why price of fertilizer in the US is high
- Based on Extract 3, the US have restricted imports of potash – a factor input of fertilizer. This creates a shortage of potash thus exerting an upward pressure on price of potash. Moreover, the price of transportation has also increased Consequently, the **cost of producing fertilizer would increase**.
- With that, suppliers are willing and able to sell fewer units of fertilisers. As such, **supply of fertilizer falls.**
- The fall in supply of fertilizer arising from both domestic and foreign factors would create a **large shortage** at the original price. The shortage exerts an upward

pressure on price. Given the large shortage, a **large increase in price is required to sufficiently reduce quantity demanded and increase quantity supply.**
- As such, fall in supply of fertilizer results in **a large increase** in price of fertilizers in the US.

Body Paragraph 1/Requirement 1: Impact of demand factor on price of fertilizers
- **Strong demand for fertilizers** could explain why price of fertilizers in the US is high
- Based on Extract 3, the US is a major producer of agricultural products such as corn, soybeans, and wheat. Such agricultural products rely heavily on fertilizer.
- **Higher demand results in higher market equilibrium price**. This is because consumers of fertilizers are willing and able to pay a much high price for each unit of fertilizers demanded.
- Moreover, the **demand for fertilizer is likely to be price inelastic** given that it is a necessity for producing agricultural goods.
- Consequently, the previously mentioned fall in supply would result in a large increase in price. This is because an increase in price would result in a less than proportionate decrease in quantity demanded. Therefore, a large increase in price is required to clear the abovementioned shortage arising from the fall in supply.
- As such, the strong demand for fertilizers coupled with demand that is price inelastic could explain the **high price of fertilizer in the US.**

Conclusion:
- Based on the above analysis, it is likely that supply factors have a greater impact on the price of fertilizers in the US.
- This is because the US agricultural sector have been one of its engines of economic growth thus the high domestic demand for fertilizer is perpetual and would not have resulted in any significant increase in price i.e. price have been and would remain high.
- However, the fall in supply of fertilizers as described in Extract 3 is unprecedented – at least in recent history. As such, the fall in supply exacerbates any shortage that could have persisted due to high demand. Moreover, the fall in supply is also severe as it stems from multiple causes that are also evolving. As such, the shortage is not only likely to be large, but it could also be growing. Consequently, a sharp increase in price is required to sufficiently reduce quantity demanded and an increase in quantity supplied.

A+A 7
- Explain price adjustment process
- **AND** Explain how PED and PES affects extent of change in price

A+C 6
- Explains price adjustment process well but did not use PED and PES
- **OR** explains PED AND PES well but not price adjustment process (although this combi is quite impossible to write)

C+C or A 5
- Explains dd factor and supply factor without price adjustment process
- Explains PED/PES concepts without link to how price is affected

C 4

Knowledge, Application, Understanding, Analysis		
L3	• Breadth	**5 – 7**

	○ Explains how demand and supply factors affect price of fertilizer ○ Considers PED and/or PES as part of demand and/or supply factor • Depth ○ Rigorous and relevant economic analysis used in explanation	
L2	• Lacking any L3 criterion	**3 – 4**
L1	• Smattering of points • Several concept flaws	**1 – 2**

Evaluation		
E2	• For an answer that builds on appropriate analysis to evaluate critically and arrives at well reasoning judgements and/or decisions	**2-3**
E1	• Unsupported evaluative statement(s) • Unsubstantiated / generic conclusion • Statements supported with very weak/incorrect/unrealistic/illogical reasoning (therefore making the judgement unconvincing)	**1**

[Total: 30]