## Suggested Answers



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| **(a)** | **Using examples from extract 1, distinguish between complements in demand and derived demand.** | **[2]** |
| ***Skills:**** *Identify examples from Extract 1 that shows complement in demand and derived demand.*
* *Explain the difference between complement in demand and derived demand.*
* **Lithium-ion batteries and electric vehicles are complements in demand** as lithium-ion battery is needed to run (used in conjunction/together) the electric vehicles
* On the other hand, **the demand for cobalt is derived from the demand for lithium-ion battery**

as cobalt is needed to manufacture (used as an input to produce) lithium-ion battery. |
| **(b)** | **With reference to Extract 1, and using a supply and demand diagram, account for the sharp increase in the global price of cobalt between 2016 and 2018.** | **[4]** |
| ***Skills:**** *Identify a factor from extract 1 that has resulted in the increase in global price of cobalt.*
* *Explain that the increase in price is caused by an increase in demand and the magnitude of increase is influenced by the price elasticity of supply.*
	+ The increase in price of cobalt is due to an **increase in demand** as there has been an increase in the use of electric vehicles which requires cobalt in the manufacturing of lithium-ion batteries to power electric vehicles.
	+ This resulted in a **rightward shift of the demand curve**  **shortage** of cobalt at the original equilibrium price  **upward pressure on price**  price increase.
	+ The sharp increase in price is due to the **supply of cobalt being price inelastic** as it takes time to mine the cobalt and most of the world’s reserves and production of cobalt are in one country, the Democratic Republic of Congo (extract 1)  producers cannot respond to the price increase quickly and thus will increase price sharply to eliminate the shortage.

Price SS1P2 P1DD1 DD2Q1 Q2 Quantity of cobalt  |

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| **(c)** | **Explain a factor that could be responsible for the trend in the global price of lithium- ion battery shown in Figure 2.** | **[3]** |
| ***Skills:**** *Identify the trend in the global price of lithium-ion battery in figure 2.*
* *Explain the price change using demand and supply concepts.*
	+ The global price of lithium-ion battery has been **decreasing** as shown in figure 2.
	+ Since the demand for electric vehicles has been increasing, which will increase the demand for lithium-ion battery and hence its price, **the fall in global price of lithium-ion battery can be attributed to a larger increase in supply**. (increase in SS > increase in DD).
	+ The increase in supply could be caused by lowering cost of production due to technology improvement, scale expansion or increase in number of lithium-ion battery manufacturers.
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| **(d)** | **Consider whether an expansion in the supply of cobalt by the mining companies will increase their total revenue.** | **[5]** |
| ***Skills:**** *Explaining the impact on an increase in supply on total revenue*
* *Explaining how the impact on total revenue is dependent on the price elasticity of demand and the strength of demand as well.*
* An expansion in the supply of cobalt by the mining companies will shift the supply curve to the right, resulting in a surplus and downward pressure on price, assuming demand is constant  **equilibrium price will fall and equilibrium quantity will increase.**
* The impact on total revenue is **dependent on the magnitude of change in price and quantity**

since total revenue is given by price multiplied with quantity. This can be determined using the concept of **price elasticity of demand**. |

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| * The **demand for cobalt is price inelastic** as there is a lack of strong substitute (extract 1)  the decrease in price will lead to a less than proportionate increase in quantity demanded  **total revenue will fall.**
* However, the **demand for cobalt is expected to increase** as demand for electric vehicle increases (extract 1) due to changing taste and preference. An increase in demand will push equilibrium quantity and price to rise, leading to an **increase in total revenue**.
* Therefore, whether the expansion in the supply of cobalt will increase the total revenue of mining companies depends on the extent of the increase in demand for cobalt in the future and the price elasticity of demand for cobalt as demand may become price elastic if a stronger substitute could be found.
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| **(e)** | **Explain whether electric vehicle is a public good.** | **[4]** |
| ***Skills:**** *Explain the characteristics of a public good and justify whether electric vehicle has those characteristics.*
* A public good will display the characteristics of **non-rivalry in consumption and non- excludability.**
* Non-excludability: Once the good is provided, it is difficult or impossible to exclude non-payers from consuming the good.
* **Application to electric vehicle**: However, the usage of electric vehicle is excludable  A non- paying individual is easily denied the usage of the electric vehicle entry if he/she has not made the necessary payment.
* Non-rivalrous in consumption: The consumption of the good for an additional user will not diminish the quantity or satisfaction of existing users consuming the good.
* **Application to electric vehicle**: However, the consumption of electric vehicle is rivalrous  there is a maximum seating capacity in an electric vehicle.
* Thus, electric vehicle **does not display BOTH characteristics of a public good** and hence it is a private good.
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| **(f)** | **Explain the market failure resulting from the usage of diesel-powered cars.** | **[6]** |
| ***Skills:**** *Explain what is meant by market failure*
* *Explain how the use of diesel-powered cars generates negative externality, leading to deadweight loss in the society.*

**Identifying the sources of market failure in the market for diesel-powered cars*** + The usage of diesel-powered cars **generates negative externalities** as it emits harmful pollutant such as nitrogen oxide and thus **pollutes the air** (extract 2).
	+ As other vehicles, the use of diesel-powered cars generates negative externalities arising from

**road congestion.*** + As negative externalities cause the **underpricing** in the production and consumption of goods, price mechanism will allocate too much resources in the market for diesel-powered cars when there is no government intervention.

**Explaining why the presence of negative externalities leads to market failure and welfare loss*** + Negative externalities arise when the usage of diesel-powered cars affects the well-being of a third party negatively and the affected-party does not receive any compensation for the effect.
	+ When driving diesel-powered cars, consumers only consider their Marginal Private Benefits (MPB) and Marginal Private Cost (MPC). The private benefit is the satisfaction derived from the convenience of driving the car while the private costs comprise the price of the car and the fuel cost.
	+ To maximize their own satisfaction, they will choose to own or use cars to the point of Qm where their MPC = MPB.
	+ However, these consumers do not take into account the Marginal External Cost (MEC) imposed on third parties.
	+ In extract 2, **these external costs are the air pollution and road congestion** which harm the well-being of the population. Road congestion causes longer journey times for other drivers on the road and result in a **less efficient transportation system**, hence lowering overall productivity in the economy
	+ Since MEC is positive, this implies that there is a divergence between MSC and MPC; and MSC > MPC as MSC = MPC + MEC. This is illustrated below.

**Benefits/****Cost MSC****B****Es****MPC****D Em****MPB = MSB****O Q**s **Q**m **Qty of diesel-powered cars*** + To society, the social optimum is at Qs where MSB = MSC, as this maximizes society welfare.
	+ As such, since Qs < Qm, there is an **overconsumption (excessive ownership or use) of diesel-powered cars** by QsQm.
	+ There is **underpricing** in the usage of diesel-powered cars and society incurs more resources than what car owners are paying, leading to **welfare loss which is the use of resources that**

**brings about net loss to society.** |

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| * There is a welfare loss of EsEmB and one of the forms of welfare loss is the total loss in national income due to various medical illnesses caused by air pollution and lower productivity due to congestion.
* Therefore, the price mechanism has failed to allocate resources in an efficient manner and thus government needs to intervene in this market to improve society’s welfare.
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| **(g)** | **With reference to Extract 3, evaluate the policies adopted by the Chinese government to increase the production of electric vehicles in China.** | **[9]** |
| ***Skills:**** *Identify the policies adopted by the Chinese government to increase the production of electric vehicles in China.*
* *Explain how these policies would increase equilibrium output in the market.*
* *Evaluate the policies using appropriate criteria such as effectiveness and sustainability of the of policies.*

**Introduction*** The Chinese government has given out **subsidies to producers and encouraged innovation** to increase production of electric vehicles in China.
* The rationale of these policies is to reduce the use of fuel-based vehicles so as to address the problem of market failure due to negative externalities as explained in part (f).

**Explaining the policy of subsidy*** A subsidy to producers is meant to lower the cost of production to producers (government absorbs part of the cost) to encourage a higher production level.
* When subsidies are given to the producers, cost of production will fall, and supply will increase. A surplus occurs and there is downward pressure on price. Thus, subsidies will lower the price of electric vehicles.
* Lower prices of electric vehicles will **reduce the demand for fuel-based ones**.

**Evaluating the policy of subsidy*** The subsidy can lead to **complacency among firms**, which has led to the production of **electric vehicles of poor quality** and loss of competitiveness.
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| * The **effectiveness** of subsidy to increase production also **depends on the price elasticity of demand of electric vehicle.** The demand of electric vehicle could be said to be price inelastic as it may be a poor substitute to diesel-powered vehicle. Therefore, even if the price of electric vehicle falls, the increase in output may be very small in extent as drivers are not very price sensitive, making the policy of subsidy an ineffective one and resulting in wastage of resources as the intended outcome could not be achieved.
* Moreover, this policy of subsidizing the producers of electric vehicle may not be **sustainable** as it will strain the Chinese government’s limited budget. To sustain the subsidy, the Chinese government may need to raise tax in the future or reallocate resources from other sectors  incurring an opportunity cost which could have been better used such as infrastructure or healthcare.

**Explaining the policy of encouraging innovation*** The Chinese government has also tried to encourage innovation among Chinese tech firms in its attempt to increase production of electric vehicle such as **making an internet-connected electric vehicle.** This would **improve the quality of electric vehicle** and catered more to the preference of the increasing tech-savvy Chinese population.
* Encouraging innovation in this case would result in an **increase in demand** for electric vehicle as consumers are more attracted to the higher quality electric vehicles. The increase in demand would result in a shortage of electric vehicle and put upward pressure on price. This would then act as a signal for producers to increase production of electric vehicle.

**Evaluating the policy of encouraging innovation*** The policy may be not very **effective** as the **success of innovation is not guaranteed**, leading to **uncertain outcomes**. Innovation may fail, and this will result in wastage of resources as a result as well.
* Moreover, **innovation takes time** and it will only increase production of electric vehicle in the **long run**. Hence it will not be able to increase production of electric vehicle immediately.
* In addition, innovation will incur **huge expenses for the firms** as research and development (R&D) is expensive as well. Some firms may not have the necessary resources to innovate and hence it may not be **feasible** for all firms to conduct innovation.

**Conclusion*** In view of the possible constraint faced by firms and to speed up the innovation process, the

**Chinese government may also need to provide R&D grants for the firms**.* The policy of **encouraging innovation is also a more effective long-term policy** while the **policy of subsidy to producers is more effective as a short-term policy** as shown by the huge number of low quality electric vehicles on the streets in China.
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| **(h)** | **Discuss whether increasing production of electric vehicles, together with driverless and ride-hailing transportation, will mean that governments do not need to intervene in the public transport market of buses and trains.** | **[12]** |
| ***Skills:**** *Explain the rationale of government intervention in the public transport market of buses and trains*

 ***to improve resources allocation in the land transport market****.** *Explain why government may not need to intervene in the public transport market of buses and trains due to increasing production of electric vehicles, together with driverless and ride-hailing transportation.*
* *Provide* ***an alternative perspective*** *on why government may still need to intervene in the public transport market of buses and trains.*
* *Provide an overall judgement on whether there is a need for government to intervene in the public transport market of buses and trains.*

**Introduction: unpacking and identifying the need for government intervention in the public transport market of buses and trains*** **Government intervention is needed when the price mechanism is unable to allocate resources efficiently or equitably.**
* In this case, government intervene in the public transport market of buses and trains due to **negative externalities generated from usage of fuel-based vehicles (air pollution and road congestion) as well as equity concern.**
* **Public transport is a substitute to various forms of private transport.** Hence governments intervene in the public transport market of buses and trains using policies such as subsidies or regulation to reduce price of public transport as well as improving quality of the trains and buses to make it a strong substitute to private transport **(fall in demand).** This would address the problem market failure in the market for car usage where there is over-allocation of resources.
* Public transport is also used by the masses and **a necessity for transportation** purposes  there is a need for government to **ensure public transport is affordable, especially for the lower income.**

**Explaining the basis of the suggestion in the questions (with electric vehicles, driverless and ride-hailing transportation, governments do not need to intervene in public transport market)*** **The development of autonomous ride-hailing using electric vehicles can correct market failure through market forces**  **less pollution and fall in car ownership**
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* The increase in production of electric vehicles means **less harmful pollutants are being released,** as car owners switch from diesel-powered cars to the more environmentally friendly electric vehicle. This would **reduce the negative externalities from air pollution.**
* Moreover, ride-hailing will be much cheaper with the use of autonomous electric vehicles as the bulk of the cost of ride-hailing is accounted to the driver (Extract 4). **Car ownership may thus fall as consumers switch from car ownership to ride hailing.**

**Evaluation:** While the options of electric vehicles and ride hailing reduce air pollution, **there will still be the market failure due to traffic congestion** if too many cars on the road, including driverless ones.

* The increasing use of ride-hailing in autonomous electric vehicle **will worsen road congestion instead as consumer switch from using public transport to ride-hailing** when ride-hailing becomes cheaper and is more comfortable.
* Ride-hailing companies such as Uber may increase their capacity by adding more cars on the road in anticipation of increasing use of ride-hailing.

## Therefore, government intervention in public transport is still needed to reduce the number of vehicles on the road to manage road congestion.

**Evaluation:** Government intervention in public transport is still needed to ensure the **affordability** of mass land transportation.

* While the increase in usage of autonomous electric vehicle may lead to a more efficient allocation of resources, **government intervention may still be needed due to equity concern.**
* Although the cost of ride-hailing may be reduced due to the autonomous electric vehicle, it may be still too expensive, especially for the lower income. Without government intervention in the public transport market, **the lower income may not have affordable mode of transport**, affecting their cost of living and quality of life.
* For example, the **Public Transport Council (PTC) regulate public transport fares in Singapore** by ensuring that the price charge reflects market dynamics (such as changes in operating cost and ridership) but remains affordable. Students and senior citizens are also given concessionary fare at lower prices.
* In addition, the **prohibitive investment and operation costs may also act as a constraint for private firms to operate public transport of buses and train**, especially that of trains since train railways are also needed. Therefore, government needs to provide for these buses and trains if private firms are unable to do so since government has greater ability to do so as it can raise tax to fund for the public transport.

**Evaluation:** However, the funding of public transport will put a **huge strain on government budget**, hence incurring a huge **opportunity cost** where the government budget could be spent on other more productive areas. Raising tax to fund for the public transport has also trade-offs that consumers have lesser disposable income and hence purchasing power, resulting in lower material standard of living in the short term if income tax was raised. Therefore, intervention does not necessarily mean providing free public transport. A reasonable extent of fares on consumers will be needed to ensure sustainability of the public transport model. **It is also important that the public transport is of sound quality in comprehensiveness and reliability to make it a viable alternative to private transport.**

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| **Conclusion: Coming to a well-reasoned judgement on the need for government intervention in the public transport market of buses and trains with increasing production of electric vehicles, together with driverless and ride-hailing transportation.*** There is still a need for government intervention in the public transport market of buses and trains even if autonomous electric vehicle and ride hailing become more affordable because traffic congestion and equity concerns will remain.
* It is also critical for the government to manage vehicle population growth and ensuring true pricing in vehicle usage because if these are not carefully calibrated, market failure in land transport will not be addressed.
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