

Pre-release material

- Reference 1
- Reference 2
- Reference 3
- Reference 4
- Reference 5

Reference 1: Road map for the global transition to electric vehicles

This media is interactive

Click on the arrows in the sign posts.



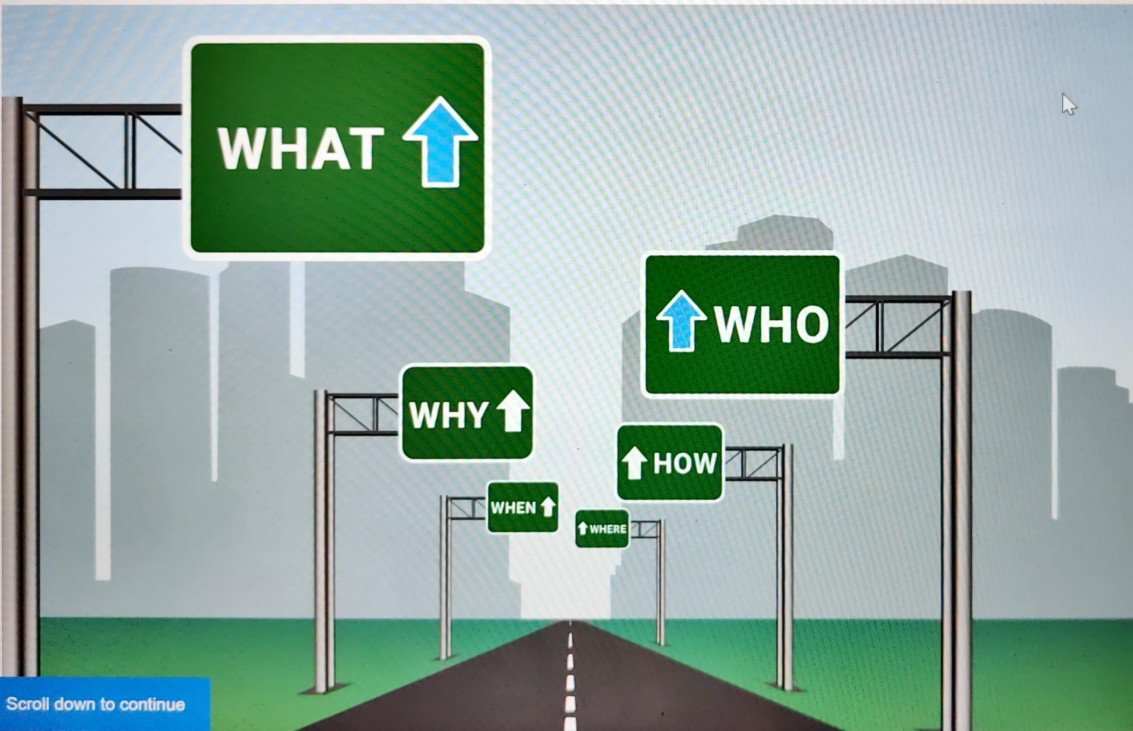
Scroll down to continue

Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

This media is interactive

Click on the arrows in the sign posts.



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Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)



Reference 1


Reference 2





Reference 3

Reference 4

Reference 5

Reference 2: The opportunities and challenges of electric vehicles



| OPPORTUNITIES | CHALLENGES |
|--|---|
| <p> Electric cars can lower CO₂ emissions by more than 40% compared to petrol cars.</p> <p> Maintaining an electric car is much cheaper than a petrol car, because there are fewer routine checks needed.</p> | <p> Electric cars are 30–40% more expensive to buy than petrol cars and, at first, there will not be many used electric cars available for sale.</p> <p> Electric cars can take several hours to charge, limiting sustained long-distance travel.</p> |

Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

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OPPORTUNITIES

CHALLENGES



Electric cars can lower CO₂ emissions by more than 40% compared to petrol cars.



Electric cars are 30–40% more expensive to buy than petrol cars and, at first, there will not be many used electric cars available for sale.



Maintaining an electric car is much cheaper than a petrol car, because there are fewer routine checks needed.



Electric cars can take several hours to charge, limiting sustained long-distance travel.



Transitioning to electric cars will reduce noise disturbance.



A major investment into nationwide electric charging infrastructure is needed before everyone can have an electric car.

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- 3 (12 marks)

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Reference 3: Brochure specifications for alternatively fuelled vehicles

This media is interactive
Click on each car for more information.

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

ALTERNATIVELY FUELLED VEHICLES



BIONIC

The Biofuel Car LPG
From \$18 500

Scroll down to continue

Click on each car for more information.

ALTERNATIVELY FUELLED VEHICLES



BIONIC

The Biofuel Car LPG
From \$18 500



SUSTAIN

The Solar Car
From \$178 500

Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

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SUSTAIN The Solar Car
From \$178 500



Terawatt The Electric Car
2023 Edition From \$38 000



INFINITY & BEYOND The Hydrogen Car
From \$68 500

- Pre-release material
- 1 (12 marks)
 - 2 (12 marks)
 - 3 (12 marks)

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**Video script:**

Lithium-ion rechargeable battery technology is responsible for innovations in technology such as smartphones, tablets and laptops and electric vehicles.

Electric vehicles are the globally accepted transport of the future, but there is an environmental cost to this battery-powered innovation.

The lithium-ion battery technology aspires to a fossil fuel-free society. However, lithium-ion batteries are made with metal components such as cobalt, nickel and manganese.

Most cobalt is mined in the Congo. Human-rights groups have exposed severe ethical and environmental issues in mining operations, such as child labour and pollution.

Fatal accidents in informal mining practices and human exposure to cobalt dust makes the process of mining cobalt hazardous.

Also, the extraction of cobalt requires a process called smelting, which emits sulphur oxide and other harmful air pollutants.

Another important component of these batteries is lithium. More than half of the world's lithium supply comes from the arid salt flats of the Atacama Desert.

The process to extract lithium uses significantly large amounts of groundwater, resulting in a decreased water supply and less accessible water for local agriculture. In the Atacama Desert, lithium mining companies have used 65 % of the region's water supply.

It is also found in Tibet. In 2016, there was a large chemical leak at a lithium

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- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)



Scroll down to continue



Also, the extraction of cobalt requires a process called smelting, which emits sulphur oxide and other harmful air pollutants.

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The process to extract lithium uses significantly large amounts of groundwater, resulting in a decreased water supply and less accessible water for local agriculture. In the Atacama Desert, lithium mining companies have used 65 % of the region's water supply.

Lithium mines can also be found in Tibet. In 2016, there was a large chemical leak at a lithium mine in the Tibetan highlands.

As a result, the river was severely polluted and several fragile ecosystems on the Tibetan plateau were devastated.

Thousands of animals, including fish and local wildlife, which relied on the water from this river were killed.

Many of the components of an old lithium-ion battery in a smartphone or laptop cannot easily be recycled and most end up in landfill. The components are highly flammable and are responsible for fires and contamination of local environment at waste facilities.

However, the news is not all bad. Old lithium-ion car batteries from electric vehicles have the potential to be repurposed. Research facilities are already working together to repurpose old batteries in other applications.

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- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)



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However, the news is not all bad. Old lithium-ion car batteries from electric vehicles have the potential to be repurposed. Research facilities are already working together to repurpose old lithium-ion car batteries in other applications.

Car manufacturers are developing cost-effective technologies to recycle 100 % of the components from lithium-ion car batteries.

As demand for electric vehicles continues to increase, waste lithium-ion car batteries have the potential to become a serious environmental problem.

A sustainable solution to the problem of repurposing and recycling lithium-ion car batteries could be the next big innovation.

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- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)



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Reference 5: Multiple perspectives on the transition to electric vehicles

Transport minister



I have real concerns about the lack of electric car charging infrastructure in this country. At the moment, we only have a fraction of the charging stations needed to charge electric cars. The average distance between charging stations in the countryside is about 50 miles, this just isn't practical for most electric car owners.

Conscientious consumer



I still can't believe that so many people still drive petrol cars. In my country, we are already at 30% electrification of all vehicles. This is because our government subsidises ownership of electric cars, which reduces the price of each electric car by 20–30%. Let's get rid of these dirty fossil-fuel cars right now!

Self-employed delivery driver

I drive my delivery truck in the city every day, all day long. Now the

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- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

Scroll down to continue



right now!

Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

Self-employed delivery driver



I drive my delivery truck in the city every day, all day long. Now the government is telling me I have to pay higher taxes if I don't switch over to an electric truck. I barely make enough money to pay for groceries for my family, and now I'm expected to pay double the price for a new electric truck. We live in an apartment with no way of charging an electric vehicle. There are some charging stations in my city, but the nearest one is an hour away from my home. Even if I were to take the truck to that charging station every day, it would still take 8 hours to fully charge the vehicle.

Automotive engineer



Electric cars are better than their petrol equivalents in a number of ways. Electric vehicles produce zero direct emissions, are 30% quieter, and have higher energy efficiency than petrol. Electric vehicles are easier to maintain; with fewer parts, they break down less often than petrol cars, and will be on the road for more years than a petrol car.



Scroll down to continue



Question 1 (12 marks)



Reference 3 - The Solar Car

Reference 3 - The Hydrogen Car

SUSTAIN

THE SOLAR CAR



HEAD TO THE LIGHT AND REDUCE THOSE ENDLESS CHARGES

FROM **\$178 500**

SUSTAIN YOUR
DREAM ROAD TRIP

Sustain Solar Car charges
twice as fast as a standard
electric car.



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Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

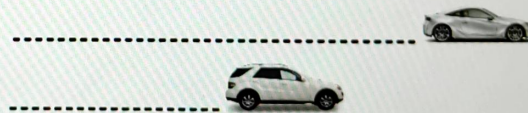
HEAD TO THE LIGHT AND REDUCE THOSE ENDESS CHARGES

FROM **\$178 500**

SUSTAIN YOUR DREAM ROAD TRIP

Sustain Solar Car charges twice as fast as a standard electric car.

The average distance travelled is twice as far as a standard electric car.



Average number of charges per 10 000 miles/
16 000 kilometres:

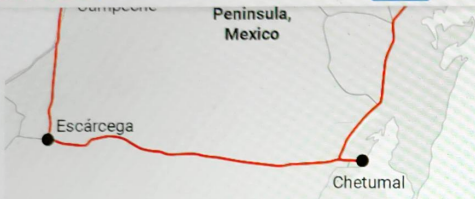
- Sustain Solar Car: 20*
- Standard electric car: 60

Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

Scroll down to continue

DISTANCE TRAVELLED



Average number of charges per 10 000 miles/ 16 000 kilometres:

- Sustain Solar Car: 20*
- Standard electric car: 60

* based on an average of 12 daylight hours of which 6 hours are direct sunlight.

DISTANCE TRAVELLED
750 MILES/
1200 KILOMETRES

0 GRAMS CO₂ EMITTED

0 CHARGES

Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

INFINITY & BEYOND THE HYDROGEN CAR



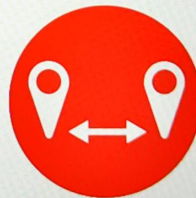
From \$68 500



0 emissions



Refuelling time
5 minutes



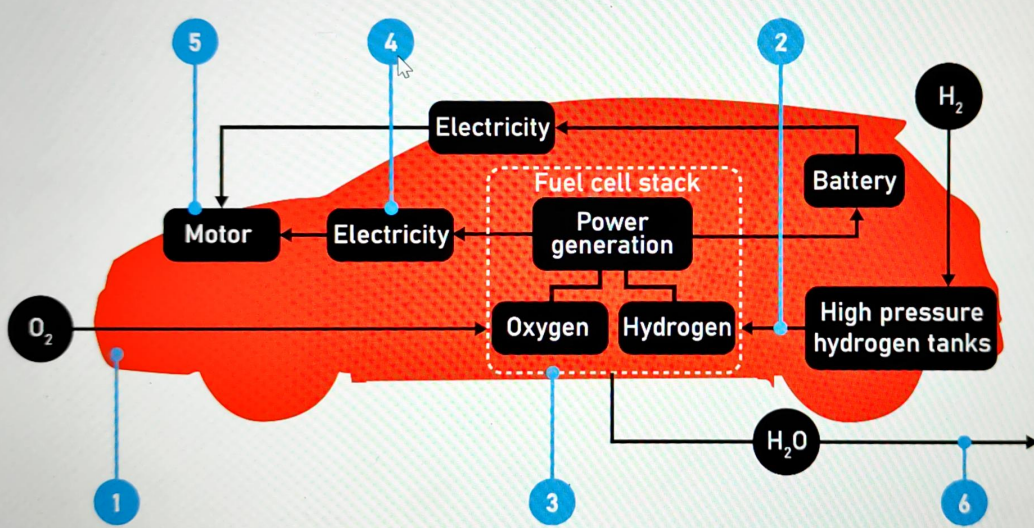
Average range
300 miles/480 km

Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

Scroll down to continue

5 minutes Average range 300 miles/480 km



- 1 Oxygen from the atmosphere enters the car's air vent.
- 2 The battery is recharged by the fuel cell stack.
- 3 The fuel cell stack generates power.
- 4 The electricity powers the motor.
- 5 The motor enables the vehicle to move.
- 6 Water is produced as a byproduct and exits the vehicle.

Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

Scroll down to continue



- 1 Oxygen from the atmosphere enters the car's air vent.
- 2 Hydrogen is transitioned to the fuel stack.
- 3 A chemical reaction generates electricity and water.
- 4 The electricity powers the motor.
- 5 The motor enables the vehicle to move.
- 6 The only waste by-product is water.

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- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

Scroll down to continue

ales brochures in the tabs above. Compare and contrast the synthesis of



Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

Refer to the two sales brochures in the tabs above. **Compare and contrast** the synthesis of mathematics and science in “The Solar Car” and “The Hydrogen Car” sales brochures. In your answer you must:

- analyse the use of mathematics and science in each brochure
- explain the strengths and weaknesses of each synthesis
- give an evaluative conclusion.

B I | | x₂ x² | | | Styles |

Scroll down to continue

Question 2 (12 marks)

You are a government official working for the department of transport. Your department is overseeing the transition to electric cars over a 10-year period.

The total budget for transport is \$20 billion. If the project costs more than \$20 billion, the extra budget funds will be taken from the budget for the environment.

The interactive media below shows the projected outcomes for three transition scenarios: 40 %, 70 % or 100 % electric vehicles.

This media is interactive

Click on the coloured tabs for each scenario and hover over the graph points for more detail.

Scenario 1

Percentage of cars electrified:
40 %

Scenario 2

Percentage of cars electrified:
70 %

Scenario 3

Percentage of cars electrified:
100 %

Total annual transport budget

Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

Scroll down to continue

Click on the coloured tabs for each scenario and hover over the graph points for more detail.

Scenario 1

Percentage of cars electrified:

40 %

Scenario 2

Percentage of cars electrified:

70 %

Scenario 3

Percentage of cars electrified:

100 %

Total annual transport budget

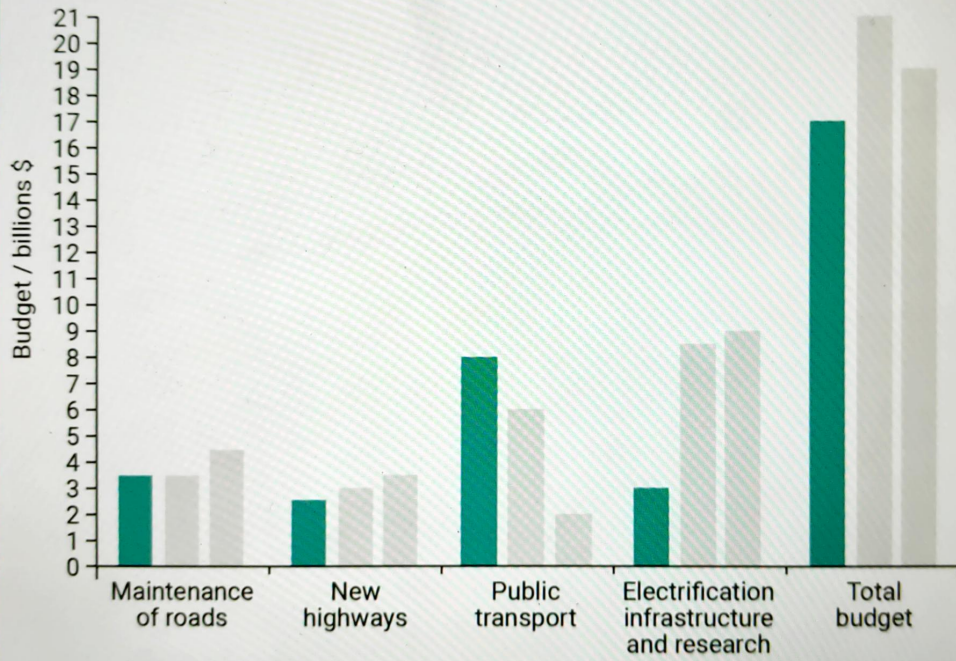


Pre-release material

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- 2 (12 marks)
- 3 (12 marks)

Scroll down to continue

total annual transport budget



Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

Stability of electricity supply

Scroll down to continue

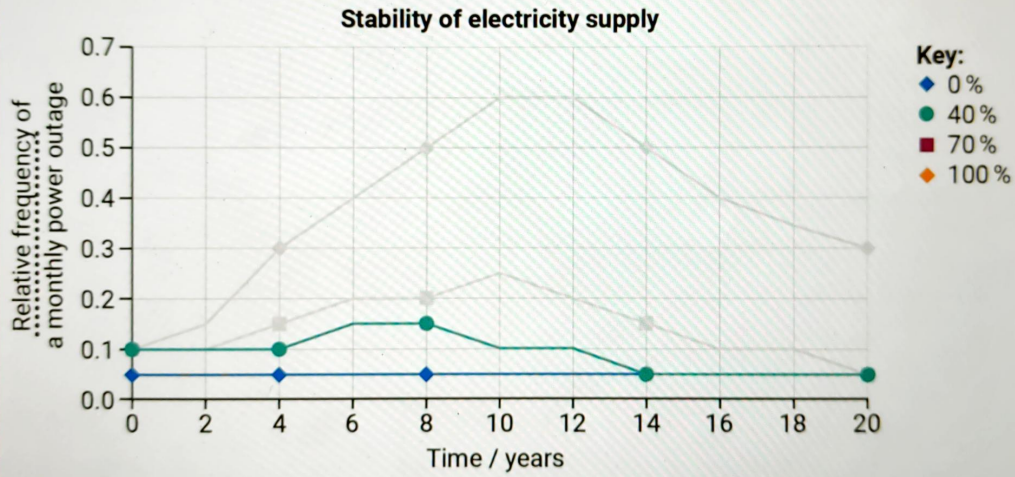
Key:
◆ 0%

Maintenance of roads New highways Public transport Electrification infrastructure and research Total budget

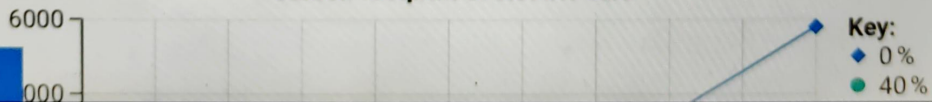
Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

40%

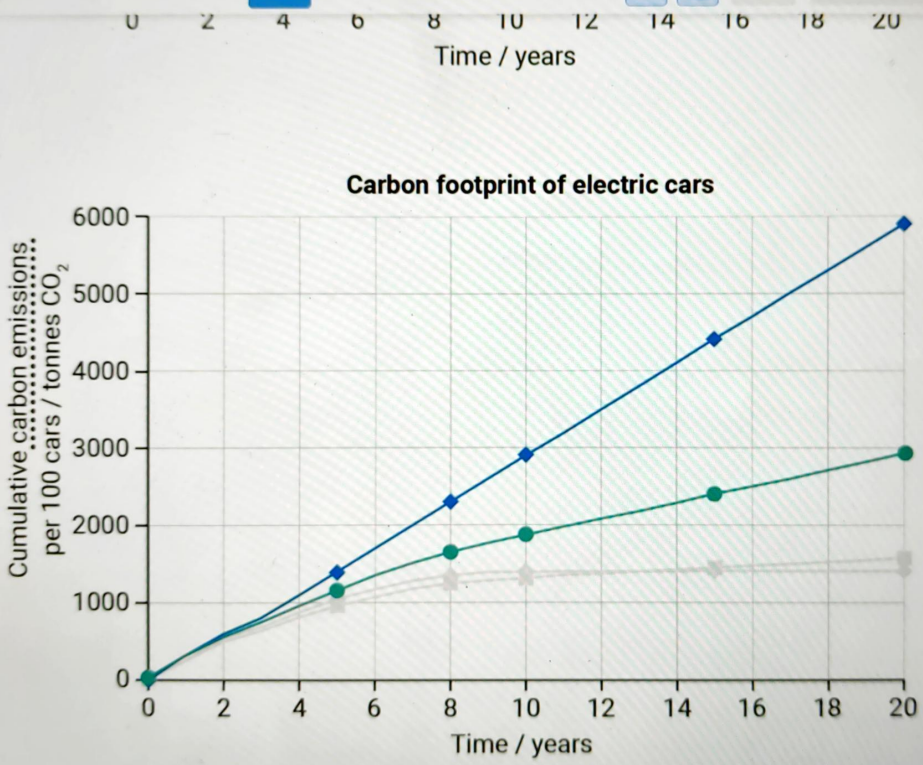


Carbon footprint of electric cars



Scroll down to continue

40%

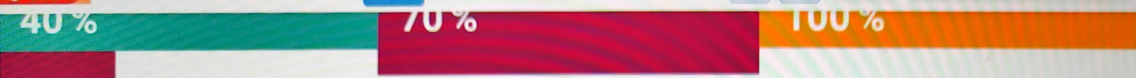


Key:
◆ 0%
● 40%
■ 70%
◆ 100%

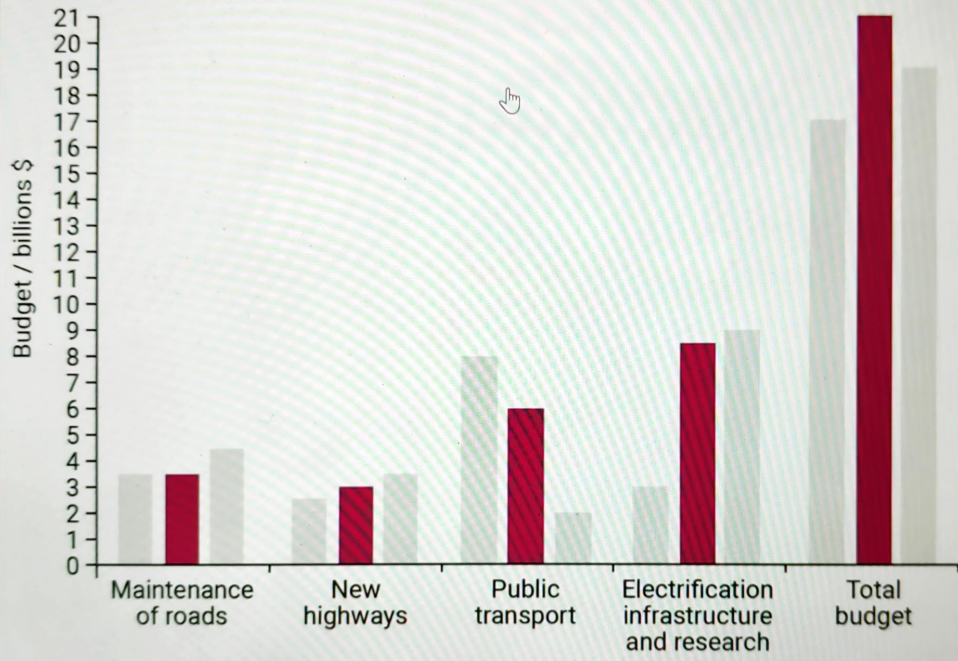
- Pre-release material
- 1 (12 marks)
 - 2 (12 marks)
 - 3 (12 marks)

Scroll down to continue

are a proposal justifying which scenario is best.



Total annual transport budget

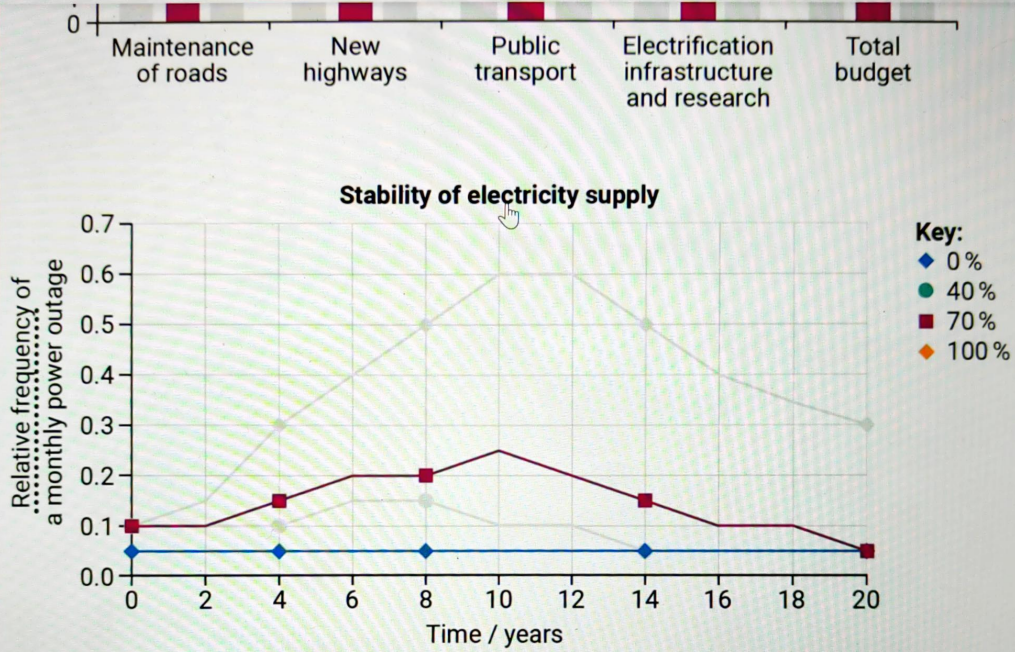


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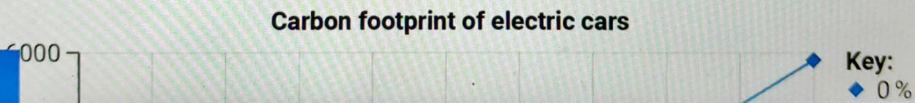
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70%



Pre-release material

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- 3 (12 marks)

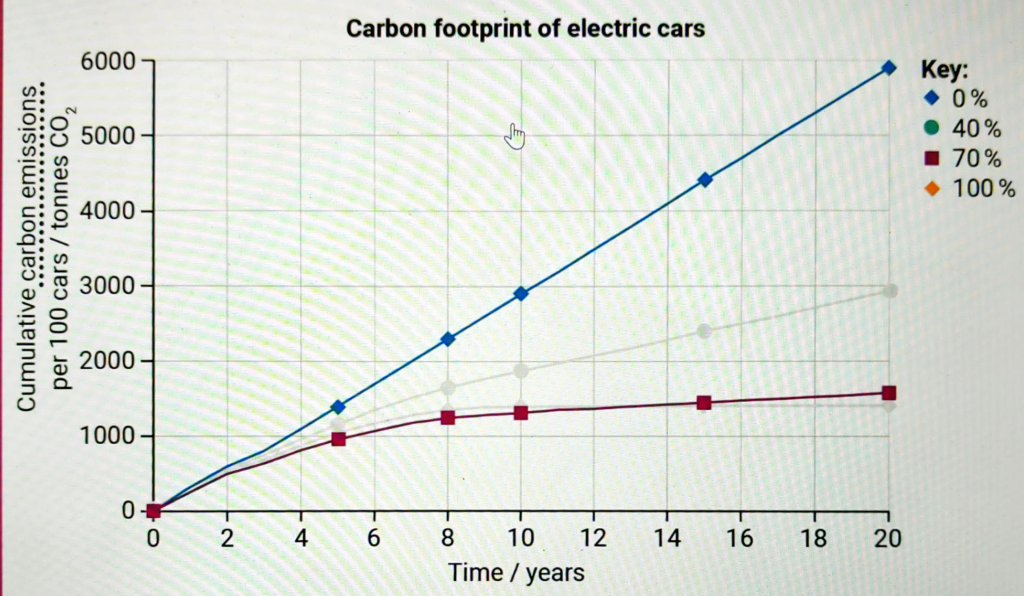


Scroll down to continue

Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

70%



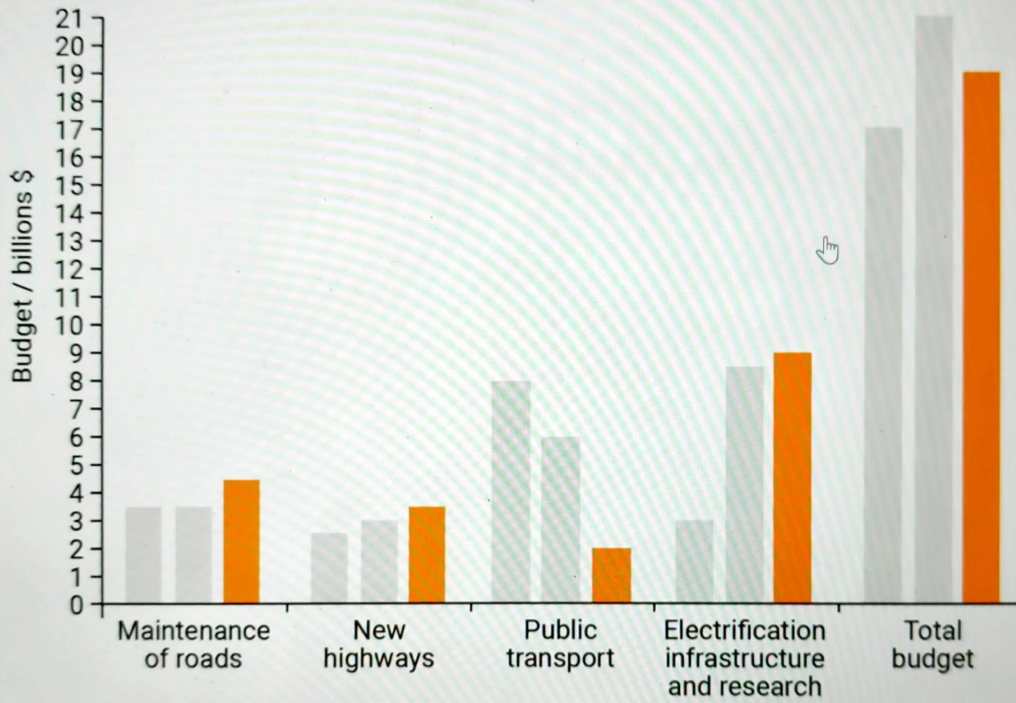
You need to prepare a proposal justifying which scenario is best.

knowledge of science and mathematics, **justify** which scenario is best.

Scroll down to continue

100%

Total annual transport budget



Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

Scroll down to continue

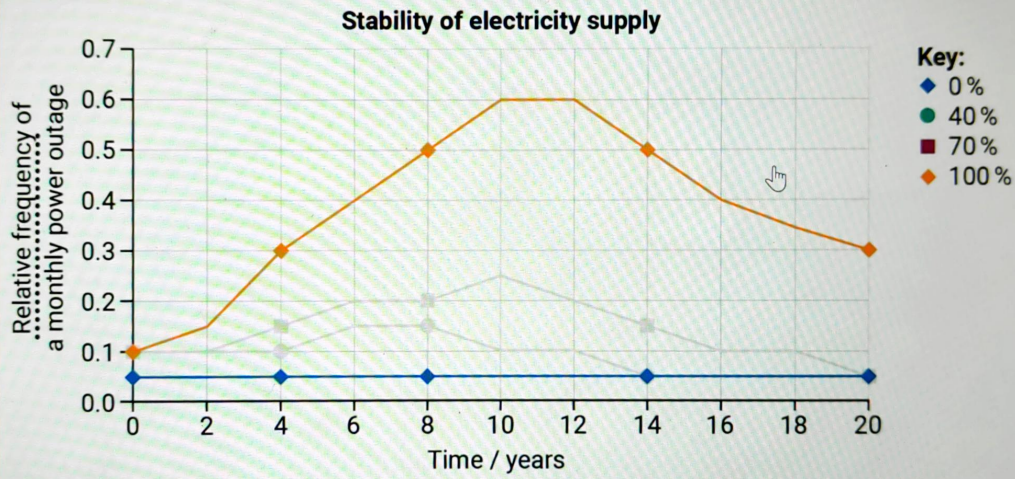
Stability of electricity supply

Maintenance of roads New highways Public transport Electrification infrastructure and research Total budget

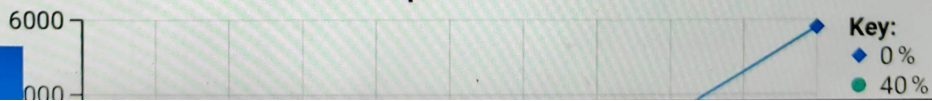
Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

100%



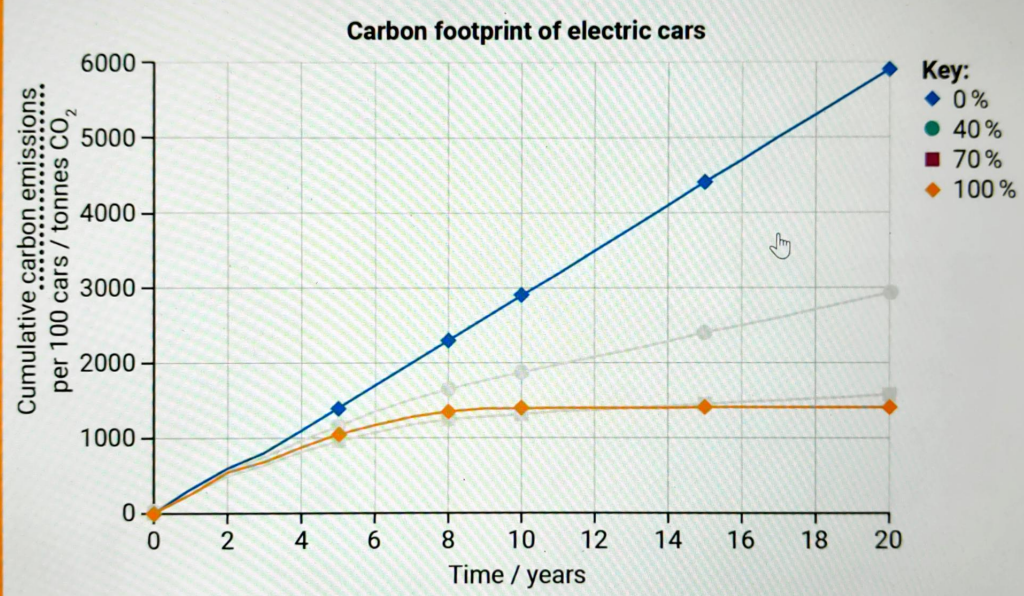
Carbon footprint of electric cars



Scroll down to continue

- Pre-release material
- 1 (12 marks)
 - 2 (12 marks)
 - 3 (12 marks)

100 %



You need to prepare a proposal justifying which scenario is best.

knowledge of science and mathematics, **justify** which scenario is best.

Scroll down to continue



time / years

You need to prepare a proposal justifying which scenario is best.

By applying your knowledge of science and mathematics, **justify** which scenario is best.

In your answer you must include:

- evidence supporting your choice using mathematical **and** scientific reasoning
- a response to the evidence against your choice using mathematical **and** scientific reasoning
- an evaluative conclusion.

B I x_2 x^2 $\frac{1}{x}$ $\frac{1}{x^2}$ Ω Σ Styles

Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

Scroll down to continue



Question 3 (12 marks)

Reference 5

Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

Transport minister



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ed delivery driver



Using your new interdisciplinary understanding, **discuss** the challenges and related solutions that electric vehicles present for the self-employed delivery driver in reference 5.

In your answer you must:

- explain **two** challenges
- explain solutions to address **both** challenges
- include evidence from the pre-release material to support your arguments.

B I | ← → | x₂ x² | \int \sum | Ω Σ | Styles |

Pre-release material

- 1 (12 marks)
- 2 (12 marks)
- 3 (12 marks)

Scroll down to continue