FOR OFFICIAL USE

National Qualifications 2018

Mark

X726/76/01 Environmental Science

THURSDAY, 31 MAY
9:00 AM – 11:30 AM

X726760 1

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth
Day Month Year

Scottish candidate number

Total marks — 100

Attempt ALL questions.

Questions 9 and 10 each contain a choice.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers and rough work is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting. Any rough work must be written in this booklet. You should score through your rough work when you have written your final copy.

Use **blue** or **black** ink.

Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

SQA ©

X726760101

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Total marks — 100

Attempt ALL questions

Questions 9 and 10 each contain a choice

1. Investigators collected samples of aquatic invertebrates upstream and downstream of the location of a suspected sewage leak in a local river. They used the kick sampling technique shown below.

(a) (i) Using the information provided describe the technique shown in the diagram. **2**

(ii) Explain why several samples were taken at each site. **1**

(iii) Suggest two measures which investigators should take to ensure that the comparison between the sites is valid. **2**

1. **(continued)**

(b) The table below shows the record of the species at the two sites.

Species	*Total biomass in sample* (g)	
	Upstream	*Downstream*
Stonefly larva	6	0
Mayfly nymph	4	0
Caddis fly larva	30	0
Freshwater shrimp	70	1
Water louse	34	4
Bloodworm	10	45
Sludge worm	2	100

Suggest why the information about the species in the table is recorded as biomass, rather than numbers of each species. **1**

(c) Water samples were taken at the two sites and the Biological Oxygen Demand (BOD) for each sample was determined. The BOD was found to be:

Upstream: 3 mg l^{-1} Downstream: 200 mg l^{-1}

(i) State what is meant by the term *Biological Oxygen Demand*. **1**

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1. (c) (continued)

(ii) Give a reason for the difference in BOD values between the two sites. 1

(iii) Describe the relationship between the BOD data and the distribution of the following two aquatic invertebrate species.

A. Stonefly larva 1

B. Bloodworm 1

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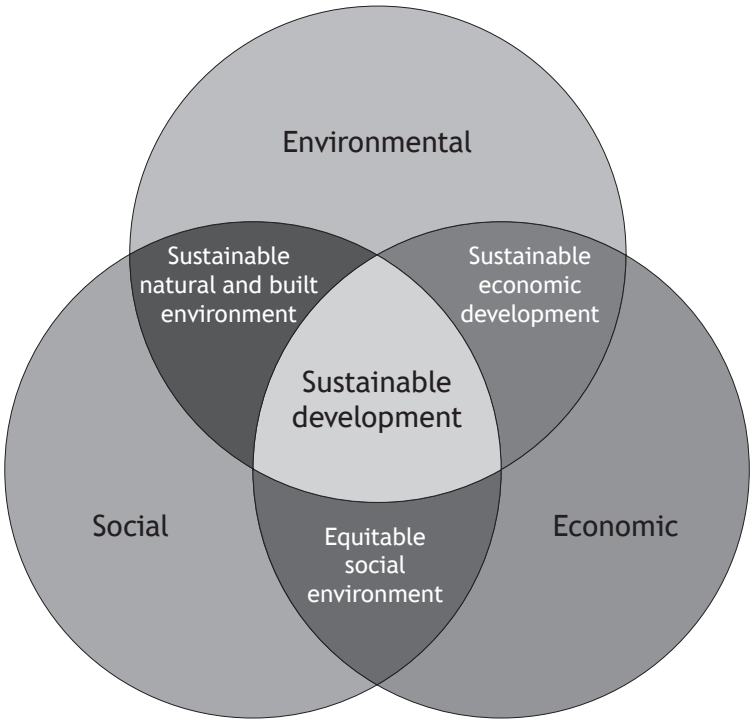
2. Sustainable development is often illustrated by the following diagram.



(a) Define *sustainable development*. **1**

(b) (i) Suggest two reasons why water conservation measures are an important part of sustainable development. **2**

(ii) Name a method of domestic water conservation that could be implemented. **1**

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2. (b) (continued)

(iii) The circular economy model is an example of sustainable economic development.

Explain what is meant by the *circular economy model*. **1**

(c) A United Nations report states that "climate change and environmental degradation undermine progress achieved, and poor people suffer the most".

(i) Suggest why climate change may have a greater impact on Economically Less Developed Countries (ELDCs). **1**

(ii) Suggest why poorer people living in Economically More Developed Countries (EMDCs) may suffer more from climate change than richer people. **1**

(d) Greenhouse gas concentrations in the atmosphere are reported to be at their highest levels in 800 000 years.

Describe two roles that the Intergovernmental Panel for Climate Change (IPCC) plays in assessing greenhouse gas emissions and climate change. **2**

3. Barley is Scotland's main cereal crop and is used extensively in the food and drinks industry.

The table below shows UK barley yield (in million tonnes) from 2011 to 2015.

Crop	*Year*				
	2011	*2012*	*2013*	*2014*	*2015*
Barley	5·5	5·5	7·1	7·0	7·3

(a) (i) Calculate the percentage increase in barley yield from 2014 to 2015. **1**

Space for calculation

(ii) Suggest two possible reasons for the variation in barley yields from year to year. **2**

3. (continued)

(b) The tables below show the percentage nitrogen content of various winter and spring barley varieties grown in the UK in 2015.

	Winter barley varieties					
	Flagon	*Pearl*	*Cassata*	*Venture*	*Maris Otter*	*Mean*
Percentage nitrogen content	1·43	1·62	1·54	1·50	1·43	

	Spring barley varieties					
	Odyssey	*Concerto*	*Propino*	*Belgravia*	*Others*	*Mean*
Percentage nitrogen content	1·46	1·41	1·58	1·72	1·50	1·53

(i) Calculate the mean percentage nitrogen content of the **winter** barley varieties. **1**

Space for calculation

(ii) Calculate the range of the percentage nitrogen content in **spring** barley varieties. **1**

Space for calculation

3. (b) (continued)

(iii) State an edaphic factor, other than nitrogen content, that farmers attempt to control when growing barley. **1**

(iv) State why brewers prefer to use spring barley rather than winter barley. **1**

(c) Many arable farmers are treating their soil with seaweed.

Explain the benefit to farmers of adding seaweed to arable soil. **2**

(d) Suggest two reasons why a brown earth soil is better suited to growing an arable crop such as barley than a podzol. **2**

(e) The Common Agricultural Policy (CAP) aims to promote sustainable farming practices.

State two ways in which CAP achieves these aims. **2**

4. The roe deer (*Capreolus capreolus*) is the most widespread species of deer in Britain. It is found in Scotland and England, and has only recently moved into Wales. It is a small species which is typical of the edge of woodlands, and it readily colonises new plantations and small woodlands.

(a) The table below shows the estimated population of roe deer in Britain in 1995.

Region	*Estimated population of roe deer*
England	150 000
Scotland	350 000
Wales	50

(i) Express the estimated population of roe deer in England, Scotland and Wales as a simple whole-number ratio. **1**

Space for calculation

: :

England Scotland Wales

(ii) The populations in the table are estimates.

Suggest why it is difficult to produce more accurate population figures. **1**

MARKS | DO NOT WRITE IN THIS MARGIN

4. (continued)

(b) (i) In many parts of Scotland deer are present in high numbers and are often out of balance with the natural environment.

State the term meaning the maximum population size of a species that can be supported indefinitely by a given environment. **1**

(ii) Name one density-dependent and one density-independent factor that could reduce a deer population. **2**

Density-dependent

Density-independent

(iii) Suggest a reason why a high deer population could be beneficial to a landowner. **1**

[Turn over for next question

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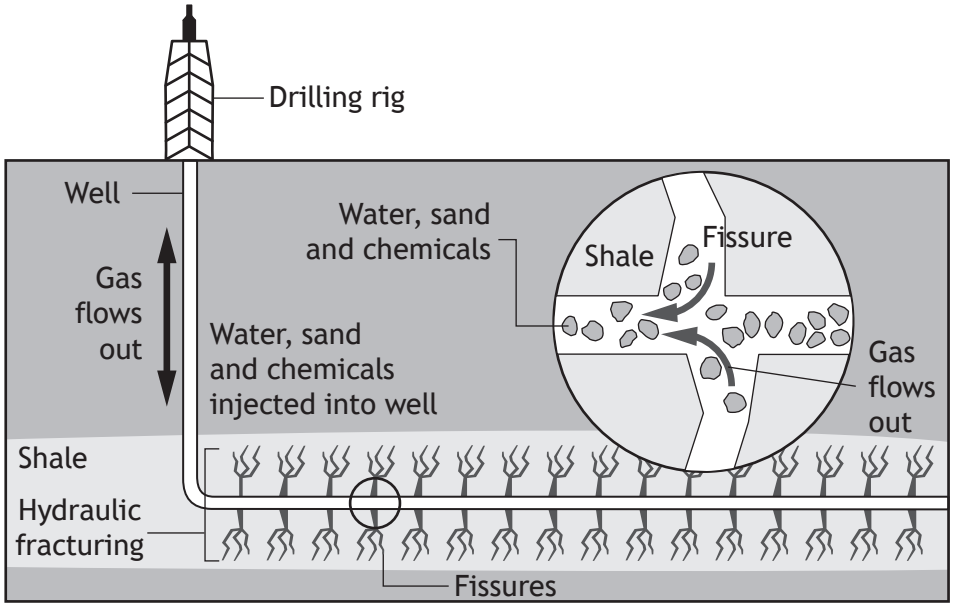
5. Shale gas forms over millions of years when organic material is buried, compressed and heated. This material then decomposes to form gas deposits within shale rock.

(a) State the main component of shale gas. **1**

(b) Shale gas can be extracted by a process known as hydraulic fracturing or 'fracking'. During this process a mix of pressurised water, sand and chemicals is used to create fractures in the shale rock.

(i) State why it is necessary to fracture the rock before the shale gas can be extracted. **1**

(ii) During the fracking process, a well is drilled vertically until it reaches the shale layer, then curved 90° and drilled horizontally as shown below.



Suggest one advantage and one disadvantage of horizontal drilling compared to vertical drilling. **2**

Advantage

Disadvantage

5. (b) (continued)

(iii) Describe why each of the substances listed below is used in the fracking process. **2**

Substance	*Reason for use*
Sand	
Chemicals	

(iv) Chemicals used in fracking could pollute subterranean water stores.

State a form of subterranean water store that could become polluted. **1**

(c) In 2016 China announced that it would be investing in the extraction of shale gas to meet the country's increasing demand for energy.

(i) Predict two impacts this increase in China's shale gas use could have on the environment at a global level. **2**

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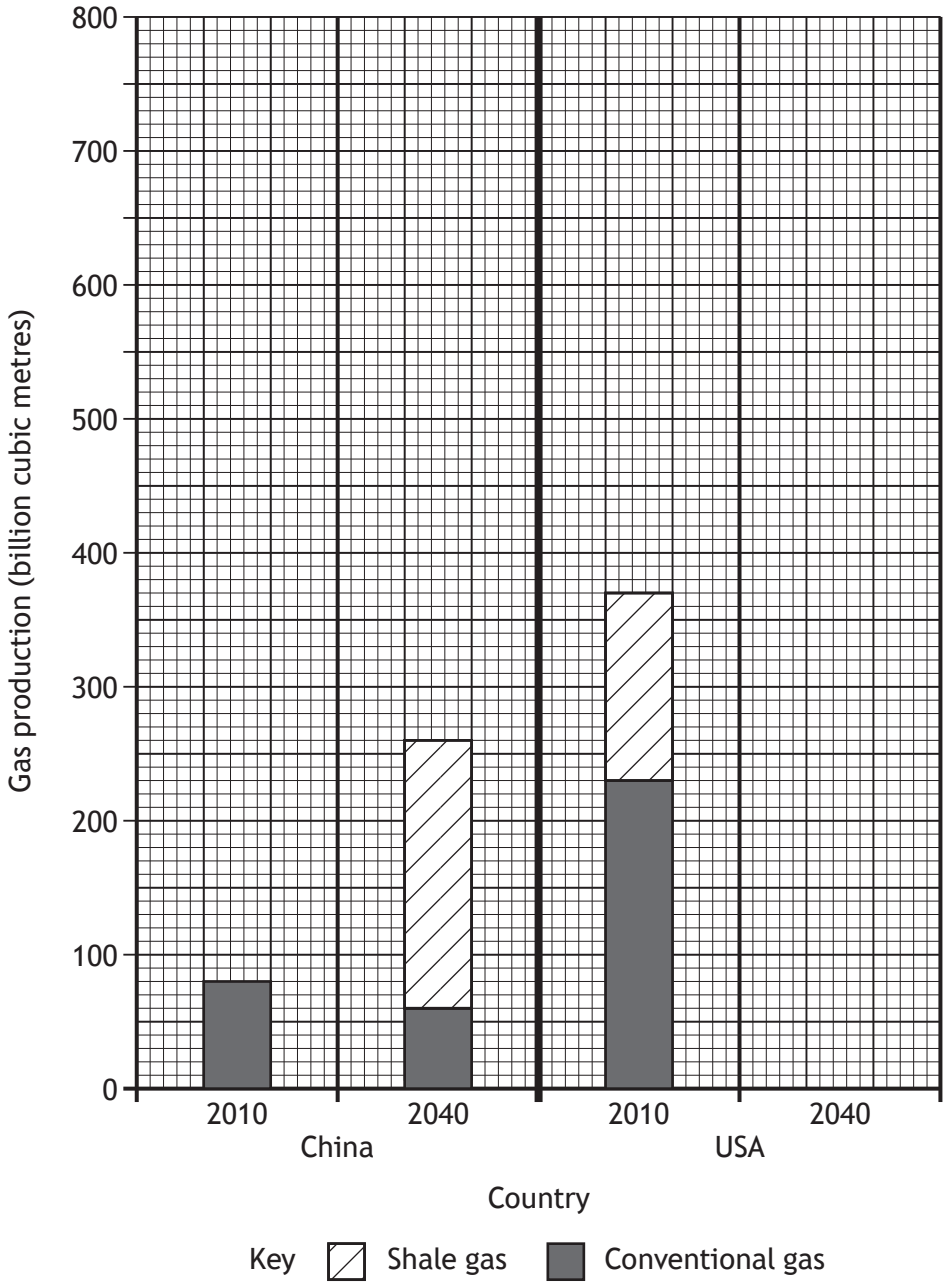
5. (c) (continued)

(ii) The partially completed graph below compares annual gas production for China and the USA in 2010, and predicts production in 2040.



(An additional graph, if required, can be found on *page 30*.)

5. (c) (ii) (continued)

Using the information in the **graph**, calculate the shale gas production value (billion cubic metres) for the USA in 2010. **1**

Country	*Conventional gas production* (billion cubic metres)		*Shale gas production* (billion cubic metres)	
	2010	*2040*	*2010*	*2040*
China	80	60	0	200
USA	230	200		500

Space for calculation

(iii) Using the information provided in the **table**, complete the graph to show conventional and shale gas production for the USA in 2040. **1**

MARKS DO NOT WRITE IN THIS MARGIN

6. *Rhododendron ponticum* (*R. ponticum*) is an invasive non-native plant species that was introduced into Britain in the late 18th century by Victorian plant collectors.

(a) Describe one way in which *R. ponticum* causes a decrease in native plant diversity. **1**

(b) Describe a method of minimising the spread of *R. ponticum*. **1**

(c) Describe the impact of a named invasive non-native animal species on biodiversity. **2**

(d) There are many species of rhododendron other than *R. ponticum*. Each has different characteristics. A paired statement key can be used to identify species.

(i) State why the correct identification of species is important in nature conservation. **1**

6. (d) (continued)

(ii) The table below shows information relating to various rhododendron species.

Species	*Petal colour*	*Leaf shape*	*Calyx length* (mm)	*Leaf margin form*
R. sikkimense	red	oblong-ovate	1 – 2	inrolled
R. fulgens	red	oval	1 – 2	inrolled
R. wallichii	pink	oblong-ovate	3 – 5	inrolled
R. aerugunosum	pink	oval	1 – 2	inrolled
R. campanulatum	pink	oval	1 – 2	not inrolled

Using the information in the table, complete a paired statement for the named species. **3**

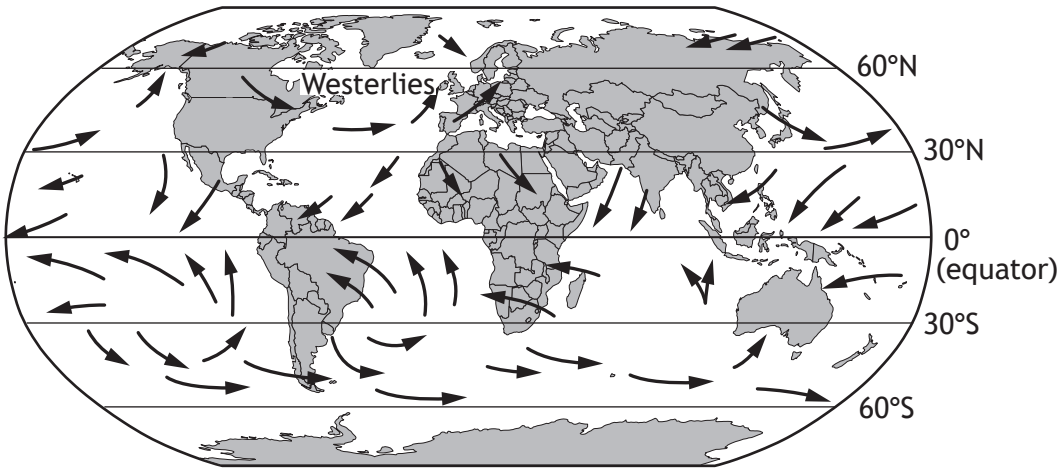
1	Red petals	go to 2
	Pink petals	go to 3
2		
3	Calyx 1 – 2 mm long	
	Calyx 3 – 5 mm long	
4		

MARKS | DO NOT WRITE IN THIS MARGIN

7. Acid rain is formed when sulfur dioxide or nitrous oxides dissolve in rain.

(a) State the main anthropogenic source of sulfur dioxide emissions. **1**

(b) Scotland's sulfur dioxide emissions are carried by south westerly winds and deposited as acid rain. This movement is shown by arrows on the diagram below.



Describe the role of atmospheric circulation in the deposition of acid rain originating from sulfur dioxide emissions released in Scotland. **3**

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7. (continued)

(c) When acid rain enters water courses it changes the pH of the water.

Describe a technique that could be used to measure the pH of water. **2**

(d) Acid rain does not directly harm the human population.

(i) Suggest one way in which acid rain could result in **indirect** harm to humans. **1**

(ii) Industries use a variety of strategies to reduce sulfur dioxide and nitrous oxide emissions.

For each of the industries below, suggest a strategy that could be used.

A. Agriculture **1**

B. Transport **1**

C. Manufacturing **1**

(iii) Lichens are sensitive to pollution.

State the term used for a group of organisms which, by their presence or absence, reveals the environmental status of a particular area. **1**

MARKS DO NOT WRITE IN THIS MARGIN

8. The United Nations Food and Agricultural Organisation (UN FAO) works with countries to eliminate food insecurity and reduce rural poverty. This can be achieved through making agriculture more productive and sustainable.

(a) (i) State two reasons why there is increased demand for food worldwide. **2**

(ii) Explain one social, one economic and one environmental impact of a named land-based strategy for increasing food production.

A. Name of land-based strategy **1**

B. Social impact **1**

C. Economic impact **1**

D. Environmental impact **1**

8. (continued)

(b) Palm oil is a common ingredient in many processed foods. The image below shows oil palm plantations, which have replaced large areas of native forest.

This is an example of a monoculture, where one crop species is cultivated over a large area.

Suggest an impact of monoculture planting on the following.

(i) The consumer **1**

(ii) The producer **1**

(iii) Biodiversity **1**

MARKS DO NOT WRITE IN THIS MARGIN

8. (continued)

(c) It is estimated that one-third of food produced globally is lost or wasted. Suggest a way that food waste can be reduced by:

(i) households **1**

(ii) schools and colleges **1**

(iii) supermarkets **1**

For questions 9 and 10 choose to attempt **either** A or B. Write your answers on the following pages. Diagrams may be used where appropriate.

9. A Lifecycle analysis (LCA) is an assessment of a product through all stages of its life, including making, using and disposing.

Discuss the LCA of a named product under the following headings. **10**

a) Materials

b) Energy

c) Transport

OR

B One of the targets of the UN Millennium Development Goals was to halve the proportion of the population without sustainable access to safe drinking water and basic sanitation. By 2015, over 90% of the world's population had access to safe drinking water.

Discuss: **10**

a) methods used to improve the quality of water supply; and

b) the advisory role of the UN and the input of named non-governmental organisations (NGOs) in the supply of safe drinking water in Economically Less Developed Countries.

10. A Biodiesel, bio-crude oil, bioethanol and biomethanol are examples of processed biofuels.

Discuss the advantages and disadvantages of using processed biofuels. **10**

OR

B Climate varies across the world.

Discuss how climatic factors can influence distribution of three named terrestrial biomes. **10**

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SPACE FOR ANSWERS

MARKS | DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS (continued)

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SPACE FOR ANSWERS (continued)

[END OF QUESTION PAPER]

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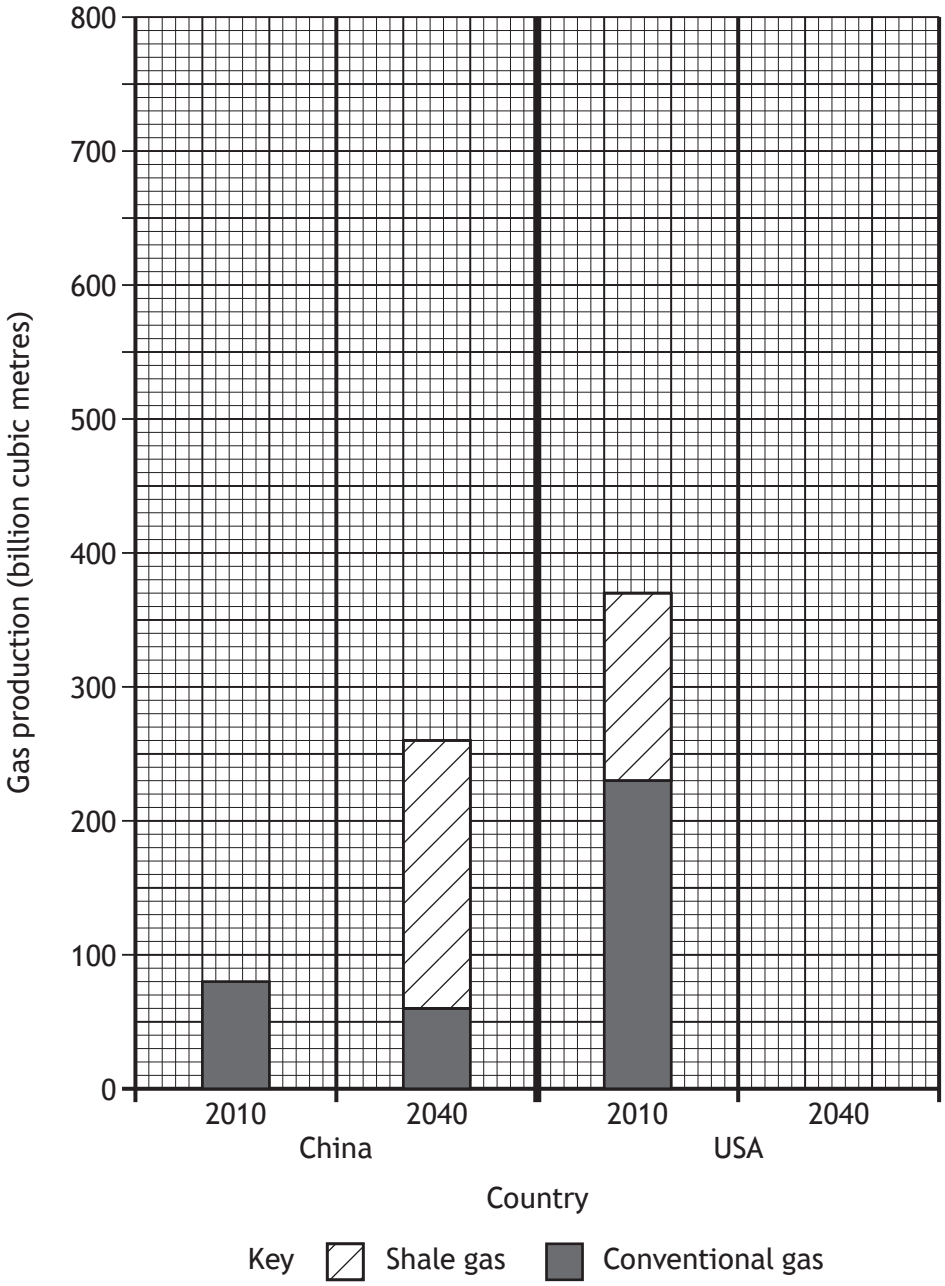
ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL GRAPH FOR QUESTION 5 (c) (ii)



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ACKNOWLEDGEMENTS

Question 2 (c) – Quote is taken from *The Millennium Development Goals Report 2015*, issued by the UN Department of Public Information – DPI/2594/2 E. © United Nations.

Question 8 (b) – KYTan/Shutterstock.com