SL Paper 1

“The ecological footprint is the best measure of the relationship between population and resources for different countries.” Discuss this statement.

Markscheme

Refer to Paper 1 Section B markbands (available under the "Resources" tab) when marking this question.

Responses should show an understanding of the ecological footprint and how it is calculated and its utility value in measuring the relationship between population and resource use in different national contexts.

Ecological footprint (EF) – The theoretical measurement of the amount of land and water a population requires to produce the resources it consumes and to absorb its waste under prevailing technology. It is usually measured in global hectares per capita – allow other valid ways in which “measurement” can be shown.

The focus of the essay should be on assessing the reliability of the EF as a measure of per capita resource use for different countries. Candidates can agree or disagree with the statement but need to be able to support their position. It is also possible that responses may take a balanced view and look at the strengths and the weaknesses of this as a measure. Responses may give some up-to-date examples/data. They may equally suggest alternative methods more suited to measuring the relationship between populations and resource consumption. It is also equally acceptable that responses refer to the Neo- and anti-Malthusian debate as it is relevant in this context.

Some possible strengths of the EF as a measure of population–resource relationships include:

- easy comparison with other countries
- temporal comparison possible
- as per capita takes into account an individual’s average consumption level
- biocapacity (global hectares)
- feel-good factor/national pride
- helps achieve targets (*eg*, Paris 2015)
- perceived to be easy to calculate
- increases awareness.

Some possible weaknesses of the EF as a measure include:

- is only an average per person / extremely wealthy have much larger footprints
- only informative and not a solution
- assumes all of Earth’s biocapacity is for human needs only
- data can be unreliable.

For band D expect some description of how the EF can help/not help measure a country’s population/resource relationship. This need not be balanced.

For band E expect either some explanation of how the EF can help/not help measure a country’s population/resource relationship or some discussion of its effectiveness using examples.

For band F expect both.

Marks should be allocated according to Paper 1 Section B markbands.

Examiners report

[N/A]

Examine the changing importance of energy sources other than oil.

Markscheme

Answers should focus on the changing importance (production/consumption) of other major energy sources. Responses could look at other non-renewable fossil fuels such as coal and natural gas and renewable energy sources such as solar, wind, bio-fuel, geothermal, tidal, hydroelectric power and of course nuclear power – although it is not essential to cover all.

Answers should recognize that the global demand for energy is increasing as populations grow and countries develop economically. Most, if not all, of the energy sources above are becoming increasingly important in terms of production and consumption. Some quantitative or qualitative detail would be expected in terms of explaining and comparing the changed importance.

Stronger responses may consider at least one fossil fuel, renewables and nuclear energy. Answers may also refer to any scale (local, national, regional, global), but this is not a requirement for the award of full marks. A discussion of national energy sources might link with the concept of energy security – this approach should be highly credited if done well.

Answers that do not describe a range of energy sources and do not examine their changing importance should not progress beyond band D.

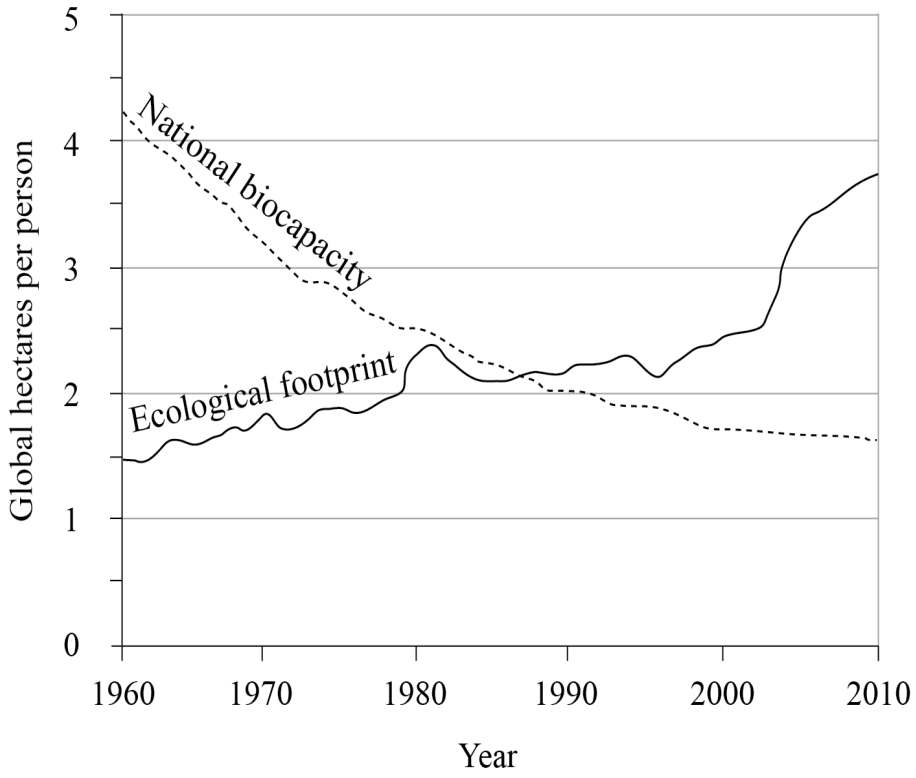
Responses based on appropriate, well-supported ideas and examples and which arrive at some conclusion about the changing importance of these sources of energy are likely to be credited at bands E/F.

Marks should be allocated according to the markbands.

Examiners report

There were some very good answers that gave comment on the reasons why oil was an issue looking at reserves, prices and geopolitical considerations. These used this as a springboard to look at the alternatives to oil and usually focusing on renewables. There was some good discussion of the importance of these energy sources and their relative merits. Candidates were usually well versed in exemplar materials. These stronger answers were well developed and covered most aspects of the question allowing the candidates to demonstrate and to discuss the shifting significance (production/consumption) of other important energy sources. These answers also made successful attempts to evaluate the different fuel options. Poor answers were characterized by weak knowledge and understanding and often with far too much emphasis on oil with hardly anything on the changing importance of other major energy sources. The weakest candidates failed to offer objective, detailed and specific examples/case studies with little attempt at any application.

The graph shows the ecological footprint for one country from 1960 to 2010.



[Richard Rhoda and Tony Burton. Geo-Mexico: The Geography and Dynamics of Modern Mexico. Sombrero Books, 2010. Used with permission.]

a. Define *ecological footprint*. [2]

b. Describe how the ecological footprint of this country has changed. [3]

c. Suggest reasons why this country's ecological footprint decreased in the 1980s. [2]

d. Explain the anti-Malthusian view of the relationship between population and resources. [5]

Markscheme

a. An ecological footprint is the theoretical measurement of the amount of land/water a population requires to produce the resources it consumes [1 mark] and to absorb its waste under prevailing technology [1 mark].

b. Overall increase [1 mark], anomaly/fluctuation in the 1980s/rate of increase increases after 2005 [1 mark], quantification [1 mark].

c. Recession, economic crisis, natural hazard, recycling, substitution, fuel costs go up. Award 1+1 mark for each identified valid reason. Do not accept population change.

d. Responses should describe the anti-Malthusian view [1 mark].

e.g.: Resources will keep pace with population growth. Carrying capacity will increase as human population increases.

Responses should explain the arguments used by anti-Malthusians [4 marks].

e.g.: Technology = higher yields.

Resource substitution will overcome resource depletion.

Recycling will conserve existing resources.

Award 1 mark for each basic explanation, with an additional 1 mark for extension or exemplification.

Examiners report

a. This was a straightforward question; the definition of "ecological footprint" is in the guide. Unfortunately a wide array of definitions was given in responses often showing a limited understanding of what the term actually means.

b. Generally answered very well. Some failed to get full marks as there was no quantification.

c. A weak area again, very few candidates scoring full marks. There were a lot of inappropriate guesses going on or often this question was left blank. It showed that many candidates have a limited understanding of the workings of the ecological footprint.

d. A significant number of candidates discussed Malthus prior to explaining the anti-Malthusian view. This impacted on time for some. Many lacked information on arguments against Malthus. Some responses showed very sound knowledge and understanding of anti-Malthusian ideas, backed up with excellent examples/detail.

Examine why most countries want to reduce their dependence on oil.

Markscheme

It is likely that there would be some introductory comments on the degree of dependence on oil (proportion of energy mix) and/or recognition that it is a finite resource.

Responses should examine several reasons for a desire to reduce dependence on oil. These might include the following:

- geo-political – insecurity about supplies (for example, US dependence on an unstable Middle East, Venezuela), the rundown of internal sources (US, North Sea)
- economic – the rising cost of oil (possibly with some evidence, such as changes in the cost per barrel)
- environmental – concern about the contribution of oil to global warming, the increased public awareness of the damage done to the environment, the Kyoto Agreement
- alternative energy sources – competition from these sources as their costs fall.

The strongest responses, accessing bands E/F, will incorporate most aspects of the reasons listed above, although these need not all be examined in equal depth.

Marks should be allocated according to the markbands.

Examiners report

[N/A]

Examine the changing importance of oil as an energy source.

Markscheme

Answers should focus on the recent changing importance (production/consumption) of oil. This may be relative to the changing use of other sources,

or in relation to consumption trends and conservation.

Answers should recognize that the global demand for oil is increasing as populations grow and countries develop economically. Some quantitative or qualitative detail would be expected in terms of explaining and comparing the changed importance. There may be some discussion of the price of oil which, at the writing of this in January 2016 has fallen to below $30 a barrel. This “cheap” oil will boost its importance as an energy source at the expense of many cleaner alternatives.

Responses could briefly look at the importance of oil in relation to other non-renewable fossil fuels, such as coal and natural gas and renewable energy sources. It is also possible that they look at new sources of oil, *eg* tar sands extraction in Canada, or fracking and the revolution that it has brought to US energy security.

Responses may address the externalities of oil production. The importance of oil has been impacted on by environmental damage caused by spills and pollution resulting from extraction. There are also geopolitical consequences of oil production when exploration for new sources causes conflict between nations.

Answers may also refer to any scale (local, national, regional, global), but this is not a requirement for the award of full marks.

Students whose world view of the importance of oil are outdated but still in line with their lifetime or in line with text book material should not be penalized.

At band D expect description of the importance of oil as an energy source over time.

At band E expect <u>either</u> detailed explanation of the changing importance of oil (probably in relation to other sources) <u>or</u> some examination of what is meant by “importance” (may examine trends for different countries/regions, or contrast local and global scales).

At band F, expect both.

Marks should be allocated according to the markbands.

Examiners report

[N/A]

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a. State and outline the units used to measure the global ecological footprint. [2]

Units:

Outline:

b. Suggest **two** reasons why the total ecological footprint of a country may grow very rapidly in the future. [4]

Reason 1:

Reason 2:

c. Explain the neo-Malthusian view of the relationship between population and resource consumption. [4]

Markscheme

a. Units: Global hectares (Gha; accept Global hectares/person) **[1]**.

Outline: area of land and water required to produce the resources consumed **[1]**.

b. *For each distinct, valid reason, award **[1]** for the reason and **[1]** for development/exemplification*.

Possible reasons include:

- increase in living standards **[1]** – rise in use of non-renewable resources required to fulfil higher living standards **[1]**
- industrialization of the economy **[1]** – industrial development or industrialization of agriculture consume more mineral resources for fertilizer
- rise in population **[1]** – each extra person requires food/energy / has to dispose of waste
- rise of consumerism **[1]** – people want more disposable goods which increases use of resources
- Urban sprawl **[1]** – urban dwellers consume more energy resources for transport.

For example:
The rise in wealth **[1]** of the people of China means that they can afford more consumer goods which take up more resources such as oil and minerals **[1]**.

Some countries have seen a large increase in population size **[1]**. These have to be fed which takes up more land for agriculture **[1]**.

c. Award **[1]** for each valid point:

- human population has a carrying capacity **[1]**
- because it increases geometrically while resources increase arithmetically **[1]**
- population growth outstrips available resources which leads to famine **[1]**
- leading to a check/crash/adjustment **[1]**

This constitutes the Malthusian approach (maximum **[2]**).

- neo-Malthusians such as Erlich/Club of Rome **[1]**
- increase in environmental degradation **[1]**
- thus a need for population control **[1]**

Other valid points may be credited.

Award a maximum of **[2]** for answers that only consider a Malthusian approach – for full marks, points from the neo-Malthusian view are needed.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

Discuss the ways in which the consumption of **one or more** resources can be reduced.

Markscheme

The main ways in which the consumption of resources can be reduced are by reducing demand (by changing pricing, access or availability), by changes in habits of recycling and reuse (government policy, civil society demand, education, fiscal incentives, legislation, change in societal values), by resource substitution, and conservation. The relative importance of these will depend on the resource (and location or locations) discussed.

Responses that arrive at a clear conclusion, after a sound discussion with a specific resource/resources referred to, are likely to be awarded band E or above.

Marks should be allocated according to the markbands.

Examiners report

There were some really quite excellent discussions of the ways in which the consumption of one or more resources can be reduced. Fossil fuels, water and even fish stocks were included. At the top end, the work included sophisticated analysis of various methods of conservation, waste reduction, recycling and substitution. Candidates were able to illustrate their work with case studies at different scales and from various parts of the world. The weaker candidates often wrote very short answers with little knowledge and/or understanding and which were largely superficial or of only marginal relevance, usually in relation to alternative energies. These responses were characterized by having no examples or irrelevant examples and case studies with very little application. It was clear that important aspects of the question had been ignored.

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a. Define *ecological footprint*. [2]

b. Describe what is meant by a neo-Malthusian view. [3]

c. Explain **three** benefits of a strategy designed to reduce resource consumption. [3x2

Markscheme

a. This can be broadly defined as the theoretical measurement of the amount of land and water a population requires to produce the resources it consumes [1 mark] (and to absorb its waste) under prevailing technology [1 mark].

b. The response should describe population growth outstripping resource availability [1 mark], and thus limiting economic development [1 mark].

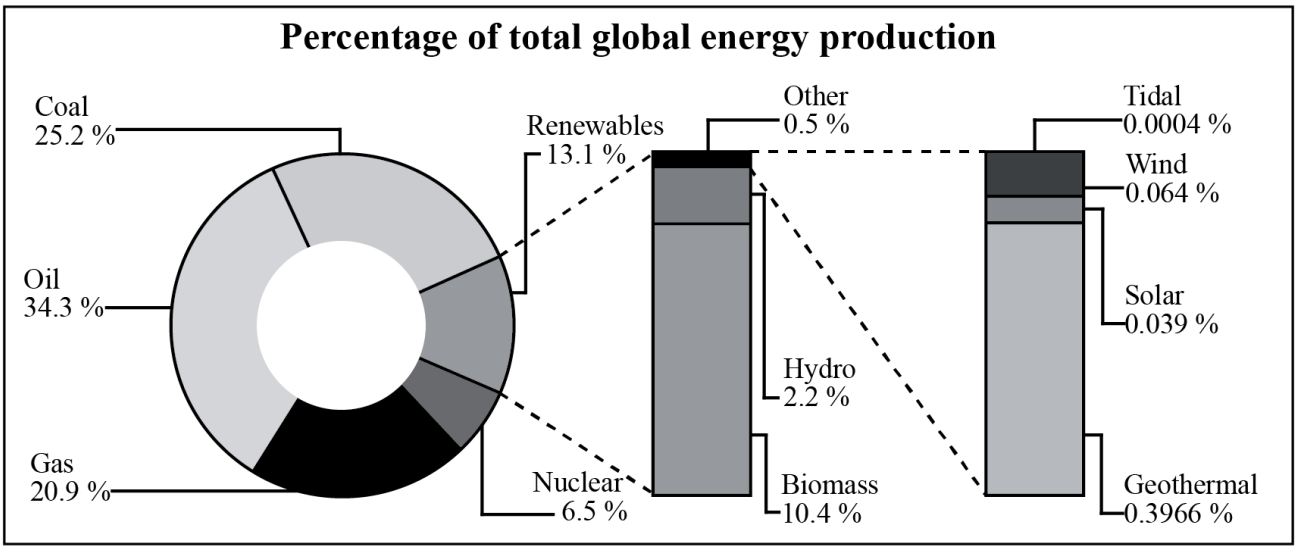
   Award 1 mark for any other valid point, development, such as reference to the Club of Rome and the Limits to Growth model, or an example of a country experiencing extreme population pressures. If only Malthus's original theory (relating population to food) is described, no more than 1 mark should be awarded.

c. Three distinct and clearly defined benefits of a strategy are required [3×2 marks]. These could be environmental, social or economic, or any combination of them, and would have to be explained, not just described, to obtain the full marks.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

The graph shows the different sources of global energy production.



[Source: Sunlit uplands, *The Economist* May 31 2007, The Economist Newspaper Limited. Reproduced with permission.]

b. Suggest **two** reasons why some areas of the world are unlikely to depend entirely on renewable energy sources. [2x2

c. Analyse how the global pattern of oil production has changed in recent decades. [5]

Markscheme

b. Award 1 mark for each basic reason, with additional 1 mark for extension and/or exemplification.

Answers can suggest reasons with validity at any scale: local, regional or national. Possible reasons include: abundant reserves of fossil fuels; insufficient capital to develop alternative energies; conscious decision to rely on nuclear power; need for portable, emergency sources of power; lack of sufficient opportunities for renewable energy; lack of political will; lack of local conditions for any renewable energy.

c. Answers may focus on spatial and/or temporal changes.

Answers should refer to sub-global regions in terms of how production is changing over time, and/or how it is changing as a proportion of the world total. Many responses will focus on the "peak oil" scenario. There should be some comment on how demand and price is driving the exploitation of oil in remote and/or previously uneconomic sources, for example, further off shore or tar sands in Alberta, Canada. Award up to 2 marks for valid descriptions of changes, 2 marks for related analysis with the final 1 mark being reserved for either.

Examiners report

b. Many candidates were able to suggest two reasons why some areas of the world are unlikely to depend entirely on renewable energy sources. The weaker candidates could only manage one basic reason and often failed to back this up with suitable extension and/or exemplification.

c. Weak candidates had great difficulty trying to analyse how the global pattern of oil production has changed in recent decades. In many cases production was confused with consumption and the changes in global pattern of oil production were not addressed. The best responses demonstrated very accurate and correct ideas with sound knowledge and understanding, for example, details about OPEC and production statistics; relevant descriptions of the global pattern of oil production with strong sound analysis of change (such as geopolitical issues, peak oil scenarios, exploitation/new reserves such as tar sands, conservation/secondary extraction). Unfortunately, these responses were quite rare.

Examine the relationship between energy consumption and environmental sustainability.

Markscheme

There are many possible approaches to this question.

Sustainability should be explained – it is achieved when resources are used at a rate which does not deplete them for future generations.

In the context of sustainability, energy use includes not only the total amount of energy required by a society but also the sources of energy required. Renewable power, such as wind and solar power, are usually sustainable sources, whereas traditional non-renewable sources of power such as coal and oil are not physical. Human and socio-economic environments can all affect the choice of energy sources.

It is possible that responses may outline specific features of energy consumption and look at their impacts on the environment. Other approaches may review developments in renewable energy and examine how they decrease the impact on the environment. Some responses may take a case study approach and review energy consumption in one or more areas to emphasize contrasts.

Reference must be made to sustainability to move beyond band D – this may be implied.

Responses that fully examine the relationship and that arrive at a clear conclusion are likely to be awarded band E or above.

Marks should be allocated according to the markbands.

Examiners report

Many candidates did not show an understanding of environmental sustainability and as such their answers lacked the correct focus. The best answers had detailed accounts of the relationship and included plenty of valid and accurate case studies. There was some detailed knowledge and understanding of how some countries are developing alternative energies and thus improving their sustainability.

“The Millennium Development Goals (MDGs) are unlikely to be achieved without a dramatic increase in global energy consumption.” Discuss this statement.

Markscheme

Responses could discuss concepts of MDGs, oil/gas resources, alternative energy sources, ecological footprint, *etc.*

There are many possible approaches to this question and each should be marked on in its merits.

An explanation of the MDGs should be given in terms of their purpose. Some of the specific MDGs should be referred to. Candidates may recognize that, as people move out of poverty (MDG 1), they will consume more energy, therefore agreeing with the statement. Other MDGs, *eg* schooling, also require energy for classrooms, *etc.* However, gender equality requires a change in attitudes not more energy. So the statement becomes invalid. Equally, it could be possible to meet some MDGs without a dramatic increase in energy, *eg* low energy technologies (solar and rechargeable).

Alternatively, some may argue that the MDGs cannot be met, irrespective of energy, because of a wide variety of other reasons. Depending on the goals and/or the countries used in the response, these reasons include: conflict (DRC/Afghanistan), HIV/AIDS, corruption, lack of political will, global recession, “cultural obstacles” to improving the status of women, natural disasters *eg* Haiti, not a level playing field, voting rights in the WB and IMF, work of the WTO, trading blocs, debt, tied aid, inappropriate aid.

The extent to which these reasons are linked to global energy consumption is debatable. Responses could look, for example, at how a rise in energy consumption might help a country develop manufacturing industry and create additional employment opportunities, offering families a way out of poverty, or increase a country’s GNI, allowing it to allocate more resources to health/education, with positive effects on gender awareness, nutrition, maternal mortality, and so on.

Answers that are simplistic and/or generalized with few or no relevant examples are unlikely to advance beyond band C.

Responses that discuss a range of ideas, supported by evidence, within a structured framework (*eg* focusing on a number of specific goals or countries) and with some recognition that there is room for alternative viewpoints, are likely to be credited at band E/F.

Marks should be allocated according to the markbands.

Examiners report

This was the least popular question. The best answers had knowledge and understanding of the Millennium Development Goals (MDGs) in terms of their purpose. Often specific MDGs were highlighted with particular case study evidence. Most candidates recognized that, as countries move out of poverty, they will consume more energy but other MDGs require a change in attitude not just more energy. The top candidates gave detailed evaluation/application and were generally accurate with their understanding of the progress towards the goals. The greatest weakness in the poor answers was a combination of lack of knowledge and understanding of the individual “goals” and a lack of case study material.

The table ranks the ten countries which had the largest oil consumption in 2010.

Rank	Country	Oil consumption (thousands of barrels/day)
1	USA	19 148
2	Country A	9057
3	Japan	4451
4	India	3319
5	Russia	3199
6	Saudi Arabia	2812
7	Brazil	2604
8	Germany	2441
9	South Korea	2384
10	Canada	2276

[Source: *BP Statistical Review of World Energy* June 2011]

a. Identify Country A. [1]

b. Briefly describe what is meant by the OPEC cartel. [2]

c. Explain **two** geopolitical impacts of the rise in global oil consumption since 1990. [4]

d. Suggest **two** reasons why sources of renewable energy have become more important in many countries in recent years. [4]

Markscheme

a. China ***[1 mark]***.

b. Award ***[1 mark]*** for a comment that recognizes what OPEC is – *eg* the Organization of Petroleum Exporting Countries or names of the members (Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates and Venezuela). Award ***[1 mark]*** for the operation as a cartel – formed to fix prices and/or production quotas.

c. There are many possibilities.

Award ***[1 mark]*** for each basic explanation of a valid impact and a further ***[1 mark]*** for its development.

The increase in global consumption has led to geopolitical pressures in some parts of the world as oil-hungry countries seek additional supplies of oil to meet their anticipated future demand. It has increased tensions in parts of the Middle East since that area has the world's largest oil reserves to which oil-importing countries such as the US want to preserve their access. Equally, it has led to growing international tension over likely sources of oil, such as those in the Arctic, Sudan and South China Sea, that are currently not exploited. On the other hand, the rise in consumption has led to higher prices for oil, leading to more investment in non-oil sources of energy. Reference may be made to conflicts that have their origin in the securing of access to oil supplies. Comments may refer to variations in the rate of increase with NICs having a faster increase in demand which causes tensions. Some impacts may arise through the transport of oil and pollution incidents that are a consequence – be careful to credit only where they lead to geopolitical impacts.

d. Award ***[1 mark]*** for each valid reason, and an additional ***[1 mark]*** for its development, exemplification or further explanation.

Possible reasons could include:

- adoption of a green agenda
- energy security
- the desire to increase sustainability
- the declining availability and/or rising costs of fossil fuels
- the need to avoid global warming
- meeting pledges, for example, Kyoto-Copenhagen
- an increased investment in renewable energy technologies
- technological breakthroughs that have reduced the costs of renewable energy infrastructure
- alternative to nuclear since Fukushima.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]
d. [N/A]

"Falling fertility rates are no guarantee of reduced resource consumption." Discuss this statement, referring to examples.

Markscheme

There are many possible approaches to this question, and each should be marked on its merits.

It would be expected that responses show a clear understanding of fertility rates. This can be defined, stated or implied. It would also be expected that most responses agree with the statement. Even though fertility rates are falling (global fertility is 2.5 in 2013), population momentum and increased longevity mean populations are still growing significantly in most regions. Many Sub-Saharan nations still have predicted doubling times of less than 30 years (*eg* Ethiopia), despite falling fertility. So falling fertility does not immediately equate with fewer people consuming fewer resources.

There should also be some understanding that when fertility does fall it is generally as a result of, or goes hand in hand with, increases in the standard of living. In the present development paradigm this is associated with increased consumption of resources. Falling fertility is thus often accompanied by an increase in a country or region's ecological footprint.

There are some obvious long-term benefits of falling fertility such as the need for smaller houses, possibly resulting in less pressure on resources and space. Responses could also look at some of the issues related to fertility rates falling below replacement level but their answer must be in relation to how this impacts upon resource consumption.

Responses should make use of examples but responses that focus on describing population policies in some nations and not the consequences of falling fertility rates on resource consumption in that country will be self-limiting as this is not the question.

For band D expect some description of costs and benefits of falling fertility rates on resource consumption. This need not be balanced.

For band E expect some explanation of costs and benefits of falling fertility rates on resource consumption and there should be some attempt at an evaluation of the statement.

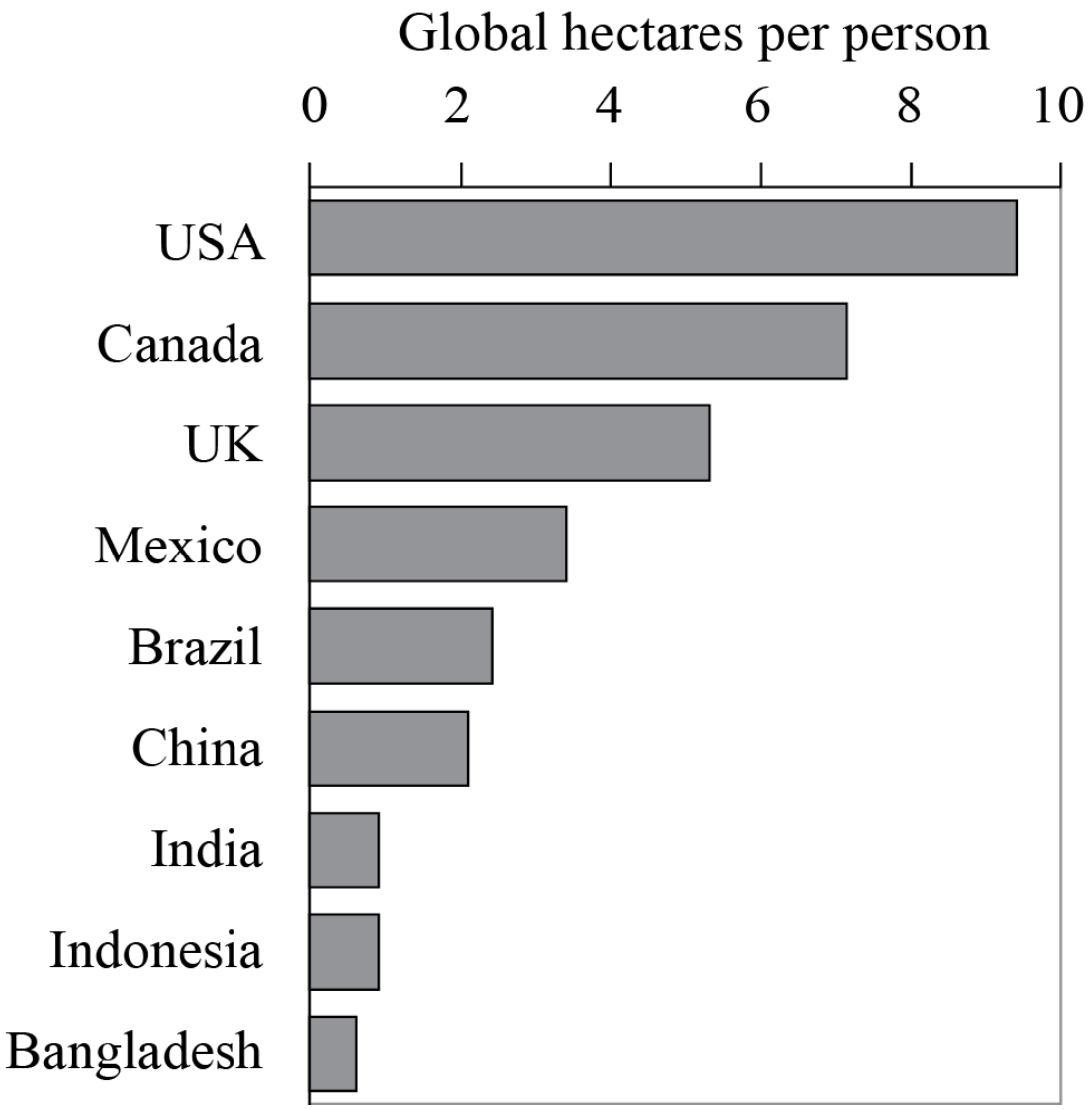
For band F expect some explanation of costs and benefits of falling fertility rates on resource consumption and there should be some attempt at an evaluation of the statement, with effective use of examples.

Marks should be allocated according to the markbands.

Examiners report

[N/A]

The graph shows the ecological footprints of various countries.



[Source: R Rhoda and T Burton, *Geo-Mexico: The Geography and Dynamics of Modern Mexico* (Sombrero Books, 2010)]

a. Define *ecological footprint*. [2]

b. Describe how the pattern of ecological footprints shown by the graph reflects economic development. [2]

ci and cii. (i) Outline a strategy at a local or national scale which is designed to reduce the consumption of **one** named resource. [2+2]

(ii) Explain **two** reasons why the strategy described in (i) **either** has **or** has not been a success.

Markscheme

a. An ecological footprint is the theoretical measurement of the amount of land and water a population requires to produce the resources it consumes [1 mark] and to absorb its waste under prevailing technology [1 mark].

b. The relationship is that countries with higher economic development have larger footprints [1 mark]. Award a further [1 mark] for quantification.

ci and cii. (i) The strategy may involve resource substitution, conservation, recycling or waste reduction. Award [1 mark] for a valid, located strategy. Award a further [1 mark] for explaining how this reduces consumption. If no resource is named, no credit can be given.

(ii) There are many possible reasons. Award [1 mark] for identifying each valid reason, with a further [1 mark] for explanation. Award a maximum of [2 marks] in the event that the strategy is not clearly linked to the response given in (i).

Examiners report

a. The majority of candidates were familiar with the definition in the guide.

b. The relationship was easily identified but weaker responses offered no quantification.

ci and cii. (i) The best answers had a valid, located (local or national) strategy with explanations of how the consumption of a named resource (water and fossil fuels being the most popular) could be reduced. Some failed to identify the resource being conserved or the location of the strategy to be evaluated and as such could not be awarded any marks.

(ii) The best answers gave valid reasons, with explanations clearly linked to the response given in (i). Unfortunately one or two ignored the "**either**" and wrote one positive and one negative explanation, for which only the better of the two received credit.

Examine the geopolitical and environmental impacts of the production and/or consumption of fossil fuels such as oil.

Markscheme

Geopolitical impacts may include the importance of Russia, the Middle East and/or OPEC members, political and economic alliances and energy-related trade agreements, wars over energy reserves, and policies to develop alternative energy resources.

Environmental impacts may include oil spills, air pollution, increased carbon emissions, water pollution, and may make it impossible to achieve environmental sustainability.

Credit should not be given for other impacts (social, demographic, economic) except where the response justifies why the impact can be considered to be either geopolitical or environmental.

Responses that consider only oil (and no other fossil fuels) may be awarded full marks.

Responses discussing both production and consumption need not consider both aspects in equal depth for the award of full marks.

At band D, expect responses to describe a range of both geopolitical and environmental impacts.

At band E, expect responses either to explain a wide range of positive and negative impacts, or to examine the variations in impacts on space/time.

At band F, expect both.

Marks should be allocated according to the markbands.

[15 marks]

Examiners report

[N/A]

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a. Identify **three** fossil fuels. [2]

b. Suggest **two** reasons for the changing importance of nuclear energy. [2x2

c. Explain the relationship between energy usage and ecological footprint for **one or more** countries. [5]

Markscheme

a. Fossil fuels include: oil, natural gas, coal, and oil shale. Peat and tar sands are also acceptable. Award 2 marks if three are correctly identified, or 1 mark if two are correct. No credit may be given if only one of the three is correct.

b. Award up to 2 marks for two distinct valid reasons, provided that they are developed by means of examples, explanation or detail.

Possible reasons include: issues associated with the disposal of nuclear waste; issues associated with safety/radiation leaks; relative cost of constructing nuclear power stations compared with other sources of power; increased need to generate electricity without relying on fossil fuels; acceptance that nuclear power is less polluting; anti-nuclear protests; decline in availability of non-renewables; costs of fossil fuels – peak oil scenario; meeting international targets for CO_2.

Note that answers may explain either an increase or a decrease in the importance of nuclear power, and do not need to consider both for the award of full marks.

c. Countries with a higher energy usage generally have a higher ecological footprint [1 mark]. This stated relationship must be relevant to the named country or countries chosen.

Explanations for the relationship must explicitly link the country's energy usage to its ecological footprint: a possible explanation for the usual relationship could be the fact that most energy is derived from fossil fuels such as coal, oil and natural gas, the use of which inevitably raises a country's ecological footprint since an ecological footprint includes the area (land) required for absorbing waste – in this case carbon dioxide emissions. Answers could also look at how increased use of renewable energy decreases the footprint.

Four basic statements of explanation [4×1 marks].

Two developed statements of explanation [2×2 marks].

One explanation with very good detail [4 marks].

If no country/countries are utilized in the response a maximum 3 marks may be awarded.

Examiners report

a. This was a straightforward question, which was remarked upon in a number of the G2 comments. Interestingly enough a large number of candidates did not score both marks here. Some interesting incorrect answers such as wood, carbon, diamonds.

b. Generally answered very well. Developed, and with examples, especially when discussing the hazardous nature of nuclear energy. Candidates perhaps do need to explain what they mean when referring to nuclear energy as "renewable" as technically this is not correct. Many responses used recent events in Japan to highlight contemporary changes taking place in some countries' nuclear programmes. Perfect.

c. Most candidates attempted to describe the ecological footprint calculation and then stated that there is a positive relationship between energy use and ecological footprint. It was best explained when two countries with differing footprint sizes and energy usage were given as examples. Few candidates mentioned the waste aspect of the footprint, that is, dealing with carbon dioxide emissions, which is very much linked to the type of energy used and hence relevant to the question.

Discuss why resource conservation strategies may be more effective than population control in reducing global resource consumption.

Markscheme

Responses should have a clear understanding of the terms “conservation strategies” and “population control” and comment on their utility value when it comes to reducing world resource consumption.

Resource conservation strategies include:

- recycling
- substitution
- waste reduction
- conservation.

Population control may relate to:

- anti-natal/pro-natal policies/trends
- migration
- positive checks including disease, famine, war (Malthus’ view)
- population control by empowering women.

Good responses that score well at AO3 (synthesis/evaluation) will consider both sides of this question and may use one or more of the following approaches:

Spatial – Responses may argue that there is a negative correlation between a country’s ecological footprint/resource consumption and high population growth rates. This will fuel the argument that conservation strategies will be more effective in reducing global resource consumption.

Temporal – Population control would only be important in terms of reducing the world’s resource consumption in the short term because conservation strategies may take a long time to enact and for their benefits to be felt. Stronger responses may comment that as nations develop, population growth rates tend to decline and as such, controls are unnecessary. This is usually accompanied by an increased ecological footprint.

Perspectives – The world’s high-income countries may have the resources to enact conservation measures, but this is unlikely to be a priority for low-income countries. Improved standards of living are linked to reduced fertility. Responses could use the Malthusian debate to help structure their viewpoint. “Control” could include government
strategy but also decisions made by the individual woman within the family.

Responses may take a balanced view or may argue one is more effective than the other. They should also tackle the question on a “global” scale (as that is the question).

At band D, responses will describe details of conservation strategies or population control (alternative approaches) making links to how they may reduce global resource consumption.

At band E, responses will either explain "two sides" of the question or will synthesize well developed themes to discuss how resource consumption is not only linked to population and conservation strategies, but extends into economic and lifestyle considerations.

At band F, expect both.

Marks should be allocated according to the markbands.

Examiners report

[N/A]

"There is no truly sustainable solution to the world's growing energy problems." Discuss this statement.

Markscheme

Responses are likely to identify energy-related problems such as: meeting the growing demand; increasing the use of renewable sources of energy; cutting energy costs, increasing energy availability; expansion of energy production into sensitive environments. There could be a brief explanation of the causes of the problems identified.

Responses could also include some discussion of what a sustainable solution involves, with clear reference to being able to meet future demand.

Candidates are likely to divide energy resources into renewable (wind, solar, geothermal, hydro, tidal) and non-renewable (fossil fuels and possibly nuclear energy). Many answers are likely to discuss each of the renewable sources, pointing out their relative merits. However, development of renewable sources (generally considered to be sustainable) is unlikely to be able to meet the growing demand owing to high investment costs and locational considerations.

In considering some of the other energy problems, the discussion might extend to strategies of energy conservation/reduction.

To reach bands E and F, responses should show a sound understanding of sustainability and a good knowledge of at least two distinct energy problems.

Marks should be allocated according to the markbands.

Examiners report

This was the most popular question. In general the best answers had excellent knowledge of the term "sustainable" when applied to specific energy issues. The grade E and F answers had a balanced approach of both energy conservation and alternative energy sources with pertinent exemplification, for example, wind farms in Denmark. Weaker candidates tended to write about the advantages and disadvantages of numerous alternative energies with little reference to either energy problems or sustainability. These were self-limiting.

"The world is far too dependent on oil." To what extent do you agree with this statement?

Markscheme

Candidates are expected to consider the importance of oil in today's world as the major source of energy as well as its significance for geo-politics.

Responses are also expected to consider the changing importance of other energy sources.

Most responses are likely to focus on the finite/non-renewable nature of oil stocks and argue that the use of renewable resources is urgently needed in order to guarantee sufficient energy availability for the future and to mitigate the adverse effects of dependence on oil, especially its adverse environmental impacts such as pollution and global climate change. It is anticipated that more than one non-renewable resource would be considered, but the discussion of non-renewable sources need not be balanced for this approach to reach the highest markbands, provided any examples given are valid and well developed.

Some candidates may argue (correctly) that the world's oil reserves are currently as high or higher than they have ever been, and that therefore there is less pressing need to develop alternatives than supporters of renewable energy sources advocate. To reach the highest markbands such an approach would need to be well-balanced (taking into account environmental impacts, especially) as well as well-evidenced, with reference to newly discovered deposits being added to reserves, to the development of less conventional sources of oil such as tar/oil sands, and to improved technologies that have enabled higher effective extraction rates.

Alternative approaches may be equally valid and should be considered on their merits.

Responses that are generalized, with little or no data, figures or examples, are unlikely to advance beyond band D.

At band F, the conclusion should be well-grounded in evidence or will demonstrate different perspectives of the ways in which dependency is a problem.

Marks should be allocated according to the markbands.

Examiners report

There were some very good answers with candidates demonstrating a wide knowledge and understanding of major issues around oil. These included geopolitics; oil as a raw material for plastics, paints, fertilizers; environmental concerns, as well as oil as the major source of fuel. The best answers were intelligent and well crafted. These responses contained accurate, specific, well detailed knowledge and understanding with named examples and case studies which were well chosen and developed. These developed essays made interesting reading with both a clear focus and balance and covered various aspects of the dependency on oil. Most candidates concentrated on the finite/non-renewable nature of oil stocks as both fuel and raw material and argued that the use of renewable resources is urgently needed in order to guarantee sufficient energy availability for the future and to mitigate the adverse effects of dependence on oil, especially its adverse environmental impacts such as pollution and global climate change as well as geo-political issues. Several candidates made reference to "energy returned on energy invested" and were well versed on facts and figures of both oil production and oil consumption.

"Only high-income countries can effectively develop sustainable sources of energy." Discuss this statement, referring to examples.

Markscheme

There are many possible approaches to this question, and each should be marked on its merits.

It is expected that candidates will mention more than one type of sustainable energy and attempt to distinguish between them. The question also demands some comparison between high-income and low-income countries in terms of the uptake of sustainable energies/renewables.

Many responses may look at the successful strides many lower income nations are making in the effective use of renewables such as India with biogas, China with hydro electric power and solar energy, and Brazil with ethanol.

Responses at band D are likely to provide a descriptive account of sustainable sources of energy and their merits, without any real attempt to link the discussion to examples that reveal the idea that adopting sustainable sources of energy could be regarded as a costly venture that only high-income countries can afford. Responses at this level may conclude that some forms of sustainable energy are less costly than others to introduce and implement.

At band E, responses are likely to demonstrate either a clear understanding that changing to sustainable sources of energy implies significant economic and possibly social costs, but that such a change is essential for development to be ecologically sustainable or contest the statement by, for instance, offering examples that demonstrate that even some non-wealthy countries have made great strides in changing to sustainable sources of energy.

At band F, responses should incorporate both these ideas, though not necessarily in equal depth, and should provide a conclusion that matches the arguments advanced.

Marks should be allocated according to the markbands.

Examiners report

[N/A]

"A falling fertility rate is always beneficial to a country." Discuss this statement.

Markscheme

There are many possible approaches to this question, and each should be marked on its merits.

Fertility rates should be defined, this can be stated or implied.

Benefits could be: reduced costs for schooling, adults can begin to save; less environmental pressure; possible reduction of resource consumption; traditional roles of women changing, increased number of women in the workforce; potential for greater gender empowerment.

Problems could be: aging population; smaller workforce; increased tax burden; reduced market; closure of schools/clinics; need for migrants to boost employment.

Responses should make use of examples.

Responses that focus on describing population policies in some nations and not the consequences of falling fertility rates in that country will be self-limiting as this is not the question. Responses that consider only one side of the argument are unlikely to progress beyond band D. Responses that look at both benefits and problems of a falling fertility rate in a more balanced manner are likely to access bands E and F.

Marks should be allocated according to the markbands.

Examiners report

[N/A]

"We still have the resources to live as wastefully as we want." Discuss this statement.

Markscheme

Whether or not the statement is accepted as holding any validity, it suggests many implications worth discussing. These implications include not only

considerations of demographic, social, cultural, economic and (geo-)political development/progress but also of environmental, social and economic

sustainability.

Many approaches are possible.

Some candidates may base their discussion around the distinction between renewable and non-renewable resources, arguing that by using the former, we can reduce or remove our concern about using the latter. Nuanced positions are also tenable since some non-renewable resources are present in such large amounts that they could easily supply our needs for many generations (no adverse implications), whereas other non-renewables are in such short supply that they do require immediate protection, conservation or substitution.

An alternative approach might be to look at the adverse effects of living wastefully and then consider how society or individuals can avoid these problems. For example, it might be argued that wastefulness could lead to positive impacts such as the stimulation of new technologies, new ideas, the substitution of resources, recycling and policies to reduce resource use.

Stronger candidates are likely to point out that there are some ways of assessing or measuring our impact(s), employing such approaches as environmental footprints and food miles. Stronger responses may also link the discussion to neo-Malthusian and opposing viewpoints about the relationship between population size and resource consumption.

Answers that are simplistic and/or generalized with few or no relevant examples are unlikely to advance beyond band C.

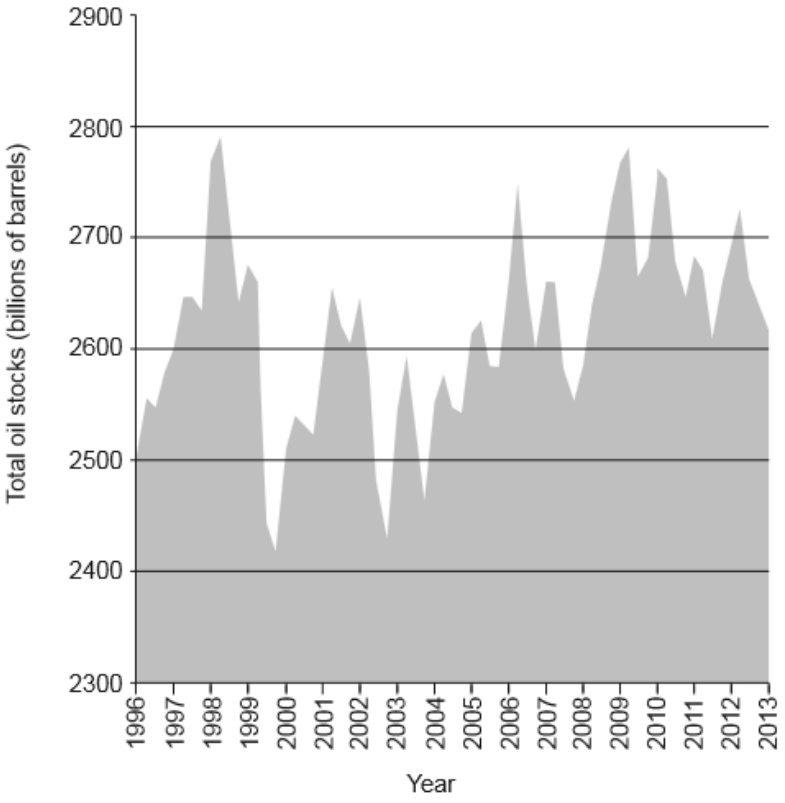
Responses that discuss a range of ideas, supported by evidence, within a structured framework (*eg* compares renewable and non-renewables, or different societies, *eg* rich/poor countries) and show some recognition that there is room for alternative viewpoints about this question are likely to be credited at band E/F.

Marks should be allocated according to the markbands.

Examiners report

This was also a popular question and many candidates approached this with a good knowledge and understanding of issues related to consumption and resource use. The best responses tended to look at a range of resources and ideas supported with evidence or actual case studies. Some responses neglected to use examples of places when discussing specific resources and this resulted in a very generic response, which was penalized by the markbands. Many responses also tended to limit themselves just to oil or energy resources, this was fine but the question was open to many other types of resources. Many candidates focused their discussions around the neo-Malthusian versus Boserup debate and examined the relationship between population size and resource consumption. The best answers had appropriate application and were developed to cover most aspects of the question. Good scripts demonstrated some evaluation of wasteful living and sustainability options.

The graph shows the total oil stocks of the world’s major economies in billions of barrels. (Oil stocks are barrels of oil that have already been extracted and stored for future use.)



[Source: adapted from www.valuewalk.com and US Energy Information Administration (EIA)]

a. State the year in which total oil stocks were at their peak. [1]

b. Referring to the graph, describe the trend in total oil stocks since the year 2000. [3]

c. Suggest **three** reasons why total oil stocks may change from one year to the next. [6]

1.

2.

3.

Markscheme

a. 1998

b. Generally upwards **[1]** though with numerous peaks and troughs **[1]**, with **[1]** for some attempt at quantification of the overall trend or of the fluctuation from the y axis.

c. Oil stocks (barrels of oil that have already been extracted and stored for future use) change due to changes in production and/or changes in demand/usage. Either approach, or both, is acceptable.

*In each case, award **[1]** for a valid reason, and **[1]** for offering some expansion, detail or exemplification that is related to changing stocks (not reserves)*.

Possibilities include:
- geopolitical reasons eg Saudi Arabia over-extraction to flood the market and lower the price
- economic recession or boom could affect consumption of oil stocks
- stocks could increase due to new oil fields coming into production / decrease due to decline of existing fields
- increased demand because of extreme weather conditions (exceptionally cold or exceptionally hot year)
- economic growth in major economies leading to increase in demand
- substitution of oil by renewable resources
- stockpiling in case of conflict.

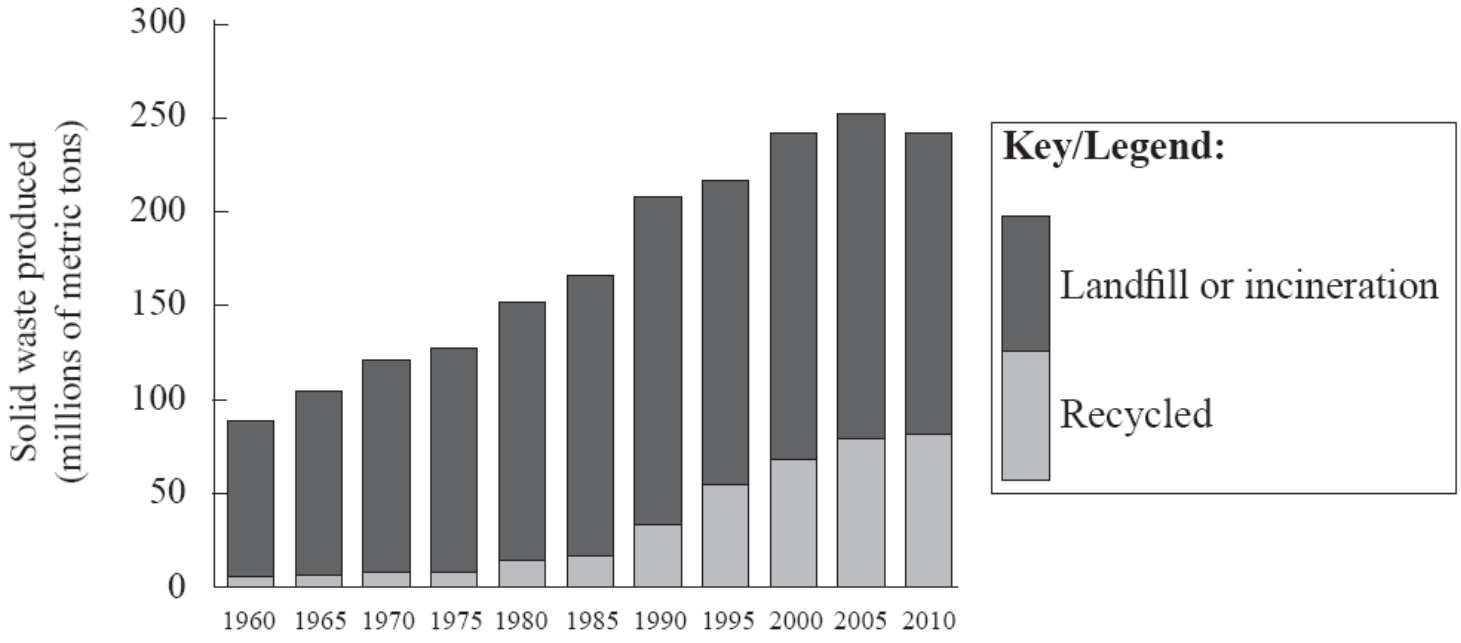
Examiners report

a. This presented no problems but candidates must not give a range of years when the question clearly asks 'state the year'.

b. This was answered well by most candidates who also included the necessary quantification.

c. This was generally well answered if the candidate had understood the meaning of 'stocks' as defined in the stem of the question. Answers varied from economic reasons such as a recession or boom impacting upon the demands of available stocks; weather-related answers explained how energy demands going up or down could impact upon the given stocks; and valid geopolitical reasons were often given as well. Weaker responses often failed to fully develop or exemplify their reasons.

The graph shows the solid waste produced in one country from 1960 to 2010.



[Source: © International Baccalaureate Organization 2013]

a. Describe the trends shown by the graph. [4]

b(i) State **one** example of resource substitution. [1]

b(ii) Explain **one** benefit of the resource substitution you have chosen in (b)(i). [2]

c. Referring to examples, distinguish between waste recycling and waste reduction. [4]

Markscheme

a. Any three of the following statements for ***[1 mark]*** each:

- solid waste produced is rising over time
- levels off/declines a little after 2005
- landfill/incineration always much larger than recycled
- recycled not taking off until 1980s
- recycling increasing as a proportion of solid waste.

One of statements must refer to data values for the final ***[1 mark].***

b(i) Example must name both the old resource and the new resource ***[1 mark]***.

Possibilities such as:

- fibre-optics replacing copper
- cotton bags replacing plastic bags
- biofuel replacing petroleum.

b(ii) Depending on the resources chosen, potential benefits include reduced costs, faster production, less pollution, less waste, replacement of non-renewable resource by renewable resource, *etc*. Benefits may be to people/the environment/industry, *etc*.

Award ***[1 mark]*** for explaining why the resource substitution chosen in (b)(i) is beneficial (*eg* cheaper/less pollution). Award ***[1 mark]*** for development and/or exemplification.

c. Waste recycling describes the re-processing of waste to produce a new product ***[1 mark]*** *eg* plastic bottles are recycled to produce new plastic products such as park benches or new bottles ***[1 mark]***.

Waste reduction describes a broader range of methods that reduces the amount of waste produced ***[1 mark]*** *eg* re-using materials, repairing broken goods, lower consumption, reduced packaging ***[1 mark]***. This strategy could include recycling.

Examiners report

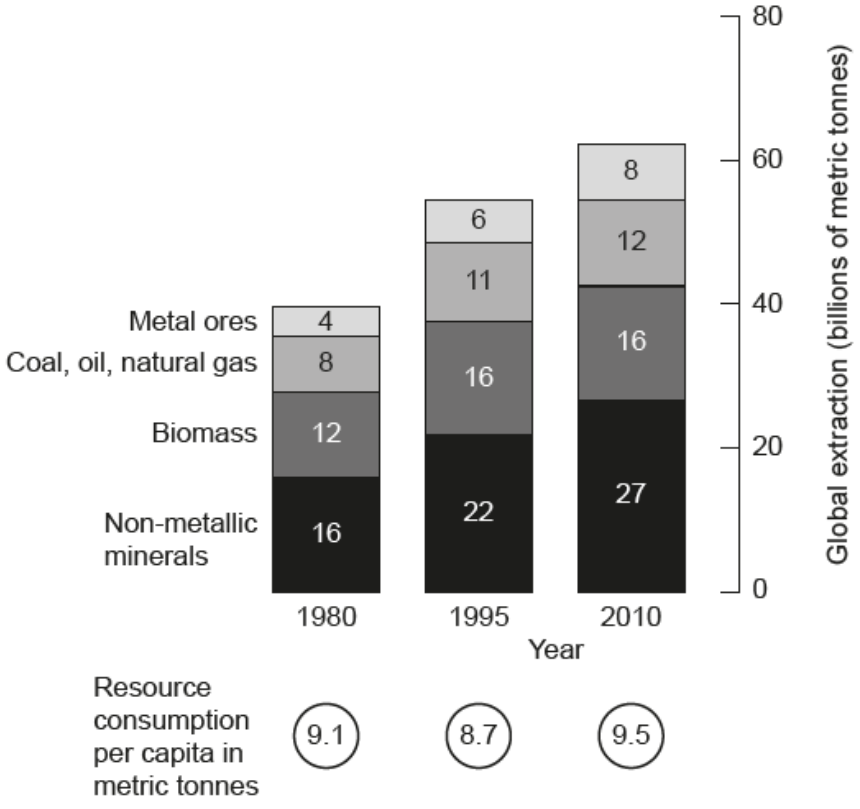
a. Straightforward description was required to demonstrate the various trends in the data. Some candidates struggled to effectively understand the complexities of a compound bar graph, others went too far with attempts at explanation of the data presented instead of a description of trends.

b(i) A wide range of examples was seen. Some candidates failed to name both the old and new resource.

b(ii) Most candidates could demonstrate why the resource substitution chosen in (b)(i) was beneficial (for example, more abundant/economical or less harm to the environment) but weaker scripts failed to gain the extra mark for development and/or exemplification.

c. The majority of candidates had no problems distinguishing between these two terms and providing relevant examples such as recycling plastic bottles into furniture, or reducing packaging for waste reduction. There were a few candidates who confused recycling with reusing.

The graph shows the global extraction of several important groups of resources and per capita consumption rates.



[Source: Ellen MacArthur Foundation, www.ellenmacarthurfoundation.org]

a. Referring to the graph, describe the trend in global biomass extraction between 1980 and 2010. [3]

b. Suggest **two** reasons why the total resource consumption per capita decreased between 1980 and 1995, even though global resource extraction was increasing. [4]

c. Suggest **two** disadvantages of recycling materials as a strategy to reduce resource consumption. [4]

Markscheme

a. Rises initially (1980–1995) from 12 to 16 **[1]** but then plateaus (1995–2010) at 16 **[1]** use of data **[1]**.

[3 marks]

b. Possible reasons include: the implementation of sustainable policies; economic downturn in resource-consuming countries; changing lifestyles reducing consumption; long-term resource storage.

*For each suggestion, award **[1]** for identifying a valid reason, and **[1]** for linking it clearly to a fall in total resource consumption per person even though global extraction is still increasing.*

For example: An economic downturn could result in less consumption **[1]** even though companies are still extracting more resources **[1]**.

For example: A large rise in population ***[1]*** occurring without with a similar rise in resource extraction ***[1]*** so per capita usage falls.

[4 marks]

c. *Award **[1]** for identifying a valid disadvantage, and **[1]** for further development/exemplification.*

Examples:

- Recycling can be expensive **[1]**; some nations/cities may not be able to afford the technology **[1]**

- Recycling involves transporting waste to processing centres **[1]**; transport and processing requires expenditure of energy such as fossil fuels, which leads to more emissions **[1]**.

Other possibilities include:

- durability of recycled products
- hygiene in recycling sites
- gives a false sense of security – consumption levels remain high.

[4 marks]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

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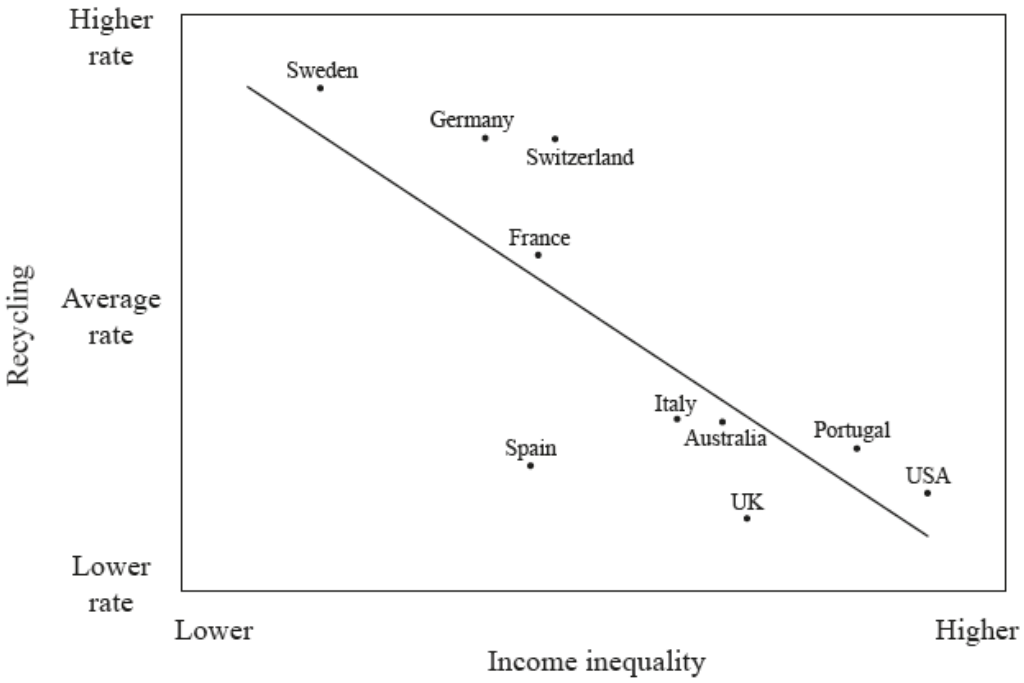
4. Patterns in resource consumption

The graph shows income inequality and recycling rates for selected high-income countries in 2010.



[Source: ©The Equality Trust. Used with permission.]

a. Describe the relationship shown on the graph. [3]

b. Explain **two** environmental benefits of recycling. [4]

c. Explain **two** disadvantages of **one named** source of renewable energy. [4]

Markscheme

a. The relationship is negative/inverse or the lower the income inequality, the more recycling takes place ***[1 mark]***. Use of valid example(s) to exemplify this relationship ***[1 mark]***. Identification of an anomaly ***[1 mark]***.

b. Award ***[1 mark]*** for each valid, distinct benefit, and ***[1 mark]*** for explanation/exemplification.

Possibilities may include:

- recycling means that fewer non-renewable resources will be needed or used ***[1 mark]***, if fewer new materials are made from scratch, the carbon footprint may be lower ***[1 mark]***
- recycling reduces solid waste and the need for waste disposal/landfill ***[1 mark]***, less green space lost/less harm to wildlife/less methane ***[1 mark]***
- recycling usually saves on the energy costs associated with transport ***[1 mark]***, since non-renewable resources often travel further to the factory than recycled resources ***[1 mark]***.

c. Award ***[1 mark]*** for each valid disadvantage and ***[1 mark]*** for explanation/exemplification.

The disadvantages depend on the choice of energy source.

Possible disadvantages:

The cost of development; the distance that power (electricity) has to be transmitted from where the resource is available; the reduction in landscape aesthetic values (*eg*, in the case of land-based wind farms); unreliable supply, dependent on weather and other conditions, meaning that the resource is not available at all times, or not available to meet peak demand times.

For example, if a candidate chooses “solar power”, the two disadvantages might be: (a) not suited to certain regions of the world (*eg*, higher latitude areas), or certain seasons (winter), and (b) installation costs remain relatively expensive.

If no valid named renewable energy source, but disadvantages are analysed, award a maximum of ***[2 marks]***.

Accept nuclear power as a renewable energy source.

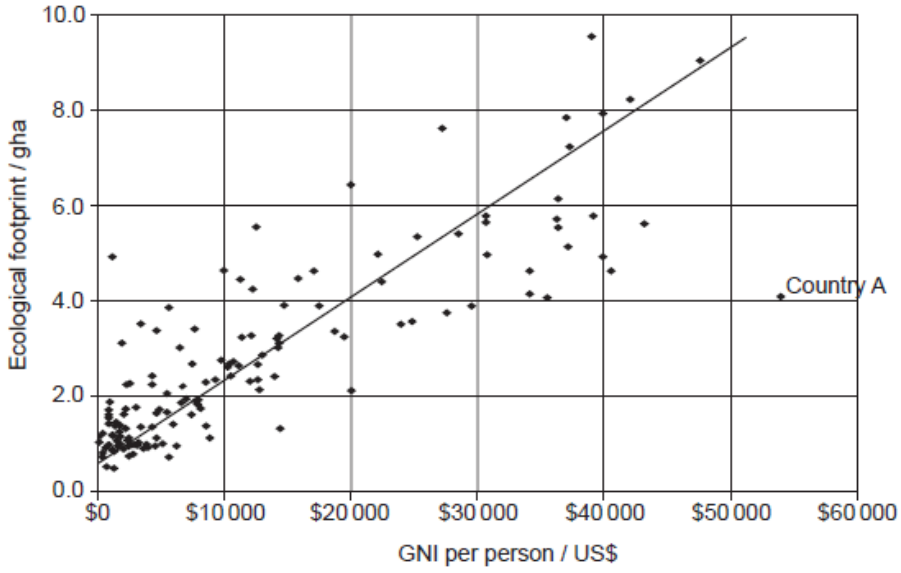
Examiners report

a. Most candidates could identify the relationship but in some cases an example and/or identification of an anomaly was missing.

b. This was well done by a large number of candidates but some missed the word “environmental” and included economic or social advantages/benefits. Reduction of landfill sites and conservation of raw materials and energy formed the most common answers with satisfactory development and/or exemplifications.

c. A very accessible and well-answered response with most candidates using solar or wind power to answer the question. Most mentioned cost of uptake with low power output as valid disadvantages and gave pertinent explanation/exemplification. There were also a number that chose HEP and illustrated this with exemplification, usually the Three Gorges Dam.

The graph shows the relationship between GNI per person and ecological footprint, in global hectares (gha), for a number of countries.



[Source: adapted from http://paulchefurka.ca]

a. State the minimum ecological footprint in global hectares for a country with a GNI of US$20 000 per person. [1]

b. Referring to the graph, describe the relationship between GNI per person and ecological footprint. [3]

c. Suggest **one** reason why country A does not fit the general pattern. [3]

d. Using examples, distinguish between recycling and resource substitution. [4]

Markscheme

a. Accept 2.1 to 2.2 **[1]**.

b. *Award **[1]** each for any three of the following:*

- positive relationship or description that matches positive
- identifying an anomaly
- a valid comment about spread/range
- a clustering of nations with low values for both variables.

Three valid descriptive points are needed and there must be some reference to data for full marks.

c. *Award **[1]** for identifying how it does not fit the trend eg higher GNI per person than would be expected given its ecological footprint.*

*Award **[2]** for identifying and developing/exemplifying a valid reason such as:*

- very good environmental policies **[1]** including things like recycling/less landfill **[1]**
- highly efficient area-intensive agriculture **[1]** which leads to high yields and involves the use of a smaller land area **[1]**
- low use of fossil fuels **[1]** due to access to renewable energy **[1]**.

d. *Award **[1]** for showing an understanding of recycling, **[1]** for showing an understanding of resource substitution, and **[2]** for examples.*

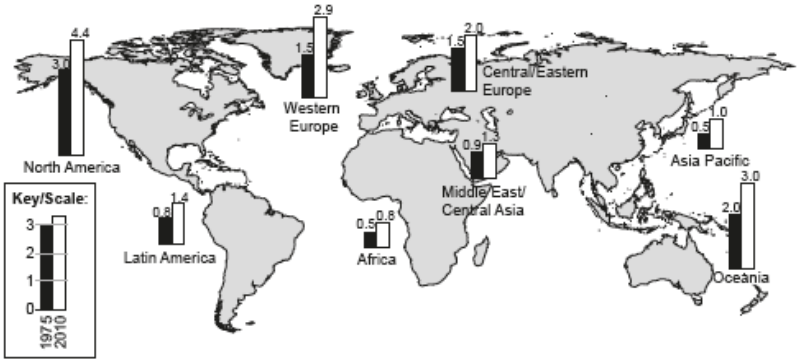
For example: Recycling is when old newspapers are processed to make new paper products, whereas resource substitution involves finding a new resource to replace an existing or depleted one, *eg* using ethanol instead of petrol. **[4]**

Examiners report

a. [N/A]
[N/A]

b. [N/A]
d. [N/A]

The map shows the ecological footprint of continental regions in 1975 and 2010. On this map the ecological footprint is a measure of the number of planet Earths needed to support the population.



[Source: © International Baccalaureate Organization 2015]

a. State which **two** regions had the most sustainable ecological footprint in 1975. [2]

b. Explain the pattern of regional ecological footprints in 2010. [4]

c. Explain the anti-Malthusian view of the relationship between population and resources. [5]

Markscheme

a. Africa **[1]** and Asia Pacific **[1]**.

b. Award **[1]** for stating a pattern of some kind. For example: “Economically developed regions (*eg* Oceania, North America, Western Europe) have higher footprints”.

Award **[1]** for each valid point made that explains why footprints may be high or low in different regions. Ideally responses should refer to both resource consumption and waste generation but this is not essential for full marks.

For example:

High Income nations that have **high standards of living [1]** tend to **consume** vast quantities of **non-renewable energy [1]** and generate lots of **greenhouse gases [1]** hence the high ecological footprint.

Possibilities include:

- quality of life/affluence
- sources of energy
- levels of energy consumption
- dominant economic activities/degree of industrialization
- levels of development
- diet, for example of ecological footprint of meat
- levels of recycling/re-use.

Accept alternative valid explanations.

Responses referring to population size should not be credited.

c. Responses should describe the anti-Malthusian view (it could be implied within the explanation) **[1]**.

For example: Resources will keep pace with population growth. Carrying capacity will increase as human population increases.

Responses should explain TWO arguments used by anti-Malthusians **[2+2]**.

Award **[1]** for each basic explanation, with an additional **[1]** for extension or exemplification.

Possibilities include:

- the use of technological fixes, *eg* in agriculture to achieve higher yields
- resource substitution overcomes resource depletion
- recycling allows conservation of existing resources.

Examiners report

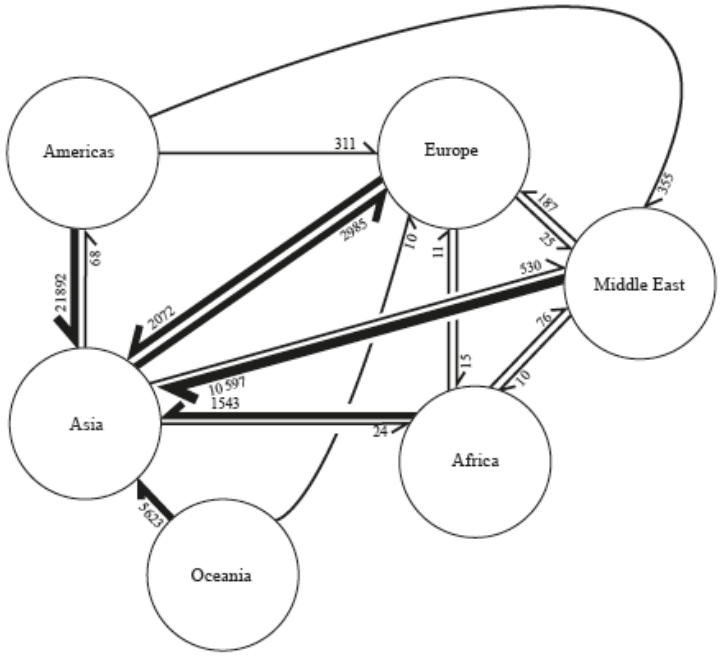
a. This was well done but there were still errors by some candidates.

b. If the question was read correctly this was a very accessible 4 marks for most candidates. Unfortunately a large number did not read the question properly and simply described the pattern with no explanations OR examined the changes between 1975 and 2010.

c. This was well done with sound knowledge and understanding of the anti-Malthusian view but explanation and exemplification were often thin. Many responses felt the need to outline the Malthusian view as well which was a waste of time and writing space. Most went for improvement in food supply by technology but there were some good responses that dealt with shift to alternatives, conservation and population control.

Patterns in resource consumption

The diagram shows the international movement of e-waste*. The numbers indicate the volume in metric tons. The arrows indicate the direction of movement and their width is proportional to the volume of movement.



[Source: adapted from J Lepawsky and C McNabb, (2010), Mapping international flows of electronic waste. *The Canadian Geographer / Le Géographe canadien* 54 (2), pages 177–195
© / Canadian Association of Geographers / L'Association canadienne des géographes]

a. With reference to the diagram, describe the movement of e-waste into **and** out of Asia. [4]

b. Briefly explain the limitations of recycling as a strategy to reduce global resource consumption. [3]

c. Explain the neo-Malthusian view of the relationship between population size and resource consumption. [4]

Markscheme

a. Possible valid statements could include:

- there is more waste going into Asia than out
- there is movement **in** from every region (all five)
- there is movement **out** to four regions (none to Oceania)
- the volume of movements **in** is very high
- Asia is the largest **importer** of e-waste mainly from Americas and the Middle East
- Asia does also **export** some e-waste, mainly to Europe

Credit other valid statements.

For the award of the full ***[4 marks]***, some mention should be included of both in (imports) and out (exports) and there should be some attempt at quantification/use of data.

b. Award ***[1 mark]*** for each valid limitation and ***[1 mark]*** for any development/exemplification (at any scale).

Possible limitations could include:

- energy is still consumed in the transportation of waste to recycling centres
- energy is used for the recycling process
- some materials cannot be recycled or are too expensive to recycle
- recycling is not available on a large enough scale to deal with all waste
- growth in recycling is outstripped by growing consumption
- there may be better alternatives, *eg* substitution, lower consumption
- desire for economic growth is greater than the desire for sustainability.

Credit other valid limitations.

c. The response must make reference to “neo-”, *eg* contemporary supporters of the views of Thomas Malthus, for ***[1 mark]***.

The remaining ***[3 marks]*** should be awarded for explanation of the view:

Human population has a carrying capacity ***[1 mark]*** because it increases geometrically while resources increase arithmetically ***[1 mark]*** leading to a check/crash/adjustment ***[1 mark]***/a need for anti-natal policies ***[1 mark]***.

Other valid points may be credited in substitution for those already mentioned.

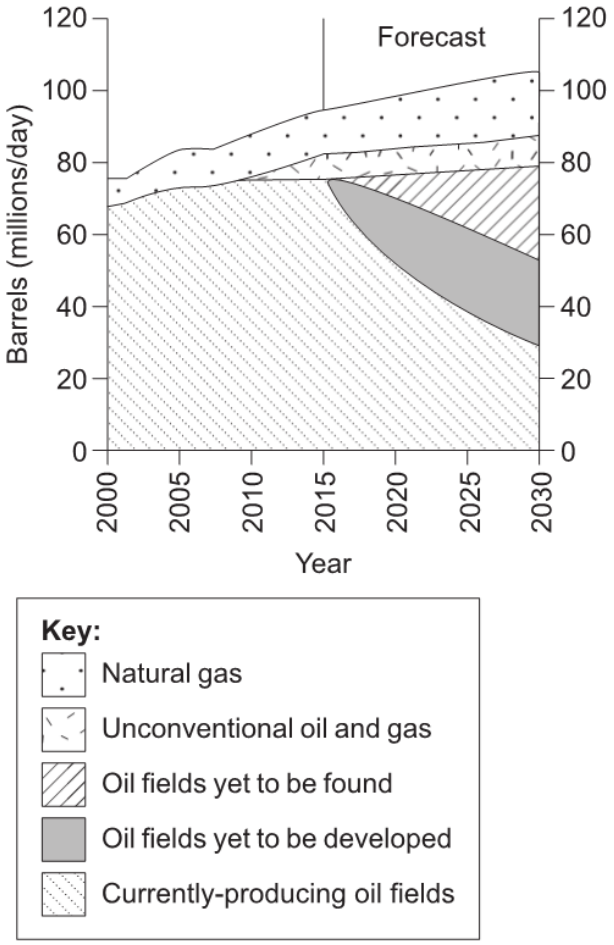
Examiners report

a. Few candidates struggled with the demands of this question. Most were able to give valid statements with effective use of quantification/data.

b. Most candidates were able to present more than one valid limitation with some development and/or exemplification. There was however some confusion between recycling and reuse.

c. Most candidates were able to give an explanation of Malthusian ideas but fewer noted the key word “neo-”. This was self-limiting. There was some sound knowledge and understanding of the “limits to growth” model and it was pleasing to see so many using annotated graphs to help their answer.

The graph shows a forecast for how future demand for oil and natural gas will be met.



a.i. Describe the trend for currently-producing oil fields shown on the graph for the period 2015–2030. [3]

a.ii. Suggest **two** possible reasons for the trend you described in (a)(i). [2]

Reason 1:

Reason 2:

b. Briefly suggest what is meant by “unconventional” oil and gas. [2]

c. Explain **two** limitations of **one named** source of renewable energy. [4]

Source of renewable energy:

Limitation 1:

Limitation 2:

Markscheme

a.i. *Award **[1]** for each of the following, up to **[3]**. Quantification required for award of full marks.*

- declining
- initially at a fast rate
- then later at a lower rate
- rate of decline changes.

a.ii. *Award **[1]** for each valid distinct reason.*

Possibilities include:

- exhaustion of existing fields
- it has become too expensive to extract
- political or government action to reduce fossil fuel use/dependence
- there is an increase in alternative sources of cleaner and/or cheaper energy / reduced demand for oil
- production from other oil fields will increase.

b. *Award **[1]** for a valid definition of "unconventional" – it is oil/gas not obtained from conventional oil/gas wells/drilling/extraction methods.*

*Award further **[1]** for naming a source, such as oil sands; oil shales; or from coal/biomass/liquids produced from the chemical processing of gas or fracking.*

c. Renewable sources of energy include solar, wind, geothermal, hydro-electric, biomass. Accept nuclear as renewable.

*In each case, award **[1]** for valid limitation and **[1]** for further development/detail.*

For example: Solar – not applicable to all areas / seasons / times of day **[1]**, including times like winter when demand in cool climates is highest **[1]**.

Other possibilities include:

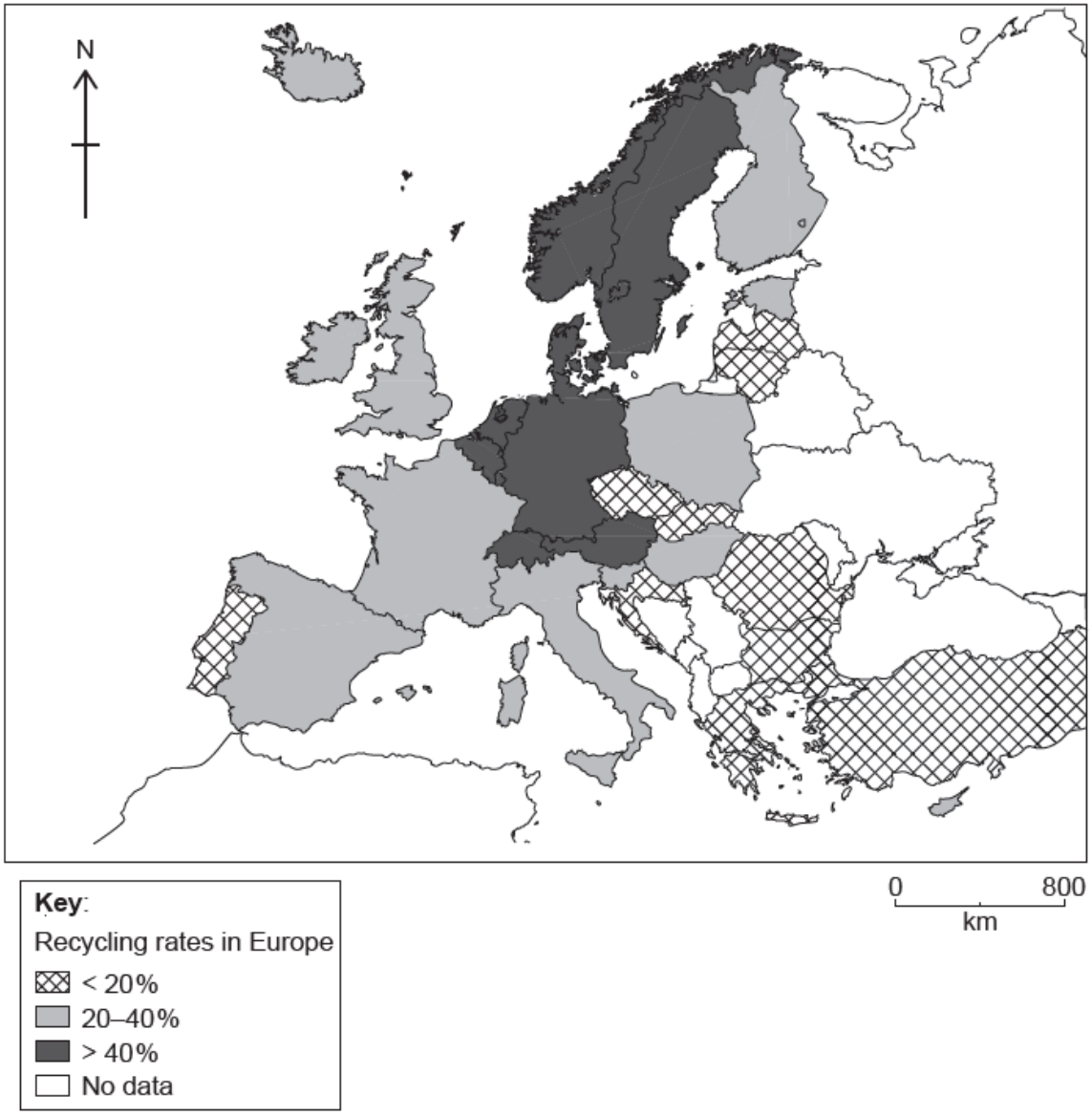
- reliance on weather
- production capacity
- expense of start-up/storage
- environmental issues
- efficiency of production / unit costs of power produced
- affordability for less developed nations.

Examiners report

a.i. [N/A]
a.ii. [N/A]
b. [N/A]
c. [N/A]

Patterns in resource consumption

The map shows recycling rates for a selection of countries in Europe in 2016.



[Source: Data adapted from European Environment Agency: www.eea.europa.eu, European Commission (c) European Union, 1995-2018 and Eurostat © European Union, 1995 - today. Eurostat do not take any responsibility for any translations or modifications to the data.]

a. Describe the pattern of recycling rates shown on the map. [3]

b. Suggest **two** reasons why recycling rates differ greatly between countries. [4]

c. Explain **two** strengths **and one** weakness of **one** local or national strategy aimed at reducing the consumption of **one named** resource. [6]

Named resource:

Local or national strategy:

Strength 1:

Strength 2:

Weakness:

Markscheme

a. *Award **[1]** for each valid descriptive point, up to a maximum of **[3]**. Must have some quantification for **[3]**.*

*Award up to a maximum of **[1]** for repeat of data for regions.*

Possibilities include:

- highest rates in Central and/or Northern Europe/Scandinavia (Germany, Austria, Switzerland, Denmark, *etc*)
- lowest rates in Eastern/South Eastern Europe (Greece, Turkey, Bulgaria, Romania, *etc*) and Portugal and Iceland
- Portugal as an anomaly
- most of Western Europe have mid-rates.

b. *In each case, award **[1]** for a valid reason and **[1]** for further development/exemplification.*

For example: Countries such as Germany, where recycling was introduced decades ago **[1]**, now have much higher recycling rates than countries such as Turkey, where recycling has only just begun **[1]**.

Possible reasons include:

- differences in government policy/prioritization of SDGs/alternative green initiatives *eg* reusing
- private sector incentives (*eg* money for returning electronics, soft drinks containers, *etc*)
- levels of education / environmental awareness
- publicity/advertising
- infrastructure available for recycling
- differences in economic development/costs of recycling – some poorer countries focus on development rather than environment.

c. *In each case, award **[1]** for the strength/weakness of one valid existing strategy and **[1]** for further development.*

*Award up to a maximum of **[4]** if there is no named resource or located/named strategy.*

The question does not refer specifically to natural resources and so enables a broad definition of resource, eg plastics.

Likely strategies include, but are not limited to: conservation, waste reduction, recycling or substitution.

For example (resource substitution): The Canadian province of Alberta has introduced a strategy to phase out the use of coal.
Strength: the province introduced this strategy in order to reduce harmful greenhouse gas emissions **[1]** with a target of zero **[1]**.
Weakness: it is expensive to develop other sources of energy **[1]** as the scale/technology for renewable sources is still in early stages of development **[1]**.

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]