ADDITIONAL MATERIALS
In addition to this question paper, you will need the Resource Folder and a pink WJEC 20 page answer book, which has been specifically designed for this examination. No other style of answer book should be used. Should you run out of space, use a standard 4 page continuation book.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen or correction fluid.
Answer all questions.
Write your answers in the separate answer book provided, following the instructions on the front of the answer book.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
You are reminded that assessment will take into account the quality of written communication used in your answers.
You are reminded that this paper is synoptic and so will assess your ability to draw on your understanding of the connections between the different aspects of the subject represented in the Geography specification.
Even where not specifically asked for, you should support your answer with examples and/or case studies.
Answer all questions.

SECTION A

In this section you may use information from the Resource Folder and your own research.

01 Describe the global pattern of food consumption. [10]
(approximately 13 minutes)

02 Outline how human activities influence the demand for water. [10]
(approximately 13 minutes)

03 Outline how physical factors influence the supply of water. [10]
(approximately 13 minutes)

04 ‘Sustainable food supply depends on managing water supplies.’ How far do you agree? [25]
(approximately 33 minutes)

SECTION B

In this section you may use information from any of your studies for AS and A2 Geography as well as from the Resource Folder and your own research.

05 Describe transport problems that one or more cities face.
To what extent is it possible to find sustainable solutions to transport problems in cities? [25]
(approximately 33 minutes)

END OF PAPER
ADVICE TO CANDIDATES

In this synoptic exercise you will be assessed on your ability to synthesise knowledge and understanding and skills derived from your A level course.

You are reminded that assessment will take into account the quality of written communication used in your answers.

The main focus of the material in this Resource Folder is related to water supplies and their relationship to food production. Much of this information is presented at the global scale. Further information related to food availability and to issues associated with food availability is presented. Information about estimates of the future availability of water supplies is also given.
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| Figure 11 | Food and Agriculture Organization’s (FAO) estimate for potential cropland expansion throughout the world | 8 |
| Figure 12 | Progress towards reducing number of hungry in the world | 9 |
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| Figure 14 | World usage of water including food production | 10 |
| Figure 15 | Use of green water and blue water (i) and losses through evapotranspiration (ii) | 10 |
| Figure 16 | Global water scarcity | 11 |
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| Figure 18 | Freshwater availability predicted for 2025 | 12 |
| Figure 19 | Options for agricultural water management | 13 |
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| Figure 21 | Usage of water by sector for selected countries | 14 |
| Figure 22 | Movements of virtual water | 15 |

Sources of information and copyright 16-17
Figure 1: Background data for selected countries and the world

<table>
<thead>
<tr>
<th>Country</th>
<th>Daily calorie consumption per person (kcal)</th>
<th>Population 2010 millions</th>
<th>Population 2025 millions (estimated)</th>
<th>GDP US$ (PPP) billions</th>
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<td>World</td>
<td>2800</td>
<td>6688</td>
<td>8004</td>
<td>82762</td>
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Sources: adapted from www.statinfo.biz and other sources

Figure 2: Selected water requirements in food production

As a general rule, to produce 1 calorie of food requires 1 litre of water.

1 kilogram grain (3400–3900 calories) requires 2225 litres of water
1 kilogram meat (1200–1700 calories) requires 10000 litres of water

Sources: www.iwmi.cgiar.org and other sources

Figure 3: Change in calorie intake in the world

Daily calorie intake per person has been growing annually throughout the world by 13.75 calories during the last 50 years.

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Source: www.guardian.co.uk

Figure 5: Average daily calorie intake by country

Source: globalist.org.ua
Figure 6: Percentage of population undernourished in each country

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<th>Number of Countries</th>
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<tr>
<td>No data</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: www.smithheggumreport.com

Figure 7: Global groundwater recharge rates

Source: adapted from ensia.com
Figure 8: The water cycle

Source: adapted from www.learnnc.org

Figure 9: The global rainfall pattern

Source: adapted from Open University
Figure 10: Index of food production for selected countries 2008–2011

Source of data: data.worldbank.org

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Source: www.fao.org
In 2009 a World Food Summit (WFS) was held. The number of hungry up to 2008 was known and an estimate for 2009 given. A target for reducing the number of hungry was set.

Figure 13: Sources of dietary energy in high-income and low-income countries by percentage

Source: fao.org
Figure 14: World usage of water including food production

Figure 15: Use of green water and blue water (i) and losses through evapotranspiration (ii)

Source: www.iwmi.cgiar.org

Source: www.iwmi.cgiar.org
Definitions and indicators

- **Little or no water scarcity.** Abundant water resources relative to use, with less than 25% of water from rivers withdrawn for human purposes.

- **Physical water scarcity (water resources development is approaching or has exceeded sustainable limits).** More than 75% of river flows are withdrawn for agriculture, industry, and domestic purposes (accounting for recycling of return flows).

- **Approaching physical water scarcity.** More than 60% of river flows are withdrawn. These basins will experience physical water scarcity in the near future.

- **Economic water scarcity (human, institutional, and financial capital limit access to water even though water in nature is available locally to meet human demands).** Water resources are abundant relative to water use, with less than 25% of water from rivers withdrawn for human purposes, but malnutrition exists.

Source: news.bbc.co.uk
Figure 17: Other challenges to water supply

- Change from fossil fuels to biofuels – will increase evapotranspiration
- Urbanisation – urban lifestyles are more demanding in terms of washing, cleaning and heating/cooling
- Climate change
  1. rising temperatures will increase evapotranspiration
  2. water requirements of crops and animals will increase
  3. patterns of rainfall distribution are likely to change

Source: adapted from news.bbc.co.uk

Figure 18: Freshwater availability predicted for 2025

Source: pm22100.net
Managing water for agriculture includes a spectrum of options – from producing under fully irrigated to purely rainfed conditions in order to support livestock, forestry, and fisheries, and to interact with important ecosystems. The continuum of water management practices starts with fields or grazing land entirely dependent on rainwater. On-farm conservation practices focus on storing water in the soil. Moving along the continuum, more surface water or groundwater is added to enhance crop production. This additional freshwater provides opportunities for multiple uses, including aquaculture and livestock within the production system.

Source: adapted from www.iwmi.cgiar.org
Figure 20: Water statistics for selected countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Total water availability from natural sources (km$^3$/yr)</th>
<th>Total water use (km$^3$/yr)</th>
<th>Total reusable water available (m$^3$/person/yr)</th>
<th>Total water withdrawals (m$^3$/person/yr)</th>
<th>Annual average precipitation (mm)</th>
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<td>2.1</td>
<td>3.6</td>
<td>92</td>
<td>160.1</td>
<td>167</td>
</tr>
</tbody>
</table>

$1\ km^3 = 1\ 000\ 000\ 000\ m^3$

Source: news.bbc.co.uk

Figure 21: Usage of water by sector for selected countries

Source: fao.org
One way to alleviate water scarcity is to grow food where water is abundant, and trade it to water-short areas. Instead of using over 2,000 litres of water to produce a kilogram of wheat, a country could simply import that kilogram of wheat, importing over 2,000 litres of virtual water.

International food trade could reduce scarcity. Instead of striving for food self-sufficiency, water-short countries would import food from water-abundant countries. Egypt, a highly water-stressed country, imported 8 million tonnes of grain from the United States in 2000. By importing grain it ‘saved’ some 8.5 billion cubic metres of irrigation water, which is the equivalent of one sixth of the annual releases from the High Aswan Dam.

Global food trade has the potential to meet all demands without worsening water scarcity or requiring additional irrigation. Water-abundant Latin America, Europe, the United States, Canada and Russia can increase food production to export food to water-short countries.

However, many countries remain wary of depending on imports to meet basic food needs, despite growing water problems. Least developed countries lacking hard currency may not be able to afford food imports and may be fearful of consequences in case of devaluation or financial crisis. Many rural poor whose livelihoods depend on locally grown crops may be affected by cheap (often subsidised or dumped) imports from Europe or the United States.

Source: news.bbc.co.uk
Sources of information and copyright

Figure 1 http://www.statinfo.biz/Data.aspx?act=7753&lang=2

Figure 2 http://www.iwmi.cgiar.org/assessment/files_new/synthesis/Summary_SynthesisBook.pdf
http://www.buywholefoodsonline.co.uk/images/P/wheat-flakes-1kg-1000.jpg
http://trivandrumgrocery.com/media/catalog/product/cache/1/image/800x800/df78eab33525d08d6e5fb8d27136e95/e/v/evenly-cut-cubed-fresh-chicken.jpg

Figure 3 http://www.iwmi.cgiar.org/assessment/files_new/synthesis/Summary_SynthesisBook.pdf

Figure 4 http://www.guardian.co.uk/environment/datablog/2009/sep/02/meat-consumption-per-capita-climate-change

Figure 5 globalist.org.ua/eng/14467-world-food-consumption-in-calories-per-day-the-map

Figure 6 http://www.smithheggumreport.com/wp-content/uploads/2011/01/undernourished_world_map.png

Figure 7 http://ensia.com/features/groundwater-wake-up/

Figure 8 http://www.learnnc.org/lp/media/uploads/2012/03/1_8.jpg

Figure 9 http://school.demo.moodle.net/pluginfile.php/2402/mod_imscep/content/2/Items/x_sdk125_1_thumbnail_id400049013219.html

Figure 10 http://data.worldbank.org/indicator/AG.PRD.FOOD.XD

Figure 11 http://www.fao.org/docrep/011/i0100e/i0100e00.htm

Figure 12 http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf

Figure 13 ftp://ftp.fao.org/docrep/fao/011/i0291e/i0291e00.pdf

Figure 14 http://www.iwmi.cgiar.org/assessment/files_new/synthesis/Summary_SynthesisBook.pdf

Figure 15 http://www.iwmi.cgiar.org/assessment/files_new/synthesis/Summary_SynthesisBook.pdf

Figure 16 and Figure 17

Figure 18 http://pm22100.net/pages/enercoop/01_dossiers/unept-water/11-watavail-1995-2025.jpg

Figure 19 http://www.iwmi.cgiar.org/assessment/files_new/synthesis/Summary_SynthesisBook.pdf
Figure 20  http://news.bbc.co.uk/1/shared/bsp/hi/pdfs/21_08_06_world_water_week.pdf
Figure 21  fao.org/nr/water/aquastat/data/query/results.html
Figure 22  http://news.bbc.co.uk/1/shared/bsp/hi/pdfs/21_08_06_world_water_week.pdf
INSTRUCTIONS TO CANDIDATES

A new copy of this Folder will be given out in the examination. This copy must not be taken into the examination.

Work through this Folder to make sure you understand all the resources. You may seek help from your teachers or any other sources in this context. You have to apply your critical understanding to an unfamiliar situation.

ADVICE TO CANDIDATES

The information in this folder relates to water supplies and their relationship to food production. Much of this information is presented at the global scale. Further information related to food availability and to issues associated with food availability is presented. Information about estimates of the future availability of water supplies is also given.
Guidelines for using the pre-release materials

The contents of the booklet should be studied carefully. The examples given will help in answering some of the questions on the question paper. To give a fuller answer, it is advisable to look at other material before the examination. This could be similar topics, related to information in other countries, or may be the same countries but in greater depth or on closely related topics. It would be particularly useful to note if other case studies seem similar in nature, or if they show contrasting perspectives to those from the material in this Resource Folder.

Some of the resource materials come from Geography textbooks, but others come from companies, pressure groups, research organisations, governments and private individuals. In some cases they are using information to promote their own interests rather than to represent an impartial view. It is worth considering if they are trying to support a particular interest group and persuade readers to agree with them. In finding other materials, it is worth bearing in mind that they might not be presented in an impartial and objective way.

Material in the Resource Folder may often be related to other themes found in G4, and to other units in Geography AS and A2. These links should be noted, as there will be opportunities to refer to such connections with other work in some of your answers. Being able to link together different parts of your Geography studies is important and will be credited. Such linkages are sometimes referred to as ‘synopticity’.

Textbooks, journals, good quality newspapers and television and radio programmes are good sources of information. Probably the most accessible source of geographical information is the Internet, but it is also the one which may be most susceptible to bias and lack of impartiality. Many of the resources are extracted or adapted from sources on the Internet. These sources have the web addresses provided only for copyright reasons. Many are only extracts or shortened versions of fuller documents and some may be inaccessible by the date of the release of this Resource Folder. Following some of these links for greater depth of reading and for more recent updates of material can be helpful but is not essential. It is not the intention that by providing these web addresses every one listed is researched.

Each candidate will be provided with a copy of the Resource Folder, for use in the examination, at the same time as the question paper is issued at the beginning of the examination on the day set for the paper.

Copies of the Resource Folder with added notes, or notes from research carried out in the previous six weeks, may not be taken into the examination.
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Source: www.guardian.co.uk

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<th>&lt; 2.5</th>
<th>No data</th>
</tr>
</thead>
</table>
| Source: www.smithheggumreport.com

Figure 7: Global groundwater recharge rates

Source: adapted from ensia.com
Figure 8: The water cycle

Condensation → Evaporation → Transpiration → Surface runoff → Streamflow → Snowmelt runoff to streams → Infiltration → Groundwater storage → Groundwater discharge → Groundwater flow → Water storage in oceans

Source: adapted from www.learnnc.org

Figure 9: The global rainfall pattern

Average annual precipitation (mm):
- 3000
- 2000
- 1000
- 500
- 250
- below 250

Source: adapted from Open University

Turn over.
Figure 10: Index of food production for selected countries 2008–2011

Source of data: data.worldbank.org

Figure 11: Food and Agriculture Organization’s (FAO) estimate for potential cropland expansion throughout the world

Source: www.fao.org
In 2009 a World Food Summit (WFS) was held. The number of hungry up to 2008 was known and an estimate for 2009 given.

A target for reducing the number of hungry was set.

Source: www.fao.org

Figure 13: Sources of dietary energy in high-income and low-income countries by percentage

**High-income countries**
- Cereals 45
- Oils and fats 13
- Sugar and sugar products 11
- Meat and offal 8
- Pulses, nuts and oilseeds 3
- Roots and tubers 1
- Others 19

**Low-income countries**
- Cereals 55
- Oils and fats 9
- Sugar and sugar products 5
- Meat and offal 3
- Pulses, nuts and oilseeds 6
- Roots and tubers 11
- Others 11

Source: fao.org
Figure 14: World usage of water including food production

Figure 15: Use of green water and blue water (i) and losses through evapotranspiration (ii)

Note: Production refers to gross value of food production. The pie charts show total evapotranspiration of water from crops in cubic kilometres by region.

Source: www.iwmi.cgiar.org
Definitions and indicators

- **Little or no water scarcity.** Abundant water resources relative to use, with less than 25% of water from rivers withdrawn for human purposes.

- **Physical water scarcity (water resources development is approaching or has exceeded sustainable limits).** More than 75% of river flows are withdrawn for agriculture, industry, and domestic purposes (accounting for recycling of return flows).

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- **Economic water scarcity (human, institutional, and financial capital limit access to water even though water in nature is available locally to meet human demands).** Water resources are abundant relative to water use, with less than 25% of water from rivers withdrawn for human purposes, but malnutrition exists.

*Source: news.bbc.co.uk*
Figure 17: Other challenges to water supply

- Change from fossil fuels to biofuels – will increase evapotranspiration
- Urbanisation – urban lifestyles are more demanding in terms of washing, cleaning and heating/cooling
- Climate change
  1. rising temperatures will increase evapotranspiration
  2. water requirements of crops and animals will increase
  3. patterns of rainfall distribution are likely to change

Source: adapted from news.bbc.co.uk

Figure 18: Freshwater availability predicted for 2025

Source: pm22100.net
Managing water for agriculture includes a spectrum of options – from producing under fully irrigated to purely rainfed conditions in order to support livestock, forestry, and fisheries, and to interact with important ecosystems. The continuum of water management practices starts with fields or grazing land entirely dependent on rainwater. On-farm conservation practices focus on storing water in the soil. Moving along the continuum, more surface water or groundwater is added to enhance crop production. This additional freshwater provides opportunities for multiple uses, including aquaculture and livestock within the production system.

Source: adapted from www.iwmi.cgiar.org
Figure 20: Water statistics for selected countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Total water availability from natural sources (km³/yr)</th>
<th>Total water use (km³/yr)</th>
<th>Total reusable water available (m³/person/yr)</th>
<th>Total water withdrawals (m³/person/yr)</th>
<th>Annual average precipitation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belarus</td>
<td>58</td>
<td>4.3</td>
<td>5992</td>
<td>435.7</td>
<td>618</td>
</tr>
<tr>
<td>Burundi</td>
<td>12.5</td>
<td>0.3</td>
<td>1553</td>
<td>42.6</td>
<td>1274</td>
</tr>
<tr>
<td>China</td>
<td>2840</td>
<td>554.1</td>
<td>2112</td>
<td>414.6</td>
<td>1245</td>
</tr>
<tr>
<td>India</td>
<td>1991</td>
<td>761</td>
<td>1618</td>
<td>644.1</td>
<td>1083</td>
</tr>
<tr>
<td>Japan</td>
<td>430</td>
<td>90.9</td>
<td>3378</td>
<td>708.4</td>
<td>1668</td>
</tr>
<tr>
<td>UK</td>
<td>147</td>
<td>13</td>
<td>2392</td>
<td>212.5</td>
<td>1220</td>
</tr>
<tr>
<td>USA</td>
<td>3069</td>
<td>478.4</td>
<td>9847</td>
<td>1550</td>
<td>715</td>
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<tr>
<td>Yemen</td>
<td>2.1</td>
<td>3.6</td>
<td>92</td>
<td>160.1</td>
<td>167</td>
</tr>
</tbody>
</table>

1 km³ = 1 000 000 000 m³

Source: news.bbc.co.uk

Figure 21: Usage of water by sector for selected countries

Source: fao.org
One way to alleviate water scarcity is to grow food where water is abundant, and trade it to water-short areas. Instead of using over 2000 litres of water to produce a kilogram of wheat, a country could simply import that kilogram of wheat, importing over 2000 litres of virtual water.

International food trade could reduce scarcity. Instead of striving for food self-sufficiency, water-short countries would import food from water-abundant countries. Egypt, a highly water-stressed country, imported 8 million tonnes of grain from the United States in 2000. By importing grain it ‘saved’ some 8.5 billion cubic metres of irrigation water, which is the equivalent of one sixth of the annual releases from the High Aswan Dam.

Global food trade has the potential to meet all demands without worsening water scarcity or requiring additional irrigation. Water-abundant Latin America, Europe, the United States, Canada and Russia can increase food production to export food to water-short countries.

However, many countries remain wary of depending on imports to meet basic food needs, despite growing water problems. Least developed countries lacking hard currency may not be able to afford food imports and may be fearful of consequences in case of devaluation or financial crisis. Many rural poor whose livelihoods depend on locally grown crops may be affected by cheap (often subsidised or dumped) imports from Europe or the United States.

Source: news.bbc.co.uk
Sources of information and copyright

Figure 1  http://www.statinfo.biz/Data.aspx?act=7753&lang=2

Figure 2  http://www.iwmi.cgiar.org/assessment/files_new/synthesis/Summary_SynthesisBook.pdf
          http://www.buywholefoodsonline.co.uk/images/P/wheat-flakes-1kg-1000.jpg
          http://trivandrumgrocery.com/media/catalog/product/cache/1/image/800x800/9df78eab33525d08d6e5fb8d27136e95/e/e/evenly-cut-cubed-fresh-chicken.jpg

Figure 3  http://www.iwmi.cgiar.org/assessment/files_new/synthesis/Summary_SynthesisBook.pdf

Figure 4  http://www.guardian.co.uk/environment/datablog/2009/sep/02/meat-consumption-percapita-climate-change

Figure 5  globalist.org.ua/eng/14467-world-food-consumption-in-calories-per-day-the-map

Figure 6  http://www.smithheggumreport.com/wp-content/uploads/2011/01/undernourished_world_map.png

Figure 7  http://ensia.com/features/groundwater-wake-up/

Figure 8  http://www.learnnc.org/lp/media/uploads/2012/03/1_8.jpg

Figure 9  http://school.demo.moodle.net/pluginfile.php/2402/mod_imscp/content/2/Items/x_sdk125_1_thumbnail_id400049013219.html

Figure 10  http://data.worldbank.org/indicator/AG.PRD.FOOD.XD

Figure 11  http://www.fao.org/docrep/011/i0100e/i0100e00.htm

Figure 12  http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf

Figure 13  ftp://ftp.fao.org/docrep/fao/011/i0291e/i0291e00.pdf

Figure 14  http://www.iwmi.cgiar.org/assessment/files_new/synthesis/Summary_SynthesisBook.pdf

Figure 15  http://www.iwmi.cgiar.org/assessment/files_new/synthesis/Summary_SynthesisBook.pdf

Figure 16  http://news.bbc.co.uk/1/hi/sci/tech/526296.stm#graphic

Figure 17  and

Figure 18  http://pm22100.net/pages/enercoop/01_dossiers/unep-water/11-watavail-1995-2025.jpg

Figure 19  http://www.iwmi.cgiar.org/assessment/files_new/synthesis/Summary_SynthesisBook.pdf
Figure 20  http://news.bbc.co.uk/1/shared/bsp/hi/pdfs/21_08_06_world_water_week.pdf
Figure 21  fao.org/nr/water/aquastat/data/query/results.html
Figure 22  http://news.bbc.co.uk/1/shared/bsp/hi/pdfs/21_08_06_world_water_week.pdf