Q1.

'The greatest challenge for mega / world cities is managing waste.'

To what extent do you agree with this view?

[20 marks]

Q2.

Figure 1 shows the percentage of low-paid residents in each London borough in 2015–16.

Figure 1

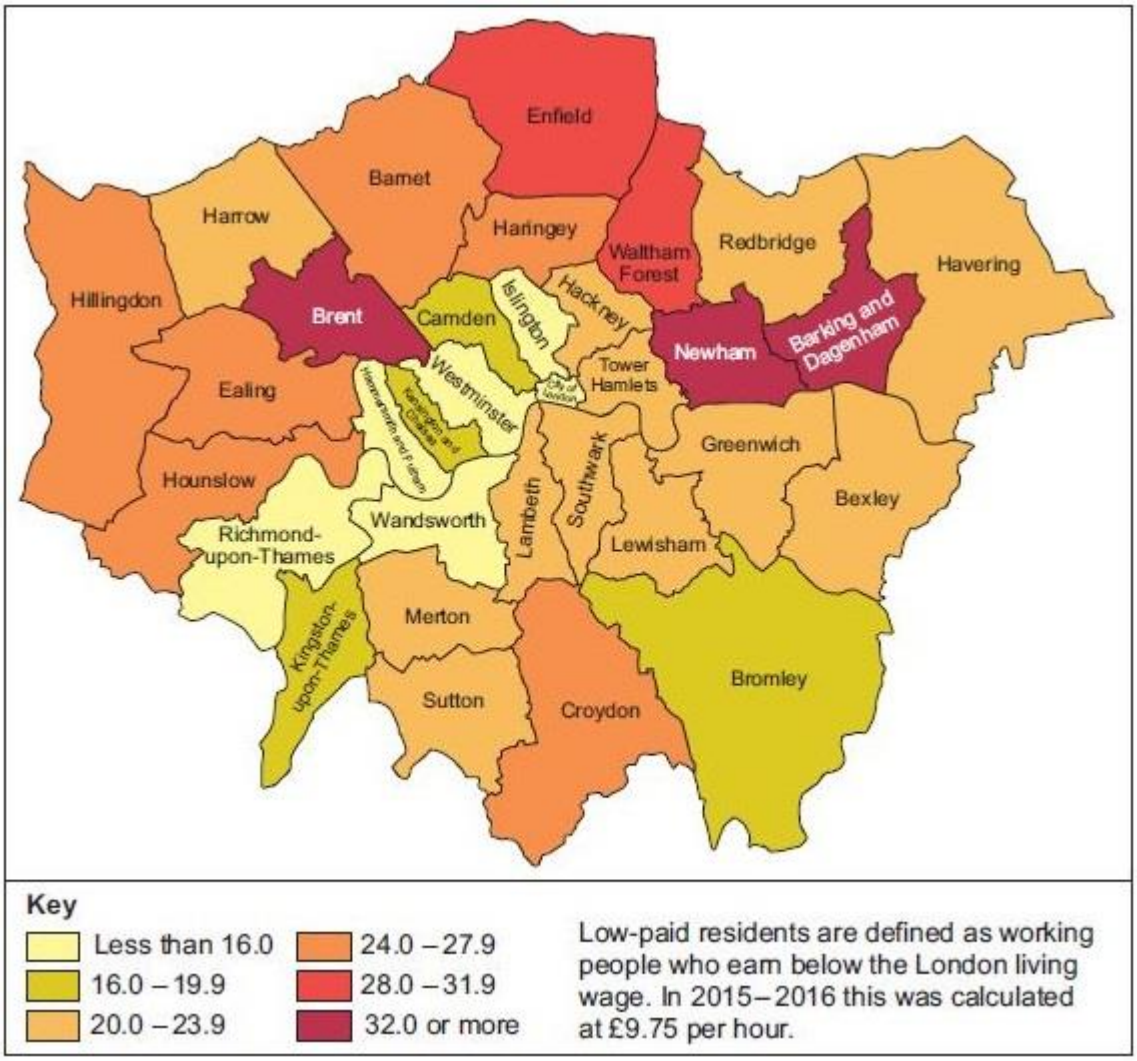

Figure 2 shows the percentage of waste that was recycled in each London borough in 2015–16.

Figure 2

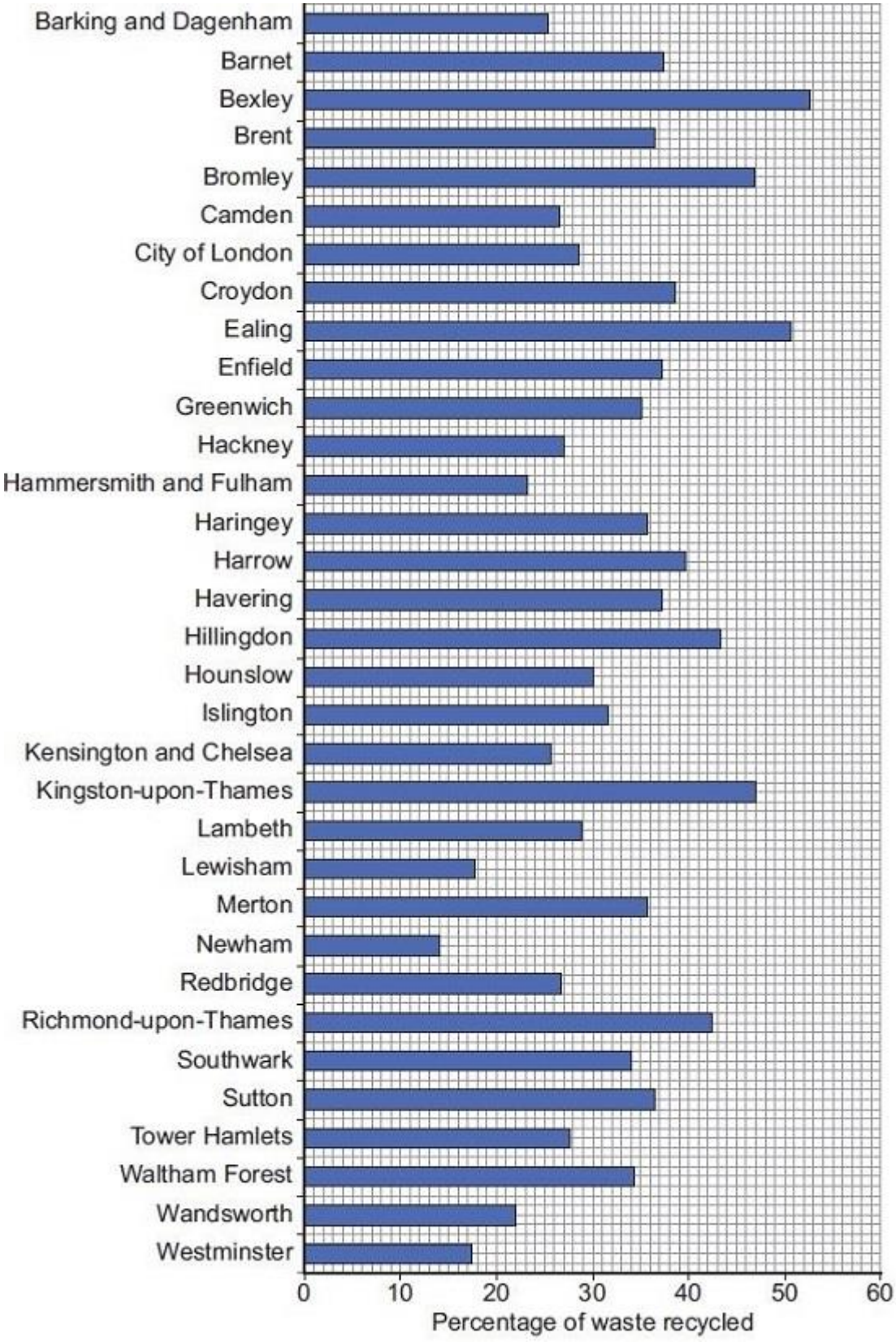

Figure 3 shows a Spearman's rank calculation used to study whether there is a relationship between the proportion of low-paid residents and rates of recycling in London boroughs
in 2015–16.

Figure 3

Rs Value	–0.206
Critical Value at 0.05 significance level (n = 33)	0.345

Analyse the data shown in **Figures 1**, **2** and **3**.

[6 marks]

Q4.

Outline environmental impacts of waste recovery.

[4 marks]

Q5.

Assess the effects on the carbon cycle of incineration and landfill approaches to waste disposal in urban areas.

[9 marks]

Q6.

Assess the extent to which incineration is a more sustainable approach to waste management than landfill.

[9 marks]

Q1.

AO1 – Knowledge and understanding of the challenges of waste management in mega / world cities.

AO2 – Application of knowledge and understanding to assess the extent to which issues relating to waste management are the greatest challenge for mega / world cities.

Notes for answers

AO1

- Contemporary characteristics of mega / world. Urban characteristics in contrasting settings. Physical and human factors in urban forms. Spatial patterns of land use, economic inequality, social segregation and cultural diversity in contrasting urban areas, and the factors that influence them.
- Urban physical waste generation: sources of waste: industrial and commercial activity, personal consumption. Relation of waste components and waste streams to economic characteristics, lifestyles and attitudes. The environmental impacts of alternative approaches to waste disposal: unregulated, recycling, recovery, incineration, burial, submergence and trade.
- Environmental problems in contrasting urban areas: atmospheric pollution, water pollution and dereliction.
- Strategies to manage these environmental problems.
- Contemporary opportunities and challenges in developing more sustainable cities.

AO2

- Expect to see reference to a wide range of mega / world cities and hence a wide range of issues relating to managing waste and other issues.
- Responses should seek to address the extent to which issues associated with waste are the greatest challenge for mega / world cities, so expect reference to other issues facing the chosen mega / world cities.
- Reference to 'mega / world cities' in the question implies the response should focus on assessing the experience of large urban areas with a population of over 10 million people, and / or urban areas that act as global centres for finance, trade, business, politics and culture.
- There is no prescription about which mega / world cities candidates should refer to. Some may focus on the experience of mega / world cities that are currently expanding at a fast rate, possibly in developing economies, or the experiences of currently large cities during their period of rapid expansion in the past.
- Responses may assess characteristics of mega / world cities that result in waste management issues. In those that are rapidly expanding in developing economies these may include:
  - many cities of this sort experience very rapid population growth rates from both rural to urban migration and natural increase (Lagos in Nigeria has an annual growth rate of over 4%)
  - many rapidly growing megacities (especially in the poorest countries) expand haphazardly with little land use planning
  - building and population density rapidly increases to extremely high levels leaving little space for other infrastructure, with what infrastructure there is rapidly reaching capacity
  - specific details will depend on the examples used to illustrate and support the response.
- Some may focus on waste management issues that have resulted in or are the experience of currently large cities during their period of rapid expansion in the past.

Specific issues will relate to the chosen urban area used to illustrate the response. Some may seek to assess the extent to which managing waste is currently the greatest challenge for these cities.

- Some responses are likely to assess the waste management issues that arise in many rapidly expanding mega / world cities. This might include:
  - keeping up with the extremely rapid increase in the volume of waste generated not only from personal consumption, but from the increasing industrial and commercial activity
  - ensuring there are facilities to deal with different categories of waste including residential, industrial and commercial, medical, agricultural and electronic waste
  - decision making on which approaches to waste disposal are most appropriate (and affordable) and dealing with issues arising from whatever approach is chosen. Approaches might include: unregulated, recycling, recovery, incineration, burial, submergence and trade
  - ensuring there is appropriate infrastructure to cope with the increase in human effluent resulting from such rapid increases in the number of residents, often in unplanned locations of the city. Construction of sewerage networks and waste water treatment works may lag behind economic development and population growth
  - large amounts of waste are unsightly and produce bad smells
  - dealing with large amounts of waste has a significant economic cost
  - poor waste management can encourage the spread of disease.
- Some responses may draw on evidence from some mega / world cities where through necessity or design waste management strategies have developed that might be seen as progressive and sustainable. Many cities, especially in poorer parts of the world, have very high levels of recycling, where some of the cities' poorest inhabitants make a living from collecting, sorting and recycling waste. Some may contrast this with different waste management strategies that have been adopted in more longstanding mega / world cities.
- Some responses may seek to assess the extent to which other issues are more important than waste management. These issues could include those listed in AO1 above, but these are not exhaustive.
- Assessment must focus on the extent to which managing waste is the greatest challenge for mega / world cities. Any view is acceptable as long as it is supported with reasoned argument and illustrative examples and evidence.

Credit any other valid approach.

Level 4 (16–20 marks)

- Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question (AO2).
- Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout (AO2).
- Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout (AO1).
- Full and accurate knowledge and understanding of key concepts and processes throughout (AO1).
- Detailed awareness of scale and temporal change which is well-integrated where appropriate (AO1).

Level 3 (11–15 marks)

- Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question (AO2).
- Generally clear, coherent and relevant analysis and evaluation in the application of

knowledge and understanding (AO2).
- Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Generally clear and relevant knowledge and understanding of place(s) and environments (AO1).
- Generally clear and accurate knowledge and understanding of key concepts and processes (AO1).
- Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).

Level 2 (6–10 marks)
- Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2).
- Some partially relevant analysis and evaluation in the application of knowledge and understanding (AO2).
- Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Some relevant knowledge and understanding of place(s) and environments which is partially relevant (AO1).
- Some knowledge and understanding of key concepts, processes and interactions and change (AO1).
- Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).

Level 1 (1–5 marks)
- Very limited and / or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (AO2).
- Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence (AO2).
- Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Very limited relevant knowledge and understanding of place(s) and environments (AO1).
- Isolated knowledge and understanding of key concepts and processes.
- Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).

Level 0 (0 marks)
Nothing worthy of credit.

AO1 = 10
AO2 = 10
[Total 20 marks]

Q2.

AO3 – Analysis of the relationship between waste streams and economic characteristics.

Mark scheme

Level 2 (4–6 marks)
AO3 – Clear analysis of the quantitative evidence provided which makes appropriate use of data to support. Clear connections between different aspects of the data.

Level 1 (1–3 marks)
AO3 – Basic analysis of the quantitative evidence provided which makes limited use of data to support. Basic or limited connections between different aspects of the data.

Notes for answers

The question requires analysis of the spatial variation in recycling rates and the proportion of low-paid workers. They should seek to analyse the relationship by comparing the graph and the map and making use of the Spearman's rank data.

For full marks there must be reference to **Figure 3**.

There is no credit for explanation of relationship.

AO3

- There is a wide variation of recycling rates across London, with a range of about 39%. The highest is in Bexley and the lowest in Newham.
- The highest recycling rates are all outer London boroughs (except for Ealing). The lowest rates are found in inner London boroughs, with the lowest being Newham in east London.
- The pattern for the spatial variation in low paid residents is not very clear. The smallest proportions occur in the west and main inner boroughs such as Westminster. The highest proportion occurs in the north both in east and west London. There is a band of 20–23.9% extending from SW to NE.
- It is clear from the Rs value that there is a negative correlation – the higher the proportion of low-paid workers the lower the rate of recycling.
- However, the relationship is not significant as the Rs value of -0.206 is below the critical value of 0.345. Therefore, we would accept the null hypothesis. Responses may note that it is fairly close to the value.
- It is clear that some of the lowest recycling rates occur in the boroughs that have the highest number of low-paid workers, for example Newham and Barking & Dagenham. However, some of the wealthiest boroughs have the lowest recycling rates such as Westminster where although less than 16% of the residents are low paid, it has the second lowest recycling rate.
- The highest rates of recycling seem to occur in boroughs which have less than 28% of people on low-pay. The highest borough, Bexley, has 20.0–23.9% of its residents on low-pay.

Credit any other valid analysis.

AO3 = 6

[Total 6 marks]

Q4.

Point marked

Allow 1 mark per valid point with extra mark(s) for developed points (d). For example:

Notes for answers

Allow credit for specific knowledge and understanding of the impacts of waste recovery. Allow credit for specific examples. The may consider the relative impacts compared to other waste disposal methods. There must be more than one impact for full marks.

- Waste recovery involves the selective extraction of waste materials for a specified use (1). Typically this reduces landfill waste and subsequent methane emissions and so has a positive environmental impact (d)(1).
- Frequently energy is generated from waste recovery for example at Avonmouth Bristol (1) meaning that not only is landfill reduced but also renewable energy is generated, reducing CO_2 emissions from using fossil fuels (d)(1). At the Avonmouth plant, 200000 tonnes of waste can be processed, generating enough electricity for 44000 homes (d)(1).

- Waste recovery also has negative impacts for example Avonmouth has been shut down as it was unable to meet its energy targets due to high costs (1) Local residents have also complained about flies and smell pollution (1).
- Recycling is also a form of waste recovery and positive impacts include less raw materials being used to make a product (1) and less waste material going to landfill, reducing methane emissions (1).

The notes for answers are not exhaustive. Credit any valid points.

AO1 = 4

[Total 4 marks]

Q5.

AO1 – Knowledge and understanding of incineration and landfill approaches to waste disposal. Knowledge and understanding of the carbon cycle.

AO2 – Application of knowledge and understanding to analyse and evaluate the impacts of these two approaches to waste disposal on carbon cycle.

Mark scheme

Level 3 (7–9 marks)
AO1 – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout.
AO2 – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Analysis and evaluation is detailed and well supported with appropriate evidence. A well-balanced and coherent argument is presented.

Level 2 (4–6 marks)
AO1 – Demonstrates some appropriate knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant though there may be some minor inaccuracy.
AO2 – Applies some knowledge and understanding appropriately. Connections and relationships between different aspects of study are emerging/evident with some relevance. Analysis and evaluation evident and supported with some appropriate evidence. A clear but partial argument is presented.

Level 1 (1–3 marks)
AO1 – Demonstrates basic/limited knowledge and understanding of concepts, processes, interactions and change. These offer limited relevance with inaccuracy.
AO2 – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Analysis and evaluation basic and supported with limited appropriate evidence. A basic argument is presented.

Notes for answers
This question links two different units of the specification, namely Water and Carbon Cycles and Contemporary Urban Environments. Students need to link their knowledge of incineration and landfill approaches to waste disposal and apply this to their knowledge and understanding of the carbon cycle. The specification requires them to study waste disposal with reference to one urban area, so expect to see specific examples. However, there is no requirement in this question for them to use a specified urban area.

AO1
- Comparison of incineration and landfill approaches to waste disposal
- Urban physical waste generation: sources of waste - industrial and commercial

activity, personal consumption.
- The environmental impacts of alternative approaches to waste disposal: unregulated, recycling, recovery, incineration, burial, submergence and trade.
- Knowledge and understanding of the carbon cycle
- Stores of carbon and factors driving change in the magnitude of carbon stores
- Changes in the carbon cycle over time

AO2
- Analysis of the link between incineration approaches and the carbon cycle. For example, in 2017 UK incinerators produced approximately 11m tonnes of CO_2, adding to atmospheric carbon stores as a fast carbon cycle.
- Evaluation of incineration approaches in removing atmospheric carbon. MSW is burnt and then used to generate electricity. It therefore reduces the impact on slow lithospheric carbon stores as it reduces need for fossil fuel consumption.
- Analysis of the link between landfill approaches and the carbon cycle. Methane is produced, a greenhouse gas, creating a fast carbon cycle.
- Evaluation of landfill approaches in changing the carbon cycle and carbon stores. It is a complex picture as once filled it can be re-landscaped with vegetation, removing atmospheric carbon and acting as a terrestrial store. Methane can also be vented and used as a fuel reducing removal of fossil fuel carbon stores.
- Evaluation of specific urban schemes on the carbon cycle. The AEB plant in Amsterdam saves about 438 kilotons of CO_2 per year. It generates about 1 million MWh electricity a year which reduces the need for fossil fuels, thereby not decreasing the size of lithospheric stores.
- They may take a comparative approach and assess the relative impacts. For example, whilst landfill produces more greenhouse gas emissions than incineration on the whole, plastics produce more CO_2 when burnt than buried, therefore for plastics the impact on fast carbon cycles is less for landfill.
- A comparison of waste approaches in one urban setting on the carbon cycle. For example, in London four times more waste goes to incineration plants than landfill so there is less impact on fast carbon release cycles. However, incineration approaches mean that recycling rates have fallen, resulting in more new products being made, requiring greater use of fossil fuels.
- They should come to an overall conclusion that evaluates the effects of both waste management approaches on the carbon cycle and/or size of carbon stores. Any view is acceptable as long as it is supported by the rest of the response.

Credit any other valid approach.

AO1 = 4, AO2 = 5

[Total 9 marks]

Q6.

AO1 – Knowledge and understanding of incineration and landfill as approaches to waste management. Knowledge and understanding of the sustainability of approaches to waste management.

AO2 – Application of knowledge and understanding to analyse and assess the sustainability of different approaches to waste management.

Level 3 (7–9 marks)
AO1 – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout.
AO2 – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Assessment is detailed and well-supported with appropriate evidence.

Level 2 (4–6 marks)
AO1 – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant, though there may be some minor inaccuracy.
AO2 – Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Assessment is evident and supported with clear and appropriate evidence.

Level 1 (1–3 marks)
AO1 – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy.
AO2 – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Assessment is basic and supported with limited appropriate evidence.

Notes for answers

AO1

- The environmental impacts of alternative approaches to waste disposal: unregulated, recycling, recovery, incineration, burial, submergence and trade.
- Comparison of incineration and landfill approaches to waste disposal in relation to a specified urban area.
- Contemporary opportunities and challenges in developing more sustainable cities.

AO2

- Responses may assess the role of both incineration and landfill as approaches to waste management.
- The direction of the response may be influenced by any exemplification or case study material.
- Assessment is likely to focus on the extent to which incineration and landfill are more or less environmentally sustainable than each other.
- Assessment could focus on the extent to which incineration and landfill are more or less sustainable than each other in different contexts, eg economic, environmental or social sustainability.
- Assessment may be illustrated and supported with evidence from places where incineration and landfill are used as approaches to managing waste.

Credit any valid assessment as long as the argument is coherent and feasible.

AO1 = 4, AO2 = 5

[Total 9 marks]

Q1.

Many students found this question challenging. Whilst many were confident in their knowledge and understanding of issues relating to managing waste in urban areas, it had to be clear that students were relating this knowledge and understanding to mega or *world cities*. If this focus was lacking, the response was considered to be 'partial' and thus limited to Level 2 marks. The least effective responses struggled to give clear assessment as to the extent to which managing waste is the greatest challenge for these cities. The most effective answers engaged well with the viewpoint set out in the question, applying their knowledge and understanding of mega / world cities and assessing the significance of managing waste for such places. Many came to the view that it depends on the nature of the mega / world city as to whether waste was the greatest threat, and as long as waste was demonstrably considered, many scored well by reviewing other great issues facing cities. Many made good and creditworthy use of illustrative examples including places such as London, New York and Mumbai. However, the question did not require a case study support, and those that gave a more theoretical response could score equally well.

It is worth reminding centres that both 20-mark questions will not always have direct links to the identified specification content. Students need to be prepared to use their knowledge and understanding of content, concepts and processes. This should then be applied to the context of questions, rather than a narrative approach of reciting learned materials which some more limited response showed.

Q2.

The most effective responses on this question looked for the connections between **Figures 1** and **2** and then stated whether the Spearman Rank Co-efficient calculation in **Figure 3** supported them. These better responses looked at spatial patterns in **Figures 1** and **2** as well as the relationship between them. For example, many noted that there was a South-West strip of boroughs radiating out from the centre which had the lowest percentages of low-paid workers. They noted, however, that with the exception of Richmond, they didn't have the highest levels of recycling and in fact Westminster actually had the second lowest rate of recycling in London. They then concluded that this was supported by **Figure 3** as you have to accept the null hypothesis.

Some students misinterpreted the Rs calculation and then sought to explain this by looking for connections in **Figures 1** and **2**. Whilst they scored credit for seeking connections, these answers often lacked precision and showed only basic analysis. Some students failed to use the Rs calculation at all. Whilst they could not score maximum marks, with clear analysis of **Figures 1** and **2** they were still able to achieve level 2.

Q5.

This was the cross-specification question making links between CUE and the Water & Carbon cycles unit from 7037/1. Some students seemed unprepared for this type of questions and were unable to apply knowledge of carbon cycles to incineration and landfill means of waste management. Most students were able to make basic links to how both waste disposal systems create more carbon dioxide or other greenhouse gases, but only the best responses were able to link this to impact on the carbon cycle. Fast and slow cycles, carbon budgets, carbon sinks were rarely talked about – most students just made broad links to global warming at a global scale; The best answers often considered timescales with the idea of incineration causing quicker release of carbon and landfill release taking place over a much longer time. Many students knew some good examples of waste management such as AEB in Amsterdam and were able to evaluate the benefits

of incineration over landfill disposal.

Q6.

This question proved accessible for most students, with around 40% accessing Level 3. Very few responses scored 3 marks or less. Generally, the AO1 knowledge and understanding of the two waste management strategies was good, with many also supporting their points with some illustrative examples or evidence. Therefore, it was the quality of the AO2 assessment that moved the best responses through the levels. It was pleasing that a number of students, widened the concept of “sustainability” beyond the physical environment, but looked at economic and social sustainability also. Although creditworthy, the question did not require a case study, and some students sought to give a detailed account of the waste management strategies in their learned case study. This could gain AO1 credit, where relevant, but a number then ran out of time, or space, to assess the sustainability, so gained few AO2 marks.