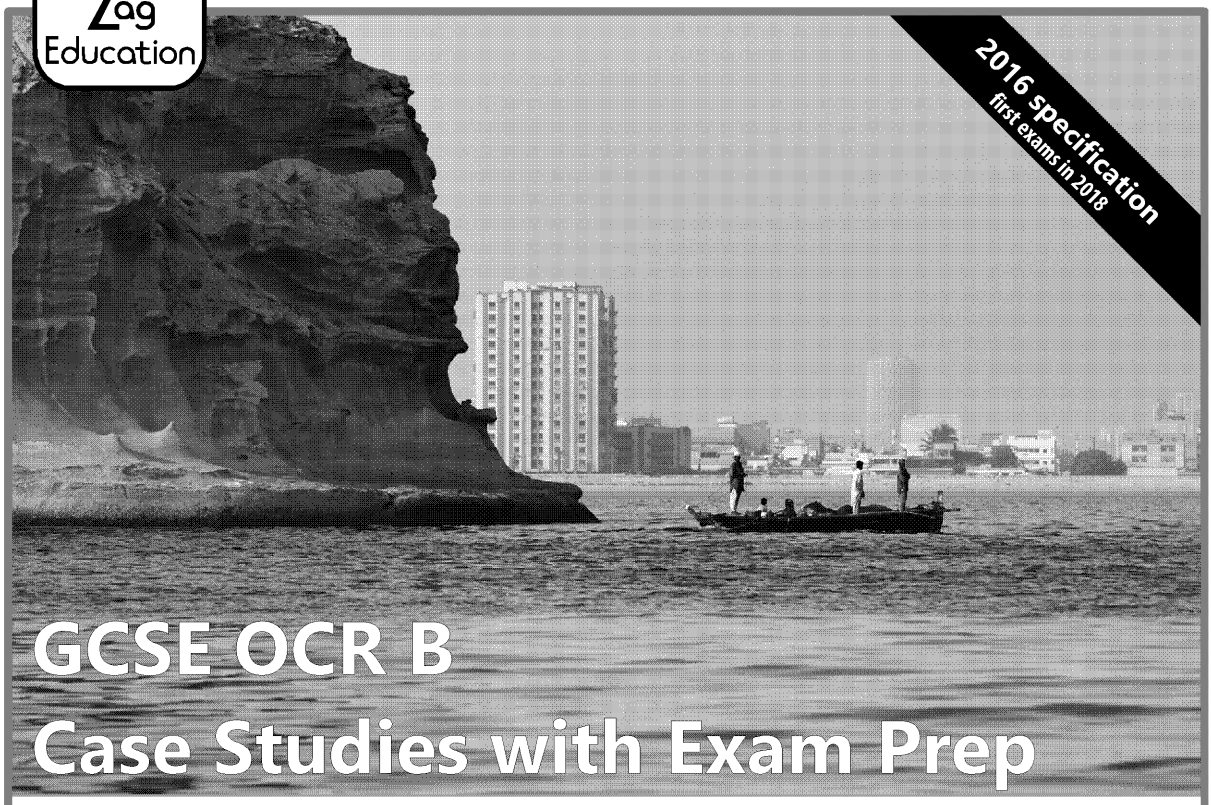
Zig Zag Education

Geography

GCSE | OCR B | J384



GCSE OCR B
Case Studies with Exam Prep

Global Hazards: Weather

Heatwave in Pakistan (2015)

zigzageducation.co.uk

POD 8846

Contents

Teacher's Introduction

This resource has been developed to provide case studies and exam preparation material to support the GCSE OCR B specification (J384) **Topic 1: Global Hazards: Weather.**

This detailed case study is on **Heatwave in Pakistan (2015)** representing a non-UK **heat wave event**.

The case study includes a main content section which can be used as part of a lesson plan or distributed to students for self-guided research; a selection of ICT interactive links to further students' research around each topic and a set of Springboard Images and discussion questions (also available as a PPT file accessible by digital download) which makes a fantastic starter activity.

*A webpage containing all the links listed in this resource is conveniently provided on ZigZag Education's website at **zzed.uk/8846***

You may find this helpful for accessing the websites rather than typing in each URL.

The exam preparation section which follows the case study contains a summary table, bringing together all of the key facts and figures relating to the case study; rapid-fire revision questions (with answers) to help recall and retention of the main points; and an exam-style question and mark scheme, written in the style of the OCR B sample material, so that students can practice answering questions relating to case studies and applying relevant knowledge in their answers.

The resource may be used as a source of reference for the required case studies for individual study, or for group work leading to discussion or debate. Subheadings in the information sections are designed to enable tabulated comparisons of social, economic and environmental impacts.

Other detailed case studies are available for this topic area representing contrasting natural weather hazard events arising from extreme weather conditions (tropical storms, flash flooding, heatwaves, and drought) in the UK and globally:

- Hurricane Sandy, USA (2012)
- Tropical Storm Chedza, Madagascar (2015)
- Flooding, Morpeth, UK (2008)
- Flooding, Texas, USA (2015)
- Heat wave, UK (2015)
- Drought, UK, (2004–2006)
- Drought, Brazil (2014–2016)

A PowerPoint presentation containing the Springboard Images starter activity to accompany this resource is available as a free digital download. Just register for free updates using the link below to download all available content for your school or purchasing site.

November 2018

Part 1: Case Study

Acronyms and Useful Terms

IPCC – Intergovernmental Panel on Climate Ch...
NDMA – The National Disaster Manage... Authority
Atmospheric Circulation
Green Roof
Heat Inde...
Heatwav...
High Pressure
Humidity
Low Pressure
Monsoon
Population Density
Pre-monsoon Rain
Sea Breeze
Urban Heat Island

Content

Causes and Prior Weather Conditions

A heatwave spread through southe... Pakistan in June 2015, with a peak of 20... June. The highest temperature was 48 °C, recorded in the city of Larkana. T... coastal city of Karachi, where temperatur... reached 45 °C, was particularly affected. Temperatures were the highest since 1979. The heatwave receded a week later as temperatures were lowered by a sea breeze, and increased cloud cover. Pre-monsoon rains were also expected.

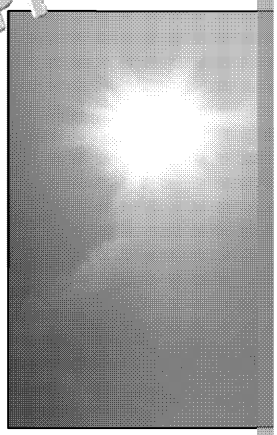


Figure 1: The heatwave

Heatwaves are common in the region. India witnessed a heatwave in May 2015 which caused 2,500 deaths. While a temperature may be relatively low, temperatures feel hotter due to a high 'heat index' due to the humidity experienced during the heatwave.

So what caused the heatwave?

- Low pressure formed over ... Arabian Sea at high altitude, whi... at the surface. Low ... was not expected in June.
- A ridg... ig... ssure formed over land.
- The lo... sure out to sea stopped the cooling sea breeze from passi...
- Without much wind, the land surface was able to heat up.
- Humidity was very high.
- The urban heat island effect was also a factor in cities.
- Possible changes to atmospheric circulation; however, this is poorly un...

Why was Karachi so badly affected?

- Very high population – the metropolitan area has approximately 23.5 million residents.
- Very high population density within the city – 4,115 per km^2.
- Poor supplies of water and electricity (e.g. electricity supplies were erratic, reducing air conditioning use).
- Tall buildings and urban s... trapped heat – urban heat island.
- Air co... ni... pumped heat outside, affecting people without air co...
- Few g... eas due to urban expansion.
- Many residents were fasting for Ramadan, meaning that they couldn't d...

Why does hig... stable weathe...

High air pressu... and warms up... don't form – ... strongly heate...

Social Impact

- The death toll was approximately 2,000, mainly from heatstroke and dehydration. The south-eastern Sindh province was worst affected.
- Most of the fatalities were to the elderly, and to those in low-income brackets, but day labourers were also included in that number.
- Mortuaries filled up and, due to power cuts, began to smell.
- The death toll was likely increased due to the power cuts, which reduced the availabilit... a... conditioning and fans, and also r... that... water pumps couldn't w... k.
- The lack of cooli... b... ade living conditions less p... t.
- The he... e began at the same time as Ramadan started, increasing t... heatstroke.

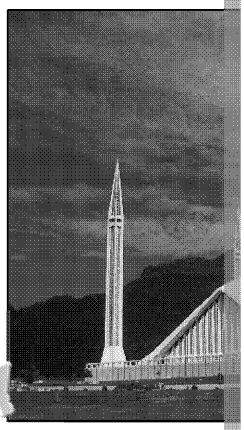


Figure 2: The heatwa... meant that Musli...

In Karachi:

- It was reported on 26th June that there had been 780 deaths within the city (especially the elderly and those who were already unwell).
- Hospitals treated 65,000 people for heatstroke.
- Many patients died in government-run hospitals.
- Mortuaries and cemeteries filled up.
- 260 unnamed bodies were b... b... a charity.
- The cit... ne... protests against the go... ent for their slowness to respond, and the electric company because the power cuts increased the mortality rate.

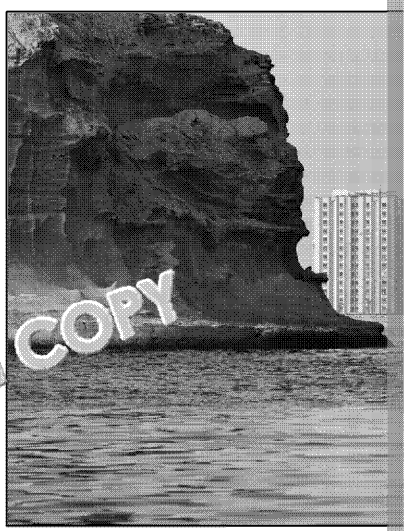


Figure 3: The po...

Economic Impact

- Livestock was killed by the heat, reducing income for farmers.
- Productivity was reduced; it was difficult to work outdoors, some people were likely to stop work during the afternoons.

Environmental Impact

- Increased risk of forest fire.

Management to Redu[illegible]s and Long-term Suggestions

There were [illegible]fatalities than expected due to:

- × Poor w[illegible]r forecasting.
- × Poor management of the event.
- × Weather forecasters were criticised due to lack of warning given.
- × The public had a poor understanding of the effects of heatstroke.
- × Due to Ramadan, some shops refused to sell water or ice during the day for fear of being fined – it is illegal to eat and drink in public in Pakistan during the month.

How c
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Take
cold

How did the government respond?

- ✓ A state of emergency was declared by the Prime Minister.
- ✓ The National Disaster Management Authority (N[illegible]MA) ordered imme
- ✓ Government-run hospitals in the Sindh P[illegible]nc[illegible]declared emergency.
- ✓ Hospitals brought in additional s[illegible]help cope, and suspended rout vaccinations.
- ✓ The army helped [illegible]p heatstroke centres, which provided water, ice
- ✓ The a[illegible]st[illegible]d order in Karachi (protests took place in the city).
- ✓ The el[illegible]or unwell are allowed to abstain from fasting during Rama messages on TV reaffirming that people who were unfit to fast, elderly stop fasting. Furthermore, Muslims were allowed to stop fasting on d recommence after the danger period was over.
- ✓ The University of Karachi pushed exams back by a month.

How can issues be addressed to lower the number of fatalities during the next heatwave?

- ✓ Provide better advice for communities – for example, to stay indoors, increase the spread of news by visiting people's houses.
- ✓ Improve water and electricit[illegible] supplies.
- ✓ Improv[illegible]at[illegible]ecasting.
- ✓ Impro[illegible]lthcare.

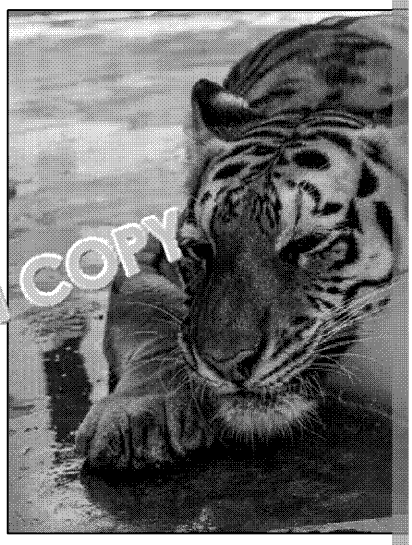


Figure 5: A tiger cooled off during

The Pakistan Government has also recommended that a new 'Heat Health' established in large cities. The system would:

- ✓ monitor and warn people
- ✓ include an early warning system
- ✓ provide better preparedness and a quick response
- ✓ include improved forecasting
- ✓ run campaigns to increase awareness and in[illegible] teaching at schools
- ✓ cool cities by increasing white urban surfaces, painting houses white, a
- ✓ increase the number of drinking water fountains
- ✓ set up 'cool centres'
- ✓ improve [illegible] and town planning

Evidence for More Extreme Weather

An employee of the Pakistan Environmental Protection Agency suggested by climate change, along with other factors. These included urbanisation, a and deforestation.

There has also been a recent increase in similar heatwaves across South Asi scientists have also reported an increase in extreme weather events. The IPC Climate Change) also suggest that climate change will increase the frequency

Fact Table

Highest temperature recorded:	49 °C
Highest temperature recorded in Karachi:	45 °C
Number of deaths:	2,000, inclu
Number of people treated in Karachi for heat stroke:	780
Number of unnamed bodies buried by charity:	280

ICT Interactive Page

Rather than type out these we

Videos

Sensitivity ... scenes of mortuaries and g

News story from 22nd Ju...

- **http://w... b... k/news/world-asia-33219890**

Footage of scenes from affected areas:

- **https://www.theguardian.com/world/video/2015/jul/14/pakistan-heat**

News Stories

Deaths in the Sindh province:

- **http://www.bbc.co.uk/news/world-asia-33236067**

Causes of the deaths in Karachi:

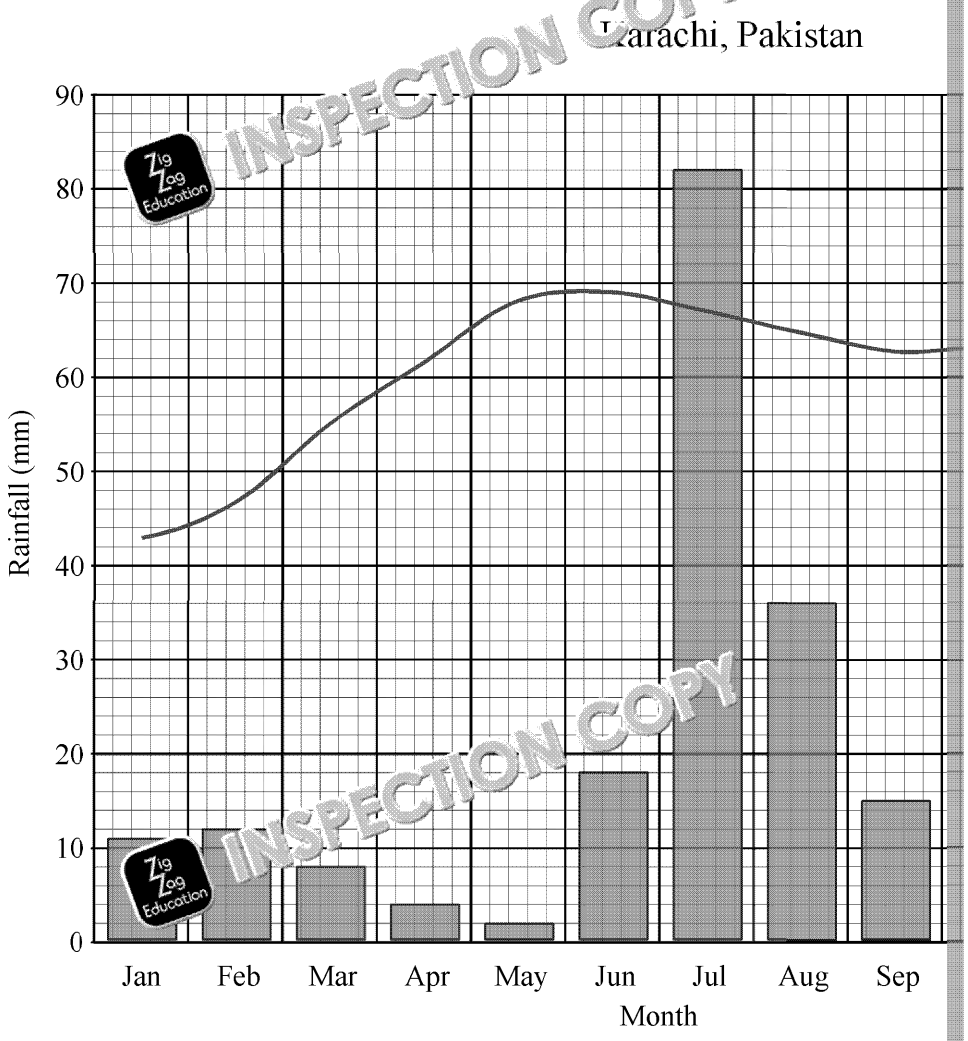
- **http://www.bbc.co.uk/news/world-asia-33358705**

Message from clerics to stop fasting:

- **http://www.independent.co.uk/news/wo... as... uk-heatwave-pakist... urge-followers-to-abstain-from-... an-fasting-10360322.html**

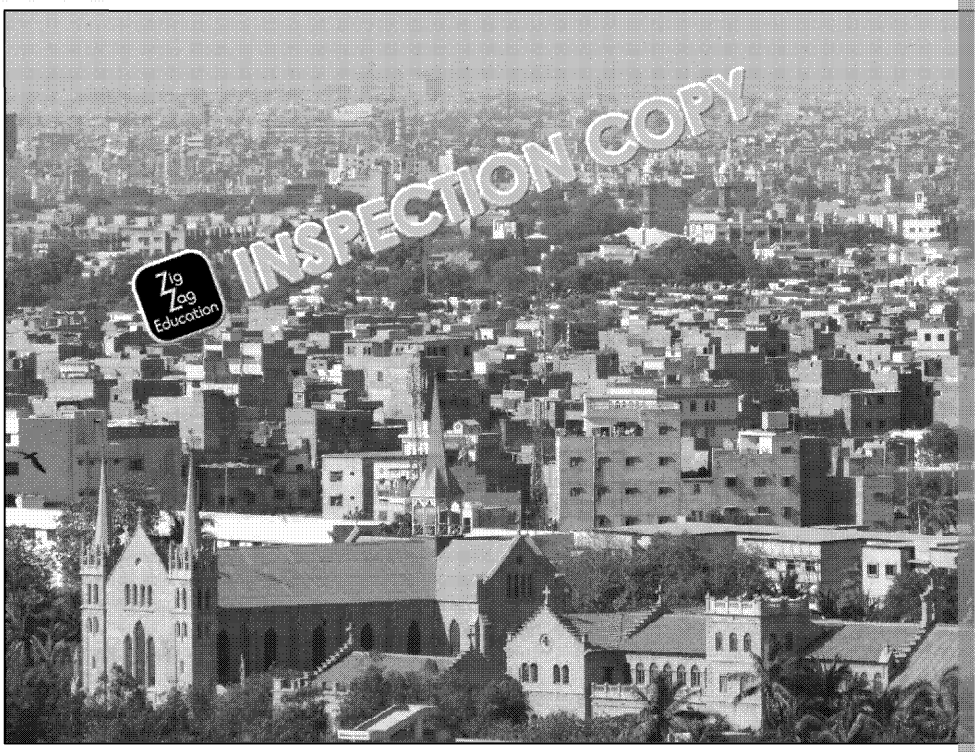
Springboards

Springboard 1



1. Describe and explain the climate of Karachi.
2. Suggest how the climate of Karachi may have increased or decreased t
3. What caused the heatwave (natural factors)?

Springboard 2



1. Using the photograph, describe the city of Ka[illegible].
2. What do you think is meant by the term 'urban heat island'?
3. How do you think the effects of the heatwave could be reduced?

Springboard Suggested Answers

Springboard 1

1	• Karachi is a coastal town. Like the majority of the region, it has a majority of rainfall occurs during the summer months, with July with 82 mm. • Temperature [illegible] builds through the first half of the year, a [illegible] 30 °C), just prior to the monsoon rains. • [illegible] monsoon occurs, temperature declines to a small peak in (rainfall.
2	• The month of June, just before the monsoon, is the hottest month • It was hoped that the effects of the heatwave would be reduced b monsoon rainfall.
3	• Low pressure over the ocean and high pressure over the land red • Clear skies over the land allowed strong sunlight to reach the gro effect. • The effects were also enhanced by the high humidity – which mo hotter than in reality – for example, under such conditions, there from the skin, and, therefore, less natural cooling of the body.

Springboard 2

1	• Karachi is a large city with a high population density. • While there are [illegible] trees, there appears to be few green spaces. • There appear to be a variety of religions (e.g. Islam and Christia • [illegible] buildings are fairly light in colour, there are few white (an buildings. • Many buildings are fairly tall, with high-rise blocks in the backgr • There appears to be relatively little planning involved – the city a time rather than having a formal layout.
2	• During the day, urban surfaces absorb heat; for example, they are vegetation. • These materials can often store a lot of heat – they have a high he • During the night, the heat is re-radiated, making the temperature surrounding rural area. • The effect is increased by human activity – such as waste heat fro industry and air conditioning. • The effect is, therefore, often higher at night.
3	• Provide adequate forecasts, warning and public information (inc • Ensure that hospital facilities can cope. • Provide access to water and other necessary supplies, public drin • [illegible] that personnel are on hand to assist, such as the army if n • Reliable power supplies so that cooling systems and water pumpin • Increase the reflectivity of urban surfaces (e.g. white buildings). • Set up cool centres. • Improve town planning.

Summary

Pakistan Heatwave

Question	A
When was the heatwave?	*17–24 June 2015*
Which part of Pakistan was most affected?	*Southern Pakistan, e.g. Sindh*
What was the highest recorded temperature?	*49 °C*
What was the highest heat index?	*66 °C*
Since when were the temperatures highest?	*1979*
What happened in India the month before?	*A heatwave that killed 2,500*
Where was the area of low pressure?	*Over the ocean (North Arabia*
Where was the area of high pressure?	*Over land*
Why was the wind reduced?	*There were few onshore winds ocean.*
Was humidity high or low?	*High*
What is the population density of Karachi?	*4,115 people per km²*
What is the effect called where cities increase the temperature higher than the surrounding countryside?	*The urban heat island*
How did power cuts affect people?	*Increased mortality and unpl conditioning, and failure of w*
Why couldn't people drink during daylight hours?	*Ramadan*
How many people died?	*2,000*
What were the causes of the deaths?	*Dehydration and heatstroke*
In which age groups were the highest number of fatalities?	*The elderly*
How many deaths occurred in Karachi?	*780 reported by 26th June*
How many people were treated in Karachi with heatstroke?	*65,000*
What happened to the unnamed bodies?	*They were buried by a charity*
How were farmers affected?	*Livestock died and outdoor lab heat.*
Why were the government and weather forecasters criticised?	*Lack of warning, slow respons*
What was poorly understood by the public?	*The effects of heatstroke*
Who declared a state of disaster?	*The Prime Minister*
How did hospitals focus on patients affected by the heat?	*By cancelling routine activitie*
What did the army help provide?	*Heatstroke centres*
How did the University of Karachi respond to the heatwave?	*They postponed exams*
What has Pakistan's government recommended to help reduce the effects of future heatwaves?	*The Heat Health Warning Sy*

Quick-fire Questions

1	Explain how [illegible] caused the heatwave.	
2	What [illegible] the human factors that worsened the effects of the heatwave?	
3	Why did the outdoor temperature feel much hotter than it actually was?	
4	Which religious factor increased the social impact?	
5	Why was there an increased need to educate the public [illegible] the effects of heat stroke?	
6	Why was criticism levelled at the [illegible] ting and managing the heatwave?	
7	How did hos[illegible] ease the care that they could provide to people affe[illegible] th[illegible] eatwave?	
8	How [illegible] essful were hospitals at treating those affected by heat-related illnesses?	
9	How could keeping citizens better informed help in the future?	
10	Why might painting buildings white improve the con[illegible]ns experienced in a future heatwave?	
11	How effective do you think th[illegible] ch[illegible] in schools would be?	
12	Do yo[illegible] ink [illegible] weather in Pakistan is becoming more extreme?	

Quick-fire Answers

1	Exp w pressure caused the heatwave.	*Low pressure o few sea breezes there were few surface.*
2	What were the human factors that worsened the effects of the heatwave?	*The urban heat Power cuts also suggested defor*
3	Why did the outdoor temperature feel much hotter than it actually was?	*The high humid*
4	Which religious fact as the social impact?	*The heatwave o during the day some were exem prohibiting drin being fined. This stroke.*
5	Why was there an increased need to educate the public on the effects of heat stroke?	*The public had*
6	Why was criticism levelled at those forecasting and managing the heatwave?	*Forecasts were thought that the in Karachi.*
7	How did hospitals increase the care that they could provide to people affected by the heatwave?	*Some hospitals cancelled routin the heatwave.*
8	How ss hospitals at treating those affected by heat-rela sses?	*Many of the dea Karachi), but th Many of the dea members of soci*

9	How could keeping citizens better informed help in the future?	*More people would have better access to advice and a better understanding of heat-related illnesses. The lower.*
10	Why might painting buildings white improve the conditions experienced in a future heatwave?	*Heat is reflected by white urban heat island effect, w*
11	How effective do you think that teaching in schools would be?	*Firstly, not everyone in P taught when very young, who do attend school, the*
12	Do you think that the weather in Pakistan is becoming more extreme?	*There have been more heat followed a severe heatwav increase in the extreme we extreme weather, then the climate change.*

Extension Questions

1. Outline why cities such as Karachi were so badly affected by the heatwave.
2. Suggest which impacts were more damaging – social or economic.
3. Evaluate the effectiveness of the government's response to the crisis.

Extension Answers

1. Some cities in Pakistan, such as Karachi, have a very high population density, due to the fact that dark, urban surfaces absorb heat, reduce wind speeds and heat outside. When electricity was available, air conditioning was used, addin There are very few open/green areas which help alleviate these effects. As wel and air conditioning, electric water pumps were knocked out, meaning that a affected due to the high population of cities such as Karachi.

2. The so[illegible]pacts are likely to have been severe – for example, the thousands conditio[illegible]and even died. While it is inevitable that businesses would have bo have been less affected than otherwise due to Ramadan – some businesses allo during this period.

3. While the government did respond to the heatwave in several ways, some pe speed and effectiveness of action – which is why rioting broke out in Karachi. army. Warning and forecasting was somewhat lacking, and later the governm establishment of a new 'Heat Health Warning System', which could be seen to existing systems are necessary.

Exam-style Question

Question 1

Case study – Extreme weather events in a UK and non-UK loc

Evalua[te] ways the responses to an extreme weather even[t] between contrasting countries.
6 marks

Level Marking

Level	Mark	Description
1	1–2	• The student evidences basic knowledge • The student evidences limited understan exist between places, environments and • A limited ability to evaluate is evidenced knowledge and understanding. (AO3) • The ideas expressed by the student are • A named example is provided but place-
2	3–4	• The student evidences some knowledge • The student evidences good understand between places, environments and proc • A reasonable ability to evaluate is evider application of knowledge and understan • The ideas expressed by the student are • A named example is provided with some
3	5–6	• The student evidences thorough knowle (AO1) • The student evidences a firm understan exist between places, environments and • A strong ability to evaluate is evidenced knowledge and understanding. (AO3) • Ideas expressed by the student are in-de • A named example and place-specific de

Suggested Content:

Name of UK extreme weather event: Morpeth Flood, 2008

Name of non-UK Extreme weather event: Pakistan heatwave, 2015

- The responses to each of the extreme weather events are very differen the hazard itself (including the scale of the event) and partly due to the to the two contrasting countries.

Pakistan heatwave	Mo
• A state of emergency was declared.	• The event was on one town • Flood watch was plan was enacted to plan the evacu warnings were iss
• There were a large number of deaths and victims of heatstroke (780 deaths and 65,000 heatstroke victims in Karachi). • As a result, hospitals brought in extra staff and the army helped set up heatstroke centres.	• There were no de – for example 913 property, sandbag residents were ev • Evacuation centre services helped e
• The heatwave occurred during the Muslim fast called Ramadan. As a result, clerics reaffirmed that people who were unfit to fast, elderly or weak were allowed to stop fasting. Furthermore, Muslims were allowed to stop fasting on doctor's orders.	While the flood oc members of the p that fewer people
• The Pakistan Government has also recommended that a 'Heat Health Warning System' is established in large cities.	• In 2012, permissi alleviation schem provided by the E Northumberland C • Further additional implemented in M and three new flo