2.2 Climate change: consequences, vulnerability and responses

Name: _____ Class: _____ Date: _____ **Total: 30 marks**

KEY WORDS vulnerability • resilience • mitigation • adaptation • carbon capture and storage • Paris Agreement • geoengineering

Objective

Build the skills to answer exam questions on the **consequences** of climate change for people and places, why **vulnerability** differs, **resilience**, and responses: **mitigation** and **adaptation** at global, national, city and civil-society scales.

You must be able to:

- explain consequences of climate change for the Earth system and for people
- explain vulnerability with exposure, sensitivity and capacity
- distinguish mitigation and adaptation with examples
- evaluate a response at a stated scale with a number and a limit
- compare two places that face a similar hazard with different capacity

1 Key knowledge and worked examples

■ Consequences

Hotter heatwaves, heavier rain, longer droughts, warmer and more acidic oceans, coral bleaching and rising seas. People are affected through **health** (heat stress, dengue spreading), **food** (lower yields in hot regions) and **migration** (people leave land that floods or dries). In July 2021, 201.9 mm of rain fell on Zhengzhou in one hour; almost 400 people died across Henan. One storm cannot prove climate change, but warmer air holds more water.

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Vulnerability and resilience

factor	meaning	example
exposure	how much of the hazard reaches a place	most of Tuvalu is under 3 m above sea level
sensitivity	how much damage it does	farmers who depend on rain, not irrigation
capacity	money, knowledge and government to respond	the Netherlands can afford strong sea defences

Resilience is the ability to cope and recover. The 1970 Bhola cyclone killed about 300,000 to 500,000 people in what is now Bangladesh; after shelters, volunteers and phone warnings, Cyclone Amphan (2020) killed a few dozen there.

Responses

- **Mitigation** reduces the cause: solar and wind power, electric vehicles, forests, **carbon capture and storage** .
- **Adaptation** reduces the damage: sea walls, heat-resistant crops, sponge cities, early warnings, moving people.

scale	example	judgement
global	**Paris Agreement** (2015): well below 2 °C, try for 1.5 °C	almost every country joined; pledges voluntary and not enough
national	China: CO_2 to peak before 2030, carbon neutral before 2060; carbon trading since 2021	large effect: China emits about a third of world CO_2
city	sponge cities from 2015 (30 pilots, e.g. Wuhan)	helps; but the Zhengzhou rain was far beyond the design
civil society	Fridays for Future school strikes from 2018	raised attention; effect on emissions hard to measure

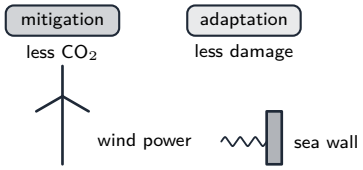
Geoengineering (e.g. particles in the upper air to reflect sunlight) might cool fast, but does not stop ocean acidification and could change rainfall elsewhere.

Worked example. *Evaluate a strategy* in four moves: name it and its scale → how it reduces the cause or the damage → a number → a limit.

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2 Practice

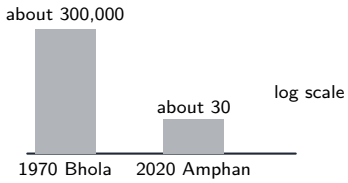
2.1 Distinguish between **mitigation** and **adaptation**, with one example of each. [2]



2.2 Explain how **capacity** affects vulnerability to sea-level rise, using **two** named countries. [3]



2.3 Deaths in Bangladesh: Bhola cyclone (1970) about 300,000; Cyclone Amphan (2020) about 30. State **two** reasons for the difference. [2]



2.4 Outline **three** ways climate change can affect human health or food. [3]



2.5 Evaluate the **Paris Agreement** (2015) as a response to climate change. [4]



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3 Exam-style questions

3.1 *(Paper 2 style.)* The table compares two cities that both face heavy rain.

(a) Using the table, identify **two** reasons why City B is more vulnerable to floods than City A. [2]

(b) Explain **two** adaptation strategies that City B could use to reduce flood damage. [4]

	City A	City B
people living on the floodplain	15 %	60 %
early-warning system	yes	no
drainage spending per person	US$120	US$9
homes in informal settlements	5 %	40 %

3.2 "Adaptation is more important than mitigation." Discuss this statement with reference to places at different scales. [10]

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Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

mitigation reduces the cause, i.e. greenhouse gas emissions, e.g. wind and solar power / planting forests; adaptation reduces the damage of the change, e.g. sea walls / drought-resistant crops / early warnings

2.2

capacity = the money, knowledge and government to respond; the Netherlands is low-lying but rich, so it can build and maintain strong sea defences, so it is less vulnerable; Tuvalu (or Bangladesh) has low land and little money, so it cannot easily protect itself and is more vulnerable

2.3

any two: thousands of cyclone shelters; early warnings by radio and phone, and evacuation; trained volunteers; better forecasting

2.4

any three: more heat stress and deaths in heatwaves; diseases such as dengue spread to new areas as mosquitoes spread; lower crop yields in hot or dry regions; floods damage crops and spread water-borne disease; warmer, more acidic oceans harm fish and coral, so less food from the sea

2.5

global: almost every country joined; aim: well below 2 °C, try for 1.5 °C, with pledges reviewed every five years; limit: pledges are voluntary, with no penalty if they are missed; judgement: even if all pledges are met, warming is still expected to pass 2 °C, so it is a step forward but not enough on its own

3.1

(a) any two: more people live on the floodplain (60 % against 15 %); no early-warning system; less money to spend per person on drainage; many homes in informal settlements / weaker houses

(b) any two, explained: an early-warning system by phone and radio, so people move to safety before the flood; sponge-city parks, wetlands and porous pavements hold rain where it falls and lower the peak; zoning to stop new building on the floodplain lowers exposure over time; raised houses or embankments keep water out of homes

3.2

Mark with the markbands: [9-10] focused on the command term, detailed and accurate knowledge, well-developed explanation, specific named examples (places, dates, numbers), balanced evaluation and a supported conclusion; [7-8] mostly focused, good knowledge and examples, some evaluation; [5-6] relevant knowledge and examples, explanation

partly developed, little evaluation; [3-4] general knowledge, few examples, mostly description; [1-2] little that is relevant. Points that may be included: adaptation saves lives now: Bangladesh shelters and warnings cut cyclone deaths from about 300,000 (1970) to a few dozen (2020); some warming is already locked in (about 1.1 °C), so places must adapt anyway; adaptation is local and visible, e.g. sponge cities such as Wuhan, so governments can act alone; but adaptation has limits: Tuvalu cannot raise its land fast enough, and the Zhengzhou rain of 2021 was far beyond the design; poor places have little capacity to adapt, so adaptation alone increases inequality; mitigation reduces the cause for everyone: the Paris Agreement aims for well below 2 °C; China's pledge to peak CO_2 before 2030 matters because it emits about a third of the world's CO_2; without mitigation, the cost of adaptation keeps rising; conclusion: both are needed; adaptation is urgent locally, but only global mitigation stops the problem growing

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