HWA CHONG INSTITUTION
JC1 Promotional Examination
Higher 2

SUGGESTED ANSWERS AND COMMENTS

Section A
Answer **both** questions.
Cluster 2 Tropical Environments

1 Resource 1 shows the Inter-Tropical Convergence Zone (ITCZ) and wind direction over the African continent in June to September, and January to March. The locations of Ouagadougou (12.4°N), capital city of Burkina Faso, and In Salah (27.2°N), an oasis town in central Algeria, are also shown in Resource 1. Resource 2A is a cross-section schematic diagram of the drainage basin system in Ouagadougou while Resource 2B shows that of In Salah. Resource 3A shows a mass movement that had occurred in Ouagadougou, and Resource 3B shows a mass movement that had occurred in In Salah.

(a) Describe the changes in winds over Ouagadougou and In Salah from June to January shown in Resource 1. **[4]**

Award 1m for changes, to a maximum of 2m for winds in Ouagadougou, and maximum of 2m for In Salah.

Possible observation of changes in winds include:

- *Onshore or offshore: e.g. Ouagadougo experiences onshore winds from Atlantic Ocean in June, but offshore from dry continental interior in Jan.*
- *Wind direction: e.g. In Salah experiences predominantly easterly winds in June, but in Jan, little/no winds as it is dominated by high pressure cell*

(b) With reference to Resource 1, suggest reasons for the differences in rainfall characteristics between Ouagadougou and In Salah. **[8]**

Award maximum of 2m for description of and differences in rainfall characteristics of Ouagadougou (marked seasonality of wet season in June, dry season in January) and In Salah (arid throughout year, with very low total annual rainfall)

Award 1m for a valid suggested reason with an additional 1 to 2m for development of point. Maximum of 6m for explanation (as 2m is needed for description)

Possible reasons:

- *Aridity of In Salah: dominance of high pressure belt shown by wind direction; ITCZ does not move into the region*
- *Seasonality of rainfall in Ouagadougou: Onshore winds: moisture laden winds forced to rise over any elevation or possibly uplifted by ITCZ low, resulting in expansion of air mass, adiabatic cooling to saturation, forming rainclouds.*
- *Proximity of Ouagadougou to ITCZ accounting for wetter climate*

(c) Describe the differences between the two drainage basin systems of Ouagadougou and In Salah shown in Resources 2A and 2B respectively. **[4]**

Award 1m for each difference with an additional 1m for development comparing the two (only if applicable and clearly a development of point), to a maximum of 2m for each difference.

Possible differences include:

- *Much higher water table in Ouagadougou than in In Salah (which is below level of river bed)*
- *Baseflow in ground water storage in Ouagadougou feeds river, while in In Salah, no baseflow feeding river*

(d) From Resources 1, 2A and 2B, suggest why overland flows may be more common in Ouagadougou than in In Salah. **[5]**

Award 1m for each suggestion with an additional 1m for explanation and development of reason (i.e. showing understanding of drainage basin water balance).

Possible suggestions include:

- *High seasonal rainfall (especially monsoonal) contributes to high average monthly rainfall in months of June-Sept, inability for all precipitation to infiltrate and percolate into soil moisture and ground water storage respectively, flow over surface as IEF*
- *SOF very possible also due to high water table in Ouagadougou: very easily prolonged monsoon rainfall can raise water table by percolating rainfall, raising water table to intersect at surface, resulting in saturated over land flow*
- *In Salah: low water table, hence SOF extremely unlikely*
- *Arid climate of In Salah means very low occurrence of precipitation which could contribute to IEF*

(e) Compare the key characteristics of the two mass movements shown in Resources 3A and 3B. **[4]**

Award 1m for each comparison of characteristic with further 1m for development, up to a maximum of 2m for each characteristic. Maximum 3m for similarities / differences.

Possible suggestions:
Differences

- *Angle of slope of failed material: near vertical and even overhanging slope at In Salah vs ~25 at Ouagadougou*
- *Amount of water: predominantly dry in In Salah vs wet slurry of Ouagadougou*

Similarities

- *Both fail under shear stress due to the pull of gravity*
- *Both leave behind scars (bare slope without vegetation) on the slopes and scarps.*

(f) With reference to Resources 1, 2A and 2B, explain why mass movement processes may differ between Ouagadougou and In Salah. **[5]**

Award 1m for each suggestion with addition 1-2m for further development of point up to a maximum of 3m for each suggestion.

Students to be able to explain the mechanism and process of mass movement – one being a wet flow vs a high speed dry rockfall, with reference to shear strength (e.g. friction between soil grains or internal strength of rock) vs shear stress (gravity acting on slope).

Possible suggestions include:

- *Amount of water: high precipitation not only adds weight to slope, increasing shear stress (gravity!) but also breaking frictional bonds between soil grains holding slope in place. With saturation of upper layer of slope, grains of soil cannot be held in place and fails as a slurry*

2 Resource 4 is a map of Peninsular Malaysia showing the locations of limestone hills. Kinta Valley (4.4°N) in Perak state, is indicated in the box. Resource 5 shows Gua Tempurung, a limestone cave in Kinta Valley. Resource 6 is a photograph of a quarry – a mining site – at Gunung Kanthan, northern Kinta Valley.

(a) From Resource 4, describe the distribution of limestone hills in Peninsular Malaysia. **[2]**

Award 1m for each valid description.

Possible descriptions include:
- *Limestone hills generally clustered*
- *Located in central and northern Peninsular Malaysia*

(b) With reference to Resource 4, explain the dominant type of weathering that is likely to occur in Kinta Valley, Malaysia. **[4]**

Award 1m for a possible valid weathering process, 1m to account for why this is likely to occur in Kinta Valley, and up to 2m for explanation.

Indicative content:
- *Dominant type of weathering is either chemical weathering or specifically carbonation (or solution).*
- *This type of weathering is likely to occur in Kinta Valley due to either its low latitude (seen in Resource – Malaysia is at about 5°N, hence indicating an* Af *climate) and/or presence/dominance of limestone rock in Kinta Valley.*
- *High total annual rainfall provides the high amount of running water to dissolve minerals in rocks, specifically calcium carbonate when water is slightly acidic (due to CO2 dissolving in it as rainwater percolates through soil)*

(c) Describe the limestone features as seen in Resource 5. **[4]**

Award 1m for each valid description.
Indicative content:
- *Large cavernous underground chamber, more than 20m high*
- *Base of cave is wider than the ceiling*
- *Visible cracks on limestone walls*
- *Numerous tapering hanging structures from roof of cave, some longer than 2m*

(d) With reference to Resource 5, explain the formation of the features shown. **[7]**

Possible features to explain are: underground cave and speleothem

Indicative content:
- *Carbonation process occurring only along structural weakness of limestone, i.e. intersecting joints, cracks and bedding planes, as limestone is inherently impermeable*
- *This widens and deepens the intersecting joints/cracks, creating shallow depressions on surface which funnel more percolating precipitation into it, which furthers the weathering*

- *This can result in a solutional doline or a collapsed doline, as the depression gets deepened and widened with carbonation*
- *Alternatively, underground bedding planes also widened due to continual carbonation, which may merge and eventually widen enough to form a cavernous space, and when water levels drop, leaving behind a cave*
- *Speleothems, on the other hand, are formed from the reverse process of carbonation: when the dissolved limestone in running slightly acidic water, i.e. carried as calcium ions in solution into the cave, comes into contact with the air inside the cave, carbon dioxide is released from the water into the cave atmosphere, making the water less acidic, and allowing the calcium ions to crystalise as the mineral calcite.*
- *For speleothems such as stalactites, the water full of calcium ions drip down these hanging features, and as CO2 bubbles out, the remaining calcium bicarbonate minerals crystallise as calcite, drip by drip, into the hanging structures seen.*

(e) From Resource 6, suggest the ecosystem services that may be provided by karst landforms in Kinta Valley. **[6]**

Award 1m for each ecosystem service named, and up to an additional 2m for explanation and development of this ecosystem service.

Indicative content:

- *Provisioning services: any type of benefit to people that can be extracted from nature, hence, from Resource, mining of limestone to provide material for construction, drainage, road bases.*
- *Regulating services: benefit provided by ecosystem processes that moderate natural phenomena: e.g. water purification: structural weakness in the limestone of cracks, joints, bedding planes, provide pathways for infiltrating precipitation*
- *Cultural services: non-material benefit contributing to development and cultural advancement of people*
- *Supporting services: sustaining basic life forms (please refer to lecture notes Chapter 23)*

(f) Explain how human activities can negatively impact karst ecosystem services. **[7]**

Award 1m for reference to specific ecosystem services, and up to a maximum of 4m for any one type of ecosystem service.

Indicative content:

- *Tourism may negatively impact many ecosystem services, e.g. on provisioning, regulating and cultural service. Influx of many visitors to a local karst site may mean greater impact on the ecosystem, which might not be fully developed or sufficient to cope with the demands, e.g. of waste, sewage, water supply, etc. The regulating ecosystem service of karst landforms may be negatively impacted, as forests are cleared for development of tourism infrastructure (roads, hotels), and waste may accumulate, and hence karst landscapes are unable to regulate water purification as infiltrating precipitation would not benefit from the natural limestone filtration but instead, having to run through improper disposal of waste instead*

Section B
Cluster 2 Tropical Environments

3 'Fluvial floods affect people minimally because of effective management strategies.'

Evaluate this statement. **[20]**

1 *EQ is not just an evaluation of various **fluvial flood management strategies,** which because of its **effectiveness**, prevent occurrence of floods, or reduce intensity of floods, hence affecting people minimally:*
   - *Hard engineering strategies: to control rivers and essentially prevent floods from occurring by various measures, e.g. increase channel capacity (levees), hold back discharge (dams), or encourage faster channel flow to drain water out of basin (channelization)*
   - *Soft engineering strategies: softer natural approach – do not seek to prevent floods but to slow down rate at which precipitation reaches river, i.e. to encourage more sub-surface flows of water instead of very rapid surface overland flows*

2 *EQ is also a discussion of whether flood management strategies, while effective in managing floods, **may still affect people negatively** (e.g. the cons of not having a river naturally flood etc)*
   - *Physical benefits to having floods: nutrients brought by rivers downstream to floodplains*
   - *Effective flood management especially hard engineering strategies may on the one hand, minimize negative effects in the immediate drainage basin as there are no floods occurring (e.g. through use of levees or channelization), however, downstream, the amount of Q is higher (levees) or faster (channelization), hence greater risk of floods downstream, hence spatially it can affect different people differently*

3 *EQ is also a discussion of how **ineffective fluvial flood management strategies** can affect people negatively*
   - *Failure of flood management strategies: e.g. levees or dams, which can amplify the damaging effects of floods even more than had there not been any strategies in the first place, especially as flood water would remain in flood plains and unable to drain away into rivers (levees)*
   - *Failure of strategies due to climate change, e.g. higher intensity rainfall, making it difficult for strategies to cope with increasing higher flood intensities, e.g. Singapore's Bukit Timah Canal has flooded in 2021 even though it is channelized, widened and smoothed: due to high intensity rainfall over many days: unprecedented*

4 *EQ is also an opportunity to examine varying effects of floods on different groups of people:*
   - ***Wealth / economic status**: more well-to-do residents able to afford to live in safer housing **within same drainage basin**, vs lower income residents with no choice to live in flood prone areas, or comparing more developed, richer **cities** with better management strategies (e.g. Singapore) vs developing cities (e.g. Cox's Bazaar in Bangladesh suffering from frequent floods)*
   - ***Gender and age**: more informed men vs women especially in less developed countries and in villages, women not informed of flood warning systems, or less access to understanding due to gender discrimination in access to education*

5 *Criteria for 'effective' management strategies: to be spelled out and defined somewhat by students e.g. to minimize economic damange, social impacts*

Variations in effects by different groups of people to be considered, but not 100% necessary, i.e. point number 4

Cluster 3 Sustainable Future and Climate Change

4 'The creation of liveable cities for women is challenging.'

Evaluate this statement. **[20]**

Possible approaches:
- *There is a need to contextualise what liveable cities for women mean.*
- *Strategies addressing issues faced by women in cities are deemed 'successful' if they plug the gaps of various needs of women, for instance, creating safer streets with well-lit roads and paths*
- *Some questions to think about: What is the criteria for 'success'? Should we prioritize women's needs in urban planning? There are many other social groups living in cities, and it is this intersectionality of social*

groups, some with conflicting, some complementary needs, which may be ignored or represented in spaces in cities.

- *It is only when needs of various social groups of cities are met (at different points in their development), would cities become truly liveable.*