ANGLO-CHINESE JUNIOR COLLEGE

JC2 Preliminary Examination

Higher 2

GEOGRAPHY

9173/02

Paper 2

16 September 2025

3 hours

Additional Materials: Insert
Cover Sheet
Answer Paper

READ THESE INSTRUCTIONS FIRST

You should follow the instructions on the cover sheet. If you need additional answer paper, ask the invigilator.
Write your index number and name on the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer Question 1 in **Section A.**
Answer Question 2 in **Section B**.
Answer **one** question in **Section C.**

Start your answer to each question on a fresh sheet of answer paper.

At the end of the examination, your answers should be separated and securely fastened into **2 bundles**. Attach a cover sheet on top of bundle 2.

- Bundle 1: Answers to Question 1. *Name and index number to be clearly indicated on the first page of the answers.*
- Bundle 2: Cover sheet and answers to Question 2 and Question 3 or 4.

The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **5** printed pages and **1** blank page.

Answer Questions 1 and 2 and
EITHER Question 3 **OR** Question 4

Section A

Cluster 4 Fieldwork

1 There are plans to turn the coastal mangrove area around the Sungai Mandai Besar River in northern Singapore into a nature park that will be named the Mandai Mangrove & Mudflat Nature Park. A group of five students wanted to assess the flood risk around the Sungai Mandai Besar River. The river is concretised into a canal for most of its course except for the short stretch at the river mouth.

The hypothesis the students chose:

'Fluvial flood risk is lower near the river mouth than around the canalised parts of the Sungai Mandai Besar River.'

To assess the flood risk of the areas surrounding the river, the students collected data on infiltration rates and selected river variables.

They collected data on a weekday in December from 10 am to 4 pm. At each site, two students worked on the infiltration test, while three worked on collecting data on selected river variables. All five of them worked at Site A first. They were only able to start work at Site B after the thunderstorm ended at 3 pm. They collected infiltration data around Site B, and only the river velocity data at Site B.

The equipment that the students used for their field investigation included:

- A single-ring infiltrometer made of white plastic tubing with a diameter of 10 cm and a height of 30 cm
- Two brightly marked half-filled plastic mineral water bottles as the velocity-floats
- Two stop watches
- A pail to fetch water from the river for the infiltration test

For the infiltration test, the students chose two locations at each site. At Site A, the infiltration test was taken at the grassy patch next to the river bank (indicated as A1 in Resource 1) and on forested land (indicated as A2). At Site B, two infiltration sites were chosen [indicated as B1 (concrete surface) and B2 (muddy river banks) in Resource 1].

Resource 1 is a land use map of the area adjacent to the Sungai Mandai Besar River, showing Sites A and B and the four infiltration sites A1, A2, B1 and B2. Resource 2 shows the photographs of Sites A and B. Resource 3 shows the infiltration rates at each of the four sites around the Sungai Mandai Besar River. Resource 4 shows the findings of the investigation at Sites A and B

	(a)	Explain whether the hypothesis chosen is suitable for their investigation of flood risk around the Sungai Mandai Besar River. [4]

Award 1 mark for each explanation of the suitability of the hypothesis for the investigation of flood risk around Sungai Mandai Besar River.
Award a maximum of 1 additional mark for further development of each explanation.

Possible responses include:

- **Scale:** The hypothesis is suitable because the area of study around the Sungai Mandai Besar River is small in scale and manageable for the group of five student investigators [1 mark]. The distance between Sites A and B is not more than 300 metres making it easily accessible for the students. [1 additional mark]
- **Accessibility:** The sites (A and B) are safe and accessible, with clear contrasts in channel form and land use shown in the resources, allowing data to be easily collected [1 mark] When the river at Site B is too wide and there is no overhead bridge, there was a ready source of data from secondary data derived from an environmental assessment report. [1 additional mark]
- **Equipment:** The measurements needed, such as infiltration rates and cross-sectional profiles, can be obtained using standard fieldwork equipment and available manpower [1 mark].
- However, the hypothesis is limited as it does not consider wider influences on flood risk such as upstream rainfall inputs or tidal effects, which are beyond the study site [1 mark].

Examiner's comments

	(b)	With reference to Resources 1 and 2, describe how the students could reduce the impacts of their investigation at the two sites A and B. [6]

Award 1 mark for each suggestion on how the students could reduce the impact of their investigation at the two sites.

Award 1 mark for each explanation on how the students could reduce the impact of their investigation, to a maximum of 6 marks.
Award a maximum of 1 additional mark for further development of each explanation, where applicable.

Possible response:

At **Site A (channelised canal with concrete banks):**
- Students could avoid obstructing the narrow footpath and at the overhead bridge and ensure equipment does not block movement along the canal [1 mark].
- Avoid throwing materials or litter into the concrete channel to prevent pollution, and bagging the thrash would be the right thing to do [1 mark].
- Avoid making loud sounds to avoid causing alarm or disturbance to the wildlife in the forests around the bridge location [1 mark].

At **Site B (natural channel with clay and silt banks in swamp/mudflat setting):**
- Students should keep to existing paths and avoid trampling swamp and mudflat vegetation to minimise habitat disturbance [1 mark].
- To prevent excessive disturbance to the soft and weak sediment, trampling may be reduce if a small plank can be placed gently on the surface and one investigator will be using the plank as the stepping point to sampling groups to reduce pressure on any single part of the site and minimise erosion of the soft riverbanks [1 additional mark].
- For infiltration tests refill holes after measurements so the ground surface is restored [1 mark].
- Since Site B is located at the natural swamp forest, it is necessary to keep noise to the minimum to prevent disturbing or alarming the wildlife [1 mark].

For both sites, a plastic bottle velocity float is used. As plastic is not biodegrable, using an orange would be more suitable since it is biodegrable, and knowing that the float cannot be retrieve without compromising safety.
Try to retrieve the plastic bottle using a net on a pole.

Examiner's comments:

	(c)	Explain how the students could overcome potential risks when they conduct their fieldwork investigation at the two sites A and B. [6]
		Award 1 mark for each explanation on how students could overcome potential risks as they conduct their fieldwork investigation at the two sites A and B. Award 1 mark for each explanation on how the students could overcome the potential risks during data collection, to a maximum of 6 marks. Award a maximum of 1 additional mark for further development of each suggestion, where applicable. Possible responses include: At **Site A (channelised canal):** • Students should stay on the footpath or bridge and avoid entering the concretised canal to prevent slipping on steep banks [1 mark]. • There should be a lookout to monitor the movement of pedestrians on the bridge to ensure that the investigator is not accidently knocked over the bridge when bending over trying to collect the river data [1 mark]. • Ideally to have a safety harness from taking readings from the bridge. • Work in pairs or groups so that students are supervised and can get help quickly if accidents occur. [1 mark]. This is particularly so since the nearest residential area is quite some distance away [1 additional mark]. At **Site B (natural river with soft clay/silt banks and swamp/mudflat):** • Avoid standing too close to unstable, erodible banks to reduce risk of collapse [1 mark]. • At Site B, the muddy river banks composed of silt and clay sediments pose a slip risk. Wear boots or appropriate footwear that is anti-slip to prevent slipping in muddy and waterlogged conditions [1 mark]. • Carry out infiltration tests and measurements in shallow areas away from deeper or faster-flowing water to minimise drowning risks [1 mark]. Examiner's report:

	(d)	Explain how the reliability of the infiltration and river variable data shown in Resources 3 and 4 could be improved. [6]

Award 1 mark for each explanation of the how the reliability of the infiltration and river variable data can be improved.
Award 1 additional mark for further development of each explanation, where applicable.

Possible responses include:

The reliability of the **infiltration data** could be improved by:

- The fact that there was a storm event between the measurements at Site A versus Site B, invalidates the results from Site B, and students will need to come back and conduct another test another day and this time to use more investigators to simultaneously collect infiltration data at the four sites [1 mark]. The students should ensure the tests are conducted under consistent conditions. For example, the initial soil moisture content and the volume of water used should be the same for all tests to ensure the results are comparable [1 additional mark].
- Collect all the infiltration data simultaneously [1 mark]
- Infiltration rates can vary significantly over short distances. Taking more measurements at each site (for example, 5 – 10 measurements instead of just 2) and calculating an average would provide a more reliable and representative value for the site [1 mark].
- The use of double-ring infiltrometers instead of a single-ring infiltrometer would increase accuracy by preventing lateral water movement and ensuring that the water infiltrates vertically into the soil.
- Another one to note is that there is much higher infiltration rate at the grass area over that of the forest is an anomaly. There could have been leakage of water from the base of the single-ring infiltrometer [1 mark]. The higher readings for the grassy area could also have been the result of a unsuitable design of the single-ring infiltrometer since it is too narrow at 10 cm while being 30 cm tall leading to wrong reading taken [1 additional mark]

The reliability of the **infiltration data** could be improved by:

- River velocity can fluctuate due to turbulence and other factors. Repeating the velocity measurement at each point several times and taking an average would help to minimize human error and provide a more reliable value.
- The use of a current meter which can be hung from the bridge railing would provide more accurate measurement of river velocity [1 mark] The current meter will allow for multiple readings across the river since river velocity varies across the width and depth of the river [1 additional mark].

Examiner's comments:

	(e)	How useful is the method of data representation of infiltration rates shown in Resource 3 for the investigation of flood risk in the Sungai Mandai Besar area? [4]
		Award 1 mark for each explanation of the usefulness of the method of data representation of infiltration rates shown in Resource 3. Award 1 a maximum of 1 additional mark for further development of each explanation, where applicable. Possible responses include: • **Ease of Comparison:** The simple table format allows for a **direct, quantitative comparison** of infiltration rates between the four different measurement sites [1 mark] This makes it easy to see, at a glance, that the concrete surface (B1) has a high infiltration rate while the swamp/mudflat (B2) and secondary forest (A1) have low rates [1 additional mark]. • **Clear Data Presentation:** The table clearly presents the key variables: the site name, the surface type, and the corresponding infiltration rate in cm/hr [1 mark]. This makes the data easy to interpret and understand [1 additional mark]. • As infiltration rates is one of the variables that is able to indicate flood risk, using a bar graph allows for flood risk assessment evaluation [1 mark]
	(f)	The students wanted to conduct a questionnaire survey of the people working and living around the Sungai Mandai Besar regarding their experience of flooding in the area. Describe a suitable sampling method that they could use for the survey. [4]
		Award 1 mark for each explanation and justification for the sampling method used. Award a maximum of 1 additional mark for the further development of each explanation, where applicable. Possible responses include: • The population of the people to be interviewed should be stratified between residents versus those working in the area [1 mark]. This is due the different time frames that residents versus workers will be in the area when possible flood events can occur [1 additional mark] • Random sampling can be conducted so that there is no bias. • The timing should be staggered so that both groups of interviewees can be captured [1 mark]. Thus, an evening timing when the Kranji Lodge migrant residents are returning home would be a good timing, and they will not be in rush. For those workers in the nearby industrial area, it the timing should be a weekday and likely during their lunch hour or after work hour. [1 additional mark]. • Specify a suitable location for surveyors to be station within the area. Examiner's comments:

	(g)	With the aid of all the Resources, assess the validity of the students' conclusion that fluvial flood risk is lower near the river mouth than around the canalised parts of Sungai Mandai Besar River. [10]

Possible Approaches

The conclusion that it is more probable to flood at Site A is largely invalid due to several flaws in the data and methodology.

Conflicting Evidence from Resources:

- **Infiltration Rates:** Resource 3 shows that Site B's concrete surface (B1) has a higher infiltration rate (46 cm/hr) than Site A's grass (A2, 28 cm/hr) and forested (A1, 12 cm/hr) surfaces. This contradicts the idea that the natural ground at Site B would be less prone to flooding due to higher infiltration. The muddy banks at Site B (B2) also show very low infiltration (5 cm/hr). This indicates that the ground at Site B would likely have high surface runoff and be more prone to flooding from rainfall.
- **River Velocity:** Resource 4 shows that the river velocity at Site B (0.092 m/s) is much slower than at Site A (1.15 m/s). A slower velocity at Site B would lead to the build-up of water and increase the risk of the river overflowing its banks, making it more probable to flood than the faster-flowing Site A.
- **Channel Characteristics:** While Site A is a channelised canal with concrete banks, it is also a significantly smaller channel in terms of width (20 m vs 78.6 m) and cross-sectional area (30.4 m^2 vs 189.43 m^2) compared to the natural river at Site B. The smaller channel size at Site A means it has less capacity to hold a large volume of water during a high flow event, which could increase its flood risk. However, the hydraulic radius at Site B is larger (1.68 vs 1.22), which indicates a more efficient channel.

Methodological Flaws:

- **Inconsistent Data Collection:** Infiltration data was collected at two sites each for A and B, but the surfaces are different. A1 is on secondary forest, A2 is on grass, B1 is on concrete, and B2 is on a swamp/mudflat. This makes direct comparison difficult as a result of varying infiltration rates based on the surface material.
- **Limited Data Collection:** The students only collected data on one weekday from 10 am to 4 pm. This is a very limited dataset and cannot be considered representative of the long-term flood risk. The fact that a thunderstorm occurred and they could only collect river velocity data at Site B after 3 pm further compromises the data's reliability, as the thunderstorm would have altered the river conditions.
- **Site B** is at river bend, will affect velocity as float may drift to the thalweg on the concave bank, increasing average river velocity reading.

Insufficient Data for Conclusion:

- The investigation lacks critical data to properly assess flood risk. They did not measure river discharge, which is the product of velocity and cross-sectional area and a key indicator of flood risk.
- They did not take into account the tidal influence on the river mouth, which would significantly impact the water level and flood risk at Site B.
- Bankfull discharge data would have been a crucial component of a proper flood risk assessment.

		• There is no information on the antecedent weather conditions before the day of the fieldwork, which affects the soil's saturation and thus the infiltration rate. **Conclusion:** Based on the available evidence, the students' conclusion that Site A is more probable to flood is invalid. While the smaller channel size at Site A may suggest a higher risk, the other data collected, such as the low infiltration at Site B and the slow river velocity, points to a higher flood risk at Site B. The data is also unreliable and insufficient for drawing a sound conclusion due to the limited time frame, inconsistent measurement sites, and a lack of key variables like discharge and tidal data. Examiner's comments

Section B

Cluster 3 Sustainable Future and Climate Change

2 Resource 5 shows the annual growth rates for the urban core and suburbs in large metro areas from 2010-2022. Resource 6 shows the city liveability index in 2024. Resource 7 shows the four main themes the United Nations has identified to improve cities for women.

(a) Compare the changes in the annual growth rates between the urban core and suburbs seen in Resource 5. [4]

Award 1 mark for each valid comparison of the annual growth rates per 100 residents between the urban core and suburbs, to a maximum of 4 marks.
Award a maximum of 1 additional mark for further development of each comparison with precise data or trend detail, where applicable.

Possible responses include:

In 2010, the urban core grew by about 0.96 per 100 residents, while the inner suburbs grew faster at about 1.06 per 100 [1 mark]. This shows the suburbs were already expanding more quickly than the core at the start of the period [1 additional mark].

By the 2016, the urban core slowed to around +0.35 per 100, while the inner suburbs stayed close to +1.2 per 100 and the outer suburbs increased to 1.05 per 100. [1 mark]. The gap widened as the core's growth nearly stalled [1 additional mark].

By 2021, the urban core turned negative at about –0.28 per 100, while both suburbs are still positive with 0.79 and 1.26 per 100 [1 mark].

(b) Explain the impacts of urban population loss in the urban core as seen in Resource 5 on progress towards sustainable development. [6]

Award 1 mark for each valid explanation of an impact of urban core population loss on sustainable urban development, to a maximum of 6 marks.
Award a maximum of 1 additional mark for further development of each explanation, where applicable.

Possible responses include:

Reduced tax revenue due to lower working population limits funding for upgrading housing, green infrastructure and public transport [1 mark]. This delays investment in retrofits, affordable housing and low-carbon systems [1 additional mark].

Weakened social cohesion as services such as schools and clinics close or consolidate [1 mark]. This undermines inclusive growth and social equity central to sustainable development [1 additional mark].

Higher per-capita carbon emissions occur as residents relocate to car-dependent suburbs [1 mark]. Longer commutes and more driving raise the city-region's carbon footprint [1 additional mark].
Loss of jobs as services catered to citizens move to the suburbs. [1 mark] This also results in a lack of services that cater to the community within the area which affects social equity. [1 additional mark].

(c) Describe the global distribution of the most and least liveable cities as seen in Resource 6. [5]

Award 1 mark for each valid description of the global distribution of the most and least liveable cities, to a maximum of 5 marks.
Award a maximum of 1 additional mark for further development of each description

Possible responses include:

The most liveable cities (scores 90 – 100) are strongly clustered in Europe [1 mark]. Examples include Vienna (rank 1), Zurich (rank 3) all located in central Europe. [1 additional mark].

Several high-scoring cities (90-100) are found in Australia and Asia [1 mark]. Melbourne (rank 4) is a coastal city in Southern Australia. [1 additional mark].

The least liveable cities (scores 40 – 60) are concentrated in Sub-Saharan Africa (SSA) [1 mark].

Other low-scoring cities are found in South Asia and the Middle East [1 mark]. The lowest being 0-40 in the Middle East. [1 additional mark].

(d) Describe two ways to measure urban liveability. [4]

Award 1 mark for each description of a way to measure urban liveability, to a maximum of 4 marks.
Award a maximum of 1 additional mark for further development.

Possible responses include:

A composite Economist Intelligence Unit (EIU) Liveability Index which scores cities on stability, healthcare, culture & environment, education and infrastructure to produce a 0–100 ranking [1 mark]. The final score is calculated by weighting indicators across these categories [1 additional mark].

The Monocle Quality of Life Survey which ranks cities using criteria such as safety, culture, nightlife, public transport and tolerance [1 mark]. Its results are aimed at globally mobile professionals and lifestyle-oriented urban residents [1 additional mark].

A Walkability Index which measures how easily residents can access daily needs on foot, including proximity to work, shops and transit [1 mark]. Scores are derived from factors such as street connectivity, pavement quality and pedestrian safety [1 additional mark].

(e) With reference to Resource 7, explain the issues that women living in the city face. [6]

Award 1 mark for each valid explanation of an issue faced by women in the city, to a maximum of 6 marks.
Award a maximum of 1 additional mark for further development of each explanation with elaboration or example, where applicable.

Possible responses include:

Resource 7 shows that the United Nations has identified four main themes to improve cities for women: safety and freedom from violence; participation in decision-making; access to decent work and services; and inclusive public spaces and services.

Theme 1: Safety and security – Women face harassment and fear of violence in public transport, dark streets and isolated spaces [1 mark]. This restricts mobility and access to work/education (e.g. avoiding night shifts or certain routes) and highlights the need for lighting, surveillance and safer travel [1 additional mark].

Theme 2: Justice and equity – Women encounter unequal access to opportunities and rights in the city, including pay gaps, insecure tenure and limited voice in planning decisions [1 mark]. Procedural inequities mean facilities like childcare or safe transit are under-provided for women's needs [1 additional mark].

Theme 3: Health and wellbeing – Gaps in affordable healthcare, reproductive services and safe sanitation disproportionately affect women [1 mark]. Exposure to long commutes, poor air quality and time poverty from unpaid care work further undermines physical and mental health [1 additional mark].

Theme 4: Enrichment and fulfilment – Limited access to inclusive education, sports/recreation and cultural/civic spaces constrains personal development [1 mark]. Lack of childcare, safe play areas and flexible programming reduces participation in community life and skills upgrading [1 additional mark].

(f) Using examples, explain the tension between sustainable urban development and liveability. [5]

Award 1 mark for each valid explanation of a tension between sustainable urban development and urban liveability, to a maximum of 5 marks.

Award a maximum of 1 additional mark for further development of each explanation with elaboration or example, where applicable.

Possible responses include:

Increasing urban density in Clarke Quay improves SUD by supporting public transport, reducing per-capita land consumption and enabling efficient mixed-use development, but UL suffers as nightlife noise, crowding and high residential rents reduce comfort and affordability [1 mark]. For instance, residents face late-night disturbances and fewer quiet zones [1 additional mark].

Heritage tourism redevelopment in Chinatown, Singapore improves SUD by conserving historic shophouses, sustaining cultural identity and promoting dense mixed-use urban form, but reduces UL as tourism-driven gentrification raises rents, displaces long-term residents and creates crowding that erodes neighbourhood character [1 mark +1].

The Formula 1 (F1) night race precinct in Marina Bay, Singapore supports SUD by hosting a global event that boosts tourism and local economy with creation of new infrastructure that the public can enjoy, but reduces UL during race periods through severe road closures, noise pollution, crowding and disruption of public transport for residents and commuters [1 mark +1].

Section C

Answer EITHER question 3 OR question 4.

3 Evaluate the success of strategies in improving the lives of slum dwellers. [20]

Possible Approaches
Candidates could approach the question by making a judgement on how far different strategies have improved living standards for slum dwellers. They may compare in-situ upgrading programmes such as Rio de Janeiro's Favela-Bairro and Jakarta's Kampung Improvement Programme (KIP) with state-led rehousing and new town schemes such as Singapore's Housing and Development Board (HDB) and the UK's post-war New Towns. Answers could consider multiple dimensions of success — physical housing quality, basic services, health, economic opportunities, social inclusion and tenure security. Other things to consider is how contextual factors such as government commitment, level of financing, land tenure security, availability of jobs, and community participation influence outcomes. Strong answers will balance achievements with the ongoing challenges of affordability, displacement and long-term maintenance.

4 'Firms play the greatest role in responding to contemporary climate change.'

Evaluate this statement. [20]

Possible Approaches
Candidates could approach the question by making a judgement on whether firms truly have the greatest influence on climate change response, or whether their actions are shaped and limited by other actors such as states, multilateral organisations and non-governmental organisations (NGOs). They may analyse the interdependence between these actors: firms often depend on state regulation, subsidies and carbon pricing to make low-carbon investments viable, while states rely on private-sector innovation and supply chains to deliver emissions cuts. Candidates might explore how multilateral agreements such as the Paris Agreement create shared targets that guide national policy, which then influences corporate strategies, and how NGOs and civil society exert pressure on both states and companies. They could also evaluate corporate reluctance such as greenwashing, cost concerns and profit motives and how strong government frameworks or global compacts are needed to turn pledges into real emissions reductions thus the state may play the greatest role in creating impetus for firms to change their policies.

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