S5 Geography Practice Paper: Plate Tectonics, Earthquakes and Volcanoes, River Landforms and Hydrology, Weather and Climate, Population Structure and Migration, Urban and Industrial Systems, Sustainable Development and Fieldwork (100 marks)

Level: S5 | Subject: Geography | 75 minutes | 100 marks | 24 questions | answer key

Part 1 Plate Tectonics, Earthquakes and Volcanoes (16 marks)

Show all formulae, substitutions and units; give percentages and ratios to 1 d.p.

#	Question	Answer	Marks
1	A plate boundary moves 5.0 cm per year on average. (a) Find the distance moved in 100 years, in metres; (b) describe three types of plate boundary and their main landforms; (c) within which plate does Hong Kong lie?	(a) Distance = 5.0 x 100 = 500 cm = 5.0 m. (b) Divergent: plates separate to form mid-ocean ridges and rift valleys. Convergent: subduction or collision builds trenches, island arcs and fold mountains. Conservative: horizontal slip produces faults and shallow earthquakes. (c) Hong Kong lies inside the Eurasian Plate, far from active boundaries, so seismicity is low.	4
2	A P wave travels at 6.0 km/s and an S wave at 3.5 km/s; a station lies 84 km from the epicentre. (a) Find the travel time of each wave; (b) find the S minus P time difference; (c) explain why this time difference gives the distance to the epicentre.	(a) P wave = 84 / 6.0 = 14.0 s; S wave = 84 / 3.5 = 24.0 s. (b) Lag = 24.0 - 14.0 = 10.0 s. (c) The two speeds are fixed, so the lag grows with distance; reading the lag on a travel-time curve gives the distance, and circles from three stations intersect at the epicentre.	4
3	Each unit of magnitude releases about 31.6 times more energy. An earthquake increases from magnitude 5.0 to 7.0. (a) Find the increase in energy; (b) if the 5.0 event releases energy E, express the 7.0 event in terms of E; (c) explain why a shallow earthquake of modest magnitude can still cause severe damage.	(a) Ratio = 31.6^2 = 998.56, about 1.0 x 10^3 times. (b) About 1000E. (c) A shallow focus loses little energy before reaching the surface; dense population, weak building codes, soft water-saturated ground and secondary hazards such as landslides, fire and burst mains add to the damage.	4
4	Acidic magma contains about 72% silica and basic magma about 50%. (a) Find the difference in percentage points; (b) compare their viscosity and eruption style; (c) explain how viscosity shapes a volcano.	(a) Difference = 72 - 50 = 22 percentage points. (b) Acidic magma is silica-rich and viscous, traps gas and erupts explosively with ash and pyroclasts; basic magma is silica-poor and fluid, degasses easily and erupts quietly as lava flows. (c) Viscous lava piles up into a steep cone; fluid lava spreads far to build a gently sloping shield volcano.	4

Part 2 River Landforms and Hydrology (16 marks)

Express discharge in m3/s and volume in m3; always state the unit.

#	Question	Answer	Marks
5	A catchment of 250 km2 receives 2400 mm of rain a year and has a runoff coefficient of	(a) Volume = 250 x 10^6 m2 x 2.4 m x 0.45 = 2.7e+08 m3. (b) Mean discharge = 2.7e+08 / (365	4

	0.45. (a) Find the annual runoff volume in m3; (b) find the mean discharge in m3/s to 1 d.p.; (c) explain how urbanisation changes the runoff coefficient and the flood peak.	x 86400) = 8.6 m3/s. (c) Impermeable surfaces cut infiltration and raise surface runoff, lifting the coefficient from about 0.2 to 0.7-0.9; drains deliver water faster, so the peak is higher and arrives sooner.	
6	A river runs 40 km from source to mouth with a fall of 320 m. (a) Find the average gradient in m/km; (b) express the gradient as a ratio; (c) describe how gradient and landforms differ between the upper, middle and lower courses.	(a) Gradient = 320 / 40 = 8.0 m/km. (b) Ratio = 320 / 40000 = 0.008, i.e. 0.8%. (c) The upper course is steep, dominated by vertical erosion, V-shaped valleys, waterfalls and rapids; the middle course has gentler gradients with lateral erosion, meanders and terraces; the lower course is almost flat and depositional, building floodplains, levees and deltas.	4
7	The outer bank of a meander retreats at 0.5 m per year and a house stands 12 m from the bank. (a) Find the retreat after 20 years; (b) decide whether the house is threatened and explain; (c) describe deposition on the inner bank and the formation of an oxbow lake.	(a) Retreat = 0.5 x 20 = 10.0 m. (b) Only 2.0 m would remain, so the house is at high risk; bank protection, foundation strengthening or relocation is needed. (c) Flow slows on the inner bank and sand and gravel are deposited on the slip-off slope; lateral migration narrows the neck, a flood cuts through and the abandoned loop becomes an oxbow lake.	4
8	The 10-year return-period flood at a gauging station is 320 m3/s. (a) Find the probability of exceeding this discharge in any one year; (b) find the chance of at least one such flood in 50 years, as a percentage to 1 d.p.; (c) explain the correct meaning of a 10-year flood and how return period guides flood defence design.	(a) Probability = 1 / 10 = 10.0%. (b) 1 - (0.9)^50 = 1 - 0.0052 = 0.9948, i.e. 99.5%. (c) A 10-year flood has a 1 in 10 chance of being exceeded in any single year; it is not due once a decade and can occur in consecutive years. Engineers size embankments, drains and storage basins from the design flood and upgrade the standard for climate change.	4

Part 3 Weather and Climate (16 marks)

Give temperatures to 1 d.p. and pressure in hPa.

#	Question	Answer	Marks
9	On a given day the air at the foot of a hill is 30.0 C, the lapse rate is 6.5 C per km and the summit is 957 m high. (a) Find the temperature drop from foot to summit; (b) find the summit temperature to 1 d.p.; (c) explain the cause of the lapse rate and why measurements are often lower than theory.	(a) Drop = 6.5 x 0.957 = 6.2 C. (b) Summit = 30.0 - 6.2 = 23.8 C. (c) The troposphere is heated mainly by long-wave radiation from the ground, so heating declines with height; rising air expands and cools as pressure falls. Inversions, cloud and humidity slow the cooling, so measured lapse rates are often below 6.5 C per km.	4
10	Saturated air at 30 C holds 30.0 g/m3 and on a given day the air holds 21.0 g/m3. (a) Find the relative humidity; (b) if the air cools to 24 C, where saturation is 21.8 g/m3, decide whether condensation occurs and explain; (c) describe how high spring and summer humidity affects daily life in Hong Kong.	(a) Relative humidity = 21.0 / 30.0 x 100 = 70.0%. (b) 21.0 g/m3 is below 21.8 g/m3, so the body of air is unsaturated and no condensation forms in it; however, a thin layer next to a cold window, tile or pipe may fall below the dew point and fog over. (c) Sweat evaporates slowly, the apparent temperature is high, clothes and walls stay damp, mould grows and asthma and skin complaints worsen.	4
11	A typhoon has a central pressure of 950 hPa, an outer pressure of 1010 hPa and a 10-minute mean wind of 150 km/h near its centre. (a) Find the pressure	(a) Pressure difference = 1010 - 950 = 60 hPa. (b) Wind speed = 150 / 3.6 = 41.7 m/s. (c) Peak level = 2.5 + 2.8 = 5.3 m, above normal coastal protection; low-lying villages, underground car	4

	difference; (b) convert the wind speed to m/s to 1 d.p.; (c) if the astronomical tide is 2.5 m and the storm surge 2.8 m, find the peak water level and explain the risk to low-lying areas.	parks and ground-floor shops face seawater flooding, so early warning, road closure and evacuation are needed.	
12	On the same afternoon the urban area records 32.4 C and the countryside 28.1 C. (a) Find the urban heat island intensity; (b) give three causes of the heat island; (c) suggest two planning measures that reduce it.	(a) Intensity = 32.4 - 28.1 = 4.3 C. (b) Concrete and asphalt absorb heat readily and have low heat capacity, warming fast and releasing heat slowly; dense tall buildings block long-wave loss and cut wind speed; vehicles, air conditioners and lighting release waste heat; sparse greenery and water weaken evaporative cooling. (c) Add roof gardens and parks and keep air ventilation corridors open; use reflective materials and permeable paving with more shade.	4

Part 4 Population Structure and Migration (16 marks)

Express rates in per thousand (permille); give population figures as whole numbers.

#	Question	Answer	Marks
13	A city of 8 million people covers 1110 km2. (a) Find the population density in persons per km2 as a whole number; (b) explain what the average hides about distribution; (c) give two planning considerations that depend on density.	(a) Density = 7,500,000 / 1110 = 6,757 persons per km2. (b) The average hides extremes: old urban blocks can exceed 100,000 persons per km2 while country parks and hillsides approach zero, so a single figure understates the needs of crowded districts. (c) Use population numbers to size schools and clinics, and density with age structure to site open space, fire access and elderly centres.	4
14	A place has a crude birth rate of 5.0 per thousand, a crude death rate of 8.0 per thousand, a net migration rate of +4.2 per thousand and a mid-year population of 7.5 million. (a) Find the rate of natural increase; (b) find the total growth rate and the annual change in population; (c) explain the main source of growth and its policy implications.	(a) Natural increase = 5.0 - 8.0 = -3.0 per thousand. (b) Total growth = -3.0 + 4.2 = +1.2 per thousand; change = 7,500,000 x 1.2 per thousand = +9,000 people. (c) Deaths exceed births, so growth depends entirely on net immigration, a form of population replacement; housing, schools, health care and transport must be planned for the inflow while ageing, skills mismatch and integration are addressed.	4
15	The age structure of a place is: 0-14 years 16.0%, 15-64 years 64.0% and 65 and over 20.0%. (a) Find the total dependency ratio; (b) find the old-age dependency ratio; (c) compare their policy meaning.	(a) Total dependency = (16.0 + 20.0) / 64.0 x 100 = 56.2%. (b) Old-age dependency = 20.0 / 64.0 x 100 = 31.2%. (c) The total ratio measures the whole burden and is sensitive to the child share, while the old-age ratio isolates the elderly; its rise means more health and long-term care but fewer taxpayers, so retirement protection, longer working lives and gerontechnology are needed.	4

16	The share of people aged 65 and over is expected to rise from 20.0% to 33.0% by 2036. (a) Find the rise in percentage points; (b) give two causes of population ageing; (c) use push and pull factors to explain a young person decision to migrate.	(a) Rise = 33.0 - 20.0 = 13.0 percentage points. (b) A persistently low birth rate (later marriage, smaller families, high child-rearing costs) shrinks the young cohort, while longer life expectancy from better medicine and public health enlarges the old cohort. (c) Push: low pay, few jobs, crowded housing or environmental risk at home; pull: wages, education, health care and welfare at the destination; intervening obstacles include immigration rules, language, qualification recognition and moving costs.	4

Part 5 Urban, Industrial and Energy Systems (16 marks)

Express energy in kWh or MWh and state every assumption.

#	Question	Answer	Marks
17	A new town of 350,000 people has a mean density of 45,000 persons per km2. (a) Find its area in km2 to 1 d.p.; (b) give one advantage and one disadvantage of high-density development for transport and energy; (c) suggest one measure that improves liveability in a high-density neighbourhood.	(a) Area = 350,000 / 45,000 = 7.8 km2. (b) Advantage: concentrated demand supports frequent public transport and the small external wall area per person lowers heating and lighting energy. Disadvantage: crowded streets and carriages, poor ventilation and air quality, a strong heat island, noise and shortage of open space and escape routes. (c) Open ground-level ventilation corridors and community gardens, and prioritise pedestrians with street planting to cut traffic and heat load.	4
18	A factory needs 4 tonnes of raw material for every 1 tonne of product; material and product cost the same to move, 2.5 dollars per tonne-kilometre, and the material site is 100 km from the market. (a) Find the material index; (b) compare transport costs and decide where the plant should locate; (c) give two modern factors that can overturn this conclusion.	(a) Material index = 4 / 1 = 4.0, a weight-losing industry. (b) Raw material freight = 4 x 100 x 2.5 = 1,000 dollars; product freight = 1 x 100 x 2.5 = 250 dollars, so materials cost 750 dollars more and the plant should sit near the raw material. (c) Containerisation and cheaper transport cut freight as a share of cost; materials can be substituted, recycled or sourced locally; automation, information technology and just-in-time production loosen the tie to the material site.	4
19	A wind turbine has a rated capacity of 3.0 MW and a capacity factor of 35%, over 8,760 hours a year; a household uses 4,500 kWh a year. (a) Find the annual output in MWh; (b) estimate the number of households it can supply, as a whole number; (c) explain the intermittency of wind power and give two ways of managing it.	(a) Output = 3.0 x 0.35 x 8,760 = 9,198 MWh. (b) Households = 9,198 x 1000 / 4,500 = about 2,044. (c) Wind speed varies with weather and season, so output can swing from nothing to full load within hours and destabilise the grid; batteries or pumped storage, interconnection with solar and gas plant, demand-side management and better forecasting are the remedies.	4
20	A housing estate installs a 1 kW solar array with 3.5 peak sun hours a day; grid emissions are 0.71 kg CO2 per kWh. (a) Find the daily and annual output in kWh; (b) find the CO2 avoided each year in kg to 1 d.p.; (c) give two constraints on rooftop solar in Hong Kong.	(a) Daily = 1 x 3.5 = 3.5 kWh; annual = 3.5 x 365 = 1,277.5 kWh. (b) Avoided = 1,277.5 x 0.71 = 907.0 kg CO2. (c) Tall dense blocks leave little usable roof area and cause shading; typhoon wind loading, waterproofing and maintenance are costly; feed-in tariffs and long payback periods weaken take-up.	4

Part 6 Sustainable Development and Fieldwork (20 marks)

Show the working for all fieldwork calculations and state the assumptions behind estimates.

#	Question	Answer	Marks
21	An ecology survey lays 20 random quadrats of 1 m2 and counts 480 plants; the meadow covers 500 m2. (a) Find the mean density in plants per m2; (b) estimate the total number of plants; (c) explain why random sampling matters and give one source of error; (d) suggest one way of making the sample more representative.	(a) Density = 480 / 20 = 24 plants per m2. (b) Total = 24 x 500 = 12,000 plants. (c) Random sampling avoids choosing lush or accessible spots, which would over-estimate density; errors come from too few quadrats, inconsistent counting of edge plants and unmixed slope or soil differences. (d) Use more quadrats placed from random coordinates, or stratified random sampling by habitat.	5
22	A river survey uses the float method: a float travels 10 m in 25 s and the channel cross-section is 2.0 m2. (a) Find the surface velocity in m/s; (b) find the discharge in m3/s; (c) if surface velocity exceeds mean velocity by about 15%, find the corrected discharge; (d) state one limitation of the float method.	(a) Surface velocity = 10 / 25 = 0.40 m/s. (b) Discharge = 0.40 x 2.0 = 0.80 m3/s. (c) Mean velocity = 0.40 / 1.15 = 0.348 m/s, so corrected discharge = 0.348 x 2.0 = 0.70 m3/s. (d) A float mainly records surface flow, which is affected by wind, turbulence and obstacles and need not equal the cross-sectional mean; floats are also hard to release and time in shallow or fast water.	5
23	A driver covers 20 km a day and the car emits 0.15 kg CO2 per km. (a) Find the daily emission; (b) find the annual emission in tonnes to 1 d.p.; (c) if the trip is made by rail, at 0.04 kg CO2 per km, find the annual saving in kg; (d) suggest two further behaviour changes that cut emissions.	(a) Daily = 20 x 0.15 = 3.0 kg CO2. (b) Annual = 3.0 x 365 = 1,095 kg, about 1.1 tonnes. (c) Rail emissions = 20 x 0.04 x 365 = 292 kg, a saving of 803 kg a year. (d) Switch to an electric car charged from renewables, and cut unnecessary trips through car sharing, public transport, walking or video meetings.	5
24	A class compares urban and rural temperatures using one station in each place, measured 4 times a day for 3 days. (a) Find the total number of readings; (b) list three variables that must be controlled; (c) explain why both sites are measured at the same time; (d) give one instrument precaution and one safety rule.	(a) Readings = 2 x 3 x 4 = 24. (b) Use the same instrument model and sensor height (about 1.5 m above ground); shield the sensor in a Stevenson screen or radiation shield; keep time of day, weather and surroundings identical, away from air conditioning vents, walls and vehicles. (c) Simultaneous readings remove time-related differences such as changing sun angle and wind, so the difference reflects the sites themselves. (d) Instrument: let the reading stabilise, avoid touching the sensor and calibrate regularly. Safety: watch traffic and weather, use sun protection and drink water, work in pairs and tell the teacher the route.	5