S6 Geography Practice Paper | Catchment runoff, slope stability, seismic wave travel times, plot ratio and density, farm profit, stack concentration and BOD

Senior Secondary Geography

S6 Geography practice paper with answers: catchment runoff, urbanisation and peak flow, slope stability, seismic lag time, plot ratio, density and farm profit.

Question 1 Catchment runoff and mean discharge

A catchment covers 250 square kilometres, receives 2,200 mm of rain a year and has a runoff coefficient of 0.45. After urbanisation the coefficient rises to 0.65, peak discharge rises from 18 to 41 cubic metres per second and the lag time falls from 6.0 hours to 3.5 hours.

#	Question
1	(a) Find the annual volume of rainfall over the catchment in million cubic metres.
2	(b) Find the annual runoff in million cubic metres and the mean discharge in cubic metres per second, to two decimal places.
3	(c) If the runoff coefficient rises to 0.65, find the annual runoff and the percentage increase, to one decimal place.
4	(d) Find the percentage rise in peak discharge and the percentage shortening of lag time, and state the effect of urbanisation on flood risk.

Question 2 Slope angle and factor of safety

Two points on a hillside are 800 m apart horizontally with a height difference of 240 m. The slope is sandstone with an angle of internal friction of 32 degrees. The design guide requires a factor of safety FS (FS = tan phi / tan beta) of at least 1.5.

#	Question
5	(a) Find the slope gradient as a percentage and as an angle, to one decimal place.
6	(b) Find the present factor of safety FS to two decimal places and state whether it meets the guide.
7	(c) If cutting raises the angle to 25 degrees, find the new FS to two decimal places and state whether it complies.
8	(d) Heavy rain lowers the effective friction angle to 24 degrees. Find FS on the 25 degree slope and explain the consequence.

Question 3 Plate motion and seismic wave lag time

Plates on either side of a boundary move 65 mm per year relative to each other. P waves travel at 6.5 km/s and S waves at 3.6 km/s. A station is 156 km from the epicentre.

#	Question
9	(a) How many years, in millions, are needed for 1,300 km of relative plate motion?
10	(b) Find the arrival times of the P and S waves and the S minus P lag, in seconds to one decimal place.

#	Question
11	(c) A second station records an S minus P lag of 28 s. Find its distance from the epicentre in km, to the nearest whole number.
12	(d) Each unit of magnitude adds about 31.6 times the energy. By what factor does energy rise from magnitude 5.0 to 7.0?

Question 4 Plot ratio and population density

A residential site of 2.0 hectares (20,000 m2) carries a 24-storey block with 1,400 m2 of floor area per floor, 8 flats per floor and 3.2 people per flat. The maximum plot ratio is 5.0. The district has 480,000 people on 12 km2 of residential land.

#	Question
13	(a) Find the total floor area in square metres and the plot ratio.
14	(b) Find the number of flats, the population as a whole number, and the site population density in persons per hectare.
15	(c) With a maximum plot ratio of 5.0, what is the greatest number of storeys the site can carry, as a whole number?
16	(d) Find the district population density in persons per hectare and the ratio to the site density, to two decimal places.

Question 5 Farm output and profit

A farm of 45 hectares yields 6.2 tonnes of rice per hectare, sold at $4,800 a tonne, with costs of $21,000 per hectare. Rice travels 1,200 km to market by lorry emitting 0.09 kg of carbon dioxide per tonne-kilometre; local supply would travel 150 km.

#	Question
17	(a) Find the total output, total revenue, total cost and profit.
18	(b) Find the profit margin to one decimal place.
19	(c) A new variety raises yield 15% and lifts cost per hectare 8%. Find the new profit and the percentage change to one decimal place.
20	(d) Find the transport carbon emissions in kg for the present and the local supply, and the percentage cut to one decimal place.

Question 6 Stack dispersion and wastewater BOD

A factory stack emits 48 kg of sulphur dioxide an hour; at 3.0 km the plume has spread to 600 m wide and 250 m high in a wind of 4.0 m/s. The one-hour standard for sulphur dioxide is 50 micrograms per cubic metre. The plant discharges 1,500 m3 of wastewater a day with BOD falling from 320 mg/L to 30 mg/L after treatment.

#	Question
21	(a) Find the plume volume flux in m3/s and the ground-level sulphur dioxide concentration in micrograms per m3, to one decimal place.

#	Question
22	(b) If output doubles and emission rises to 96 kg an hour, find the new concentration and its percentage of the standard, to one decimal place.
23	(c) Find the daily BOD load in kg before and after treatment.
24	(d) Find the daily BOD removed and the removal efficiency to one decimal place.