S5 Geography Practice Paper I River discharge, dependency ratios, plot ratio and population density, farm self-sufficiency, industrial costs, lapse rate

S5 Geography I Time allowed: 60 minutes I Total: 100 marks I 24 questions

Question 1: Catchment runoff and discharge (18 marks)

Catchment system

1. (a) A catchment has an area of 240 km², mean annual rainfall of 2 200 mm and a runoff ratio of 0.45. Find the total volume of rainfall and the volume of runoff in a year, in m³. (6 marks)

> **Answer:** Rainfall volume = 240 × 10^6 m² × 2.2 m = 5.28 × 10^8 m³. Runoff volume = 5.28 × 10^8 × 0.45 = 2.376 × 10^8 m³.

2. (b) Find the mean discharge of the river in the catchment, in m³ s^{-1}. (5 marks)

> **Answer:** One year = 365 × 24 × 3 600 = 3.1536 × 10^7 s. Mean discharge = 2.376 × 10^8 / 3.1536 × 10^7, about 7.53 m³ s^{-1}.

3. (c) Urbanisation raises the runoff ratio from 0.45 to 0.70. Find the new mean discharge and the percentage increase in discharge. (4 marks)

> **Answer:** New runoff volume = 5.28 × 10^8 × 0.70 = 3.696 × 10^8 m³, new discharge = 3.696 × 10^8 / 3.1536 × 10^7, about 11.72 m³ s^{-1}. Increase = (0.70 − 0.45) / 0.45 × 100%, about 55.6%.

4. (d) Explain why urbanisation raises the runoff ratio. (3 marks)

> **Answer:** Concrete and asphalt seal the ground so infiltration falls sharply; removal of trees cuts interception and transpiration; drains remove rainwater quickly, so a larger share of the same rainfall becomes surface runoff.

Question 2: Population structure (17 marks)

Population data

5. (a) A place has a population of 7.50 million: 1.05 million aged 0–14, 5.40 million aged 15–64 and 1.05 million aged 65 or above. Find the youth, old-age and total dependency ratios. (5 marks)

> **Answer:** Youth ratio = 1.05 / 5.40 × 100%, about 19.4%; old-age ratio = 1.05 / 5.40 × 100%, about 19.4%; total ratio = 2.10 / 5.40 × 100%, about 38.9%.

6. (b) In a year there are 60 000 births and 45 000 deaths. Find the birth rate, death rate and rate of natural increase, per 1 000 people. (5 marks)

> **Answer:** Birth rate = 60 000 / 7.50 × 10^6 × 1 000 = 8.0; death rate = 45 000 / 7.50 × 10^6 × 1 000 = 6.0; natural increase = 8.0 − 6.0 = 2.0 per 1 000.

7. (c) Net migration in the year is −10 000. Find the net migration rate and the overall population growth rate, per 1 000 people. (4 marks)

> **Answer:** Net migration rate = $-10\,000 / 7.50 \times 10^6 \times 1\,000$, about -1.33; net gain = $15\,000 - 10\,000 = 5\,000$ people, so the growth rate is about 0.67 per 1 000.

8. (d) The population pyramid of this place is lantern-shaped. Explain two causes. (3 marks)

> **Answer:** A persistently low birth rate narrows the base; good medical care and long life expectancy keep a large share of elderly people, giving a wide middle with narrow top and bottom.

Question 3: Plot ratio and population density (16 marks)

Urban land use

9. (a) A residential site of 8 000 m² has a plot ratio of 7.5. Find the total permissible floor area. (4 marks)

> **Answer:** Total floor area = $8\,000 \times 7.5 = 60\,000$ m².

10. (b) If the average floor area of a flat is 50 m², find the number of flats. (4 marks)

> **Answer:** Number of flats = $60\,000 / 50 = 1\,200$.

11. (c) If each flat houses 3.2 people on average, find the population and the population density of the site in persons per hectare and per km². (5 marks)

> **Answer:** Population = $1\,200 \times 3.2 = 3\,840$; site area = 8 000 m² = 0.8 hectare = 0.008 km²; density = $3\,840 / 0.8 = 4\,800$ per hectare = 480 000 per km².

12. (d) If the plot ratio is relaxed to 9.0 with all else unchanged, by how many people does the population rise? (3 marks)

> **Answer:** Floor area = $8\,000 \times 9.0 = 72\,000$ m², flats = 1 440, population = 4 608, an increase of $4\,608 - 3\,840 = 768$ people.

Question 4: Farm production and food self-sufficiency (17 marks)

Farming system

13. (a) A farm of 120 hectares has a rice yield of 5.4 tonnes per hectare. Find its total annual output. (4 marks)

> **Answer:** Total output = $120 \times 5.4 = 648$ tonnes.

14. (b) If local annual demand for rice is 12 000 tonnes, find the self-sufficiency rate for rice. (4 marks)

> **Answer:** Self-sufficiency rate = $648 / 12\,000 \times 100\% = 5.4\%$.

15. (c) Production cost is 18 000 dollars per hectare and rice sells at 4 200 dollars per tonne. Find total revenue, total cost and profit. (6 marks)

> **Answer:** Revenue = $648 \times 4\,200 = 2\,721\,600$ dollars; cost = $120 \times 18\,000 = 2\,160\,000$ dollars; profit = $2\,721\,600 - 2\,160\,000 = 561\,600$ dollars, or 4 680 dollars per hectare.

16. (d) Suggest two measures that could raise local food self-sufficiency. (3 marks)

> **Answer:** Raise yield per hectare through better seed, mechanisation, irrigation and pest control; cut post-harvest losses and develop peri-urban farmland or urban farming to increase local supply.

Question 5: Industrial location and profit (16 marks)

Manufacturing location

17. (a) A factory produces 3 000 tonnes of finished goods a year, sold at 900 dollars per tonne. Find its annual revenue. (4 marks)

> **Answer:** Revenue = 3 000 × 900 = 2 700 000 dollars.

18. (b) The factory uses 4 000 tonnes of raw material a year at 30 dollars per tonne freight, and pays 45 dollars per tonne to ship finished goods. Find the annual transport cost. (4 marks)

> **Answer:** Transport cost = 4 000 × 30 + 3 000 × 45 = 120 000 + 135 000 = 255 000 dollars.

19. (c) Wages total 1 200 000 dollars and other fixed costs are 800 000 dollars. Find total cost and profit. (5 marks)

> **Answer:** Total cost = 1 200 000 + 800 000 + 255 000 = 2 255 000 dollars; profit = 2 700 000 – 2 255 000 = 445 000 dollars.

20. (d) If the factory moves next to the raw material source so that raw material freight is halved, find the new profit and explain the location choice of such an industry. (3 marks)

> **Answer:** Raw material freight falls from 120 000 to 60 000 dollars, so profit rises to 445 000 + 60 000 = 505 000 dollars. The raw material is heavier than the finished product (4 000 against 3 000 tonnes), so this is a raw-material-oriented industry that gains most by locating near the source.

Question 6: Lapse rate and condensation level (16 marks)

Weather and climate

21. (a) At the foot of a hill (0 m) the air temperature is 28.5 °C and the dew point is 20.0 °C. The dry adiabatic lapse rate is 10 °C/km. Find the condensation level of the rising air parcel. (5 marks)

> **Answer:** Condensation level = (28.5 – 20.0) / 10 = 0.85 km = 850 m.

22. (b) The parcel rises to a summit at 1 800 m, where the saturated adiabatic lapse rate is 6 °C/km. Find the temperature at the summit. (5 marks)

> **Answer:** Above the condensation level the parcel rises 1 800 – 850 = 950 m = 0.95 km, cooling by 0.95 × 6 = 5.7 °C, so the summit temperature is 20.0 – 5.7 = 14.3 °C.

23. (c) Explain why the parcel cools more slowly above the condensation level. (3 marks)

> **Answer:** Condensation releases latent heat, which offsets part of the adiabatic cooling, so the saturated lapse rate (6 °C/km) is smaller than the dry rate (10 °C/km).

24. (d) The parcel then descends the leeward slope from the summit to the foot (1 800 m), warming at the dry adiabatic lapse rate. Find the temperature at the foot and name the phenomenon. (3 marks)

Answer: Descending 1.8 km warms the parcel by 1.8 × 10 = 18.0 °C, giving 14.3 + 18.0 = 32.3 °C at the foot. The phenomenon is the foehn effect.
