S6 Geography Practice Paper (Set 4): plate tectonics and earthquakes, weathering and slopes, rivers and floods, coasts and reclamation, urban land use, climate and air qual

Level: S6 | Subject: Geography | Time: 75 min | Total: 100 marks | Items: 24

Question 1 Plate motion and earthquakes

Take $\log_{10}E = 4.8 + 1.5M$ with E in joules. Give answers to 3 s.f.

1. Two plates separate at a mid-ocean ridge at 25 mm per year. Find the time needed for the ocean floor to widen by 120 km, in million years. (4 marks)

2. In a region, P waves travel at 6.0 km s^{-1} and S waves at 3.5 km s^{-1}. A station records the S wave 20 s after the P wave. Find the distance from the focus to the station. (4 marks)

3. Compare the energy released by magnitude 6.0 and 7.0 earthquakes. Find the energy ratio and the energy of the magnitude 7.0 event. (4 marks)

4. A submarine earthquake generates a tsunami in water of mean depth 4000 m. Find the deep-water tsunami speed in km h^{-1} and estimate the time to cross 1500 km. (5 marks)

Question 2 Weathering and slope processes

Take $g = 9.81$ m s^{-2}, $\sin 25° = 0.4226$ and $\cos 25° = 0.9063$.

5. A 3.0 m thick limestone bed is dissolved by rainwater at 0.05 mm per year. Find the time needed to dissolve the whole bed. (4 marks)

6. A regolith has cohesion $c = 15$ kPa, normal stress $\sigma = 60$ kPa and angle of internal friction $\phi = 30°$. The shear stress along the slip plane is 45 kPa. Find the factor of safety and state whether the slope is stable. (4 marks)

7. A 40 kg rock lies on a 25° slope. The coefficient of friction between rock and slope is 0.40. Find the net force acting down the slope. (4 marks)

8. Soil on a hillside creeps downslope at 8 mm per year. Find the cumulative displacement after 50 years and name this slope process. (5 marks)

Question 3 River discharge and flooding

Give answers to 3 s.f.

9. A river reach has cross-sectional area 45 m^2 and mean velocity 1.8 m s^{-1}. Find its discharge. (4 marks)

10. A 60 km^2 catchment receives 120 mm of rain in 6 hours; the runoff coefficient is 0.35. Find the total runoff volume and the mean discharge over that period. (4 marks)

11. At a gauging station the 50-year flood has a return period of 50 years. Find the probability that a flood of this size occurs at least once in the next 20 years. (4 marks)

12. In the same reach (width 6.0 m) the stage rises from 1.5 m to 2.0 m while velocity stays at 1.8 m s^{-1}. Find the percentage increase in discharge. (4 marks)

Question 4 Coastal processes and reclamation

Take deep-water wavelength $L = 1.56T^2$ with L in m and T in s.

13. Waves at a site have period 8.0 s. Find the deep-water wavelength and wave speed. (4 marks)

14. A coast receives 30 000 m^3 and loses 45 000 m^3 of sediment per year. Find the net erosion and estimate the rate of coastline retreat (coast length 2.0 km, beach scarp height 2.0 m). (5 marks)

15. Longshore drift along a coast is 25 000 m^3 per year; a groyne traps 80% of it. Find the volume trapped in 5 years. (4 marks)

16. A reclamation scheme creates 300 ha of land, 45% of which is residential; residential land carries 1 200 persons per hectare. Find the population the new town can hold. (4 marks)

Question 5 Urban land use

An urban district covers 12.5 km^2. Land use: residential 42%, commercial 8%, industrial 6%, transport 18%, open space 12%, others 14%.

17. Verify that the land-use percentages add up to 100%. (4 marks)

18. The district has 480 000 residents. Find the population density. (4 marks)

19. A 2 000 m^2 site carries a building with 18 000 m^2 of gross floor area. Find the plot ratio. (4 marks)

20. Assume the number of trips varies inversely with the square of the distance to the CBD. A point 2 km from the CBD generates 40 000 trips a day. Find the trips at 4 km and explain the pattern. (4 marks)

Question 6 Climate data and air quality

Monthly mean temperature (°C): 16.5, 17.0, 19.2, 23.0, 26.4, 28.6, 29.2, 28.9, 27.8, 25.4, 21.6, 18.0. Monthly rainfall (mm): 32, 38, 62, 118, 246, 382, 356, 332, 268, 96, 44, 28. Take 1 ppb NO_2 ≈ 1.88 $\mu g\ m^{-3}$.

21. Find the annual mean temperature and the annual temperature range. (4 marks)

22. Find the annual total rainfall and state the wettest month. (4 marks)

23. The 24-hour mean NO_2 concentration on a day is 45 ppb. Express it in $\mu g\ m^{-3}$. (4 marks)

24. The annual mean PM2.5 in the district is 28.4 $\mu g\ m^{-3}$ against an annual limit of 35 $\mu g\ m^{-3}$. Find the measured value as a percentage of the limit and comment on air quality. (5 marks)
