Question 1 — Bivariate Data Analysis **(8 marks)**

Top Ranked Tutoring recorded, for six Year 11 Mathematics Applications students, the number of hours of extra practice completed in a fortnight (x) and the improvement in that student's test score from their first topic test to their second topic test, as a percentage (y).
Hours of practice, x: 2 4 6 8 10 12 Score improvement, y (%): 3 7 8 13 16 19

(a) Calculate the equation of the least-squares line of best fit for y on x, giving the gradient and the y-intercept correct to one decimal place. (3 marks)

(b) Interpret the gradient of this line of best fit in the context of the data. (1 mark)

(c) The correlation coefficient for this data is r = 0.992. Describe the strength and direction of the relationship between hours of practice and score improvement. (1 mark)

(d) Calculate the residual for the student who completed 6 hours of practice. (2 marks)

(e) One student completed 20 hours of practice in a fortnight. Explain why it would not be appropriate to use this line of best fit to predict that student's score improvement. (1 mark)

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Question 2 — Loans & Investments **(8 marks)**

Chevron wants to borrow $18,000 to buy a car. Bank A offers a reducible-interest loan at 7.2% p.a., compounded monthly, with repayments of $450 at the end of each month. Bank B offers a flat-rate loan at 5% p.a. flat interest, to be repaid over 4 years.

(a) For Bank A's loan, write a recurrence relation for the balance owing, A_n, after n months, in terms of A_{n-1}, and state the value of A_0. (2 marks)

(b) Use your recurrence relation to calculate the balance owing after 2 months, A_2. (2 marks)

(c) For Bank B's flat-rate loan, calculate the total amount Chevron would repay over the 4 years, and hence his monthly repayment amount. (3 marks)

(d) Chevron notices that Bank A's and Bank B's monthly repayments are both close to $450. Explain, without further calculation, why Bank A's loan would end up cheaper overall. (1 mark)

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Question 3 — Networks & Decision Mathematics **(8 marks)**

A citrus orchard near Manjimup has six pump stations, A, B, C, D, E and F, which must be connected by underground irrigation pipe. The list below shows every possible direct pipe connection between two stations and its length, in metres. (No other direct connections are possible.) AB: 120 m AC: 200 m BC: 150 m BD: 180 m CD: 90 m CE: 220 m DE: 140 m DF: 160 m EF: 100 m

(a) Use Kruskal's algorithm to determine a minimum spanning tree connecting all six pump stations. List the edges in the order in which you add them, and give a brief reason for stopping. (4 marks)

(b) Calculate the total length of pipe required for the minimum spanning tree. (1 mark)

(c) The irrigation company charges \$18.50 per metre to lay pipe. Calculate the total cost of laying the minimum spanning tree network. (2 marks)

(d) Explain why the edge D–F, with length 160 m, is not included in the minimum spanning tree. (1 mark)

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