More Applications of Linear Systems

Instructions: For each problem, define your variables, write two linear equations, and solve algebraically using substitution or elimination. Show your calculations and answer in context.

MILD

1. Festival Lighting. A community festival uses two lengths of electrical cable. The longer cable is 3 m more than twice the length of the shorter cable. Together, the two cables are 39 m long. Determine the length of each cable.

MEDIUM

2. Mapping Intersecting Paths. A park map uses coordinates in meters, with x representing distance east and y representing distance north of a reference point. Two straight paths cross the park. Path A passes through (0, 1) and (3, 7). Path B passes through (0, 13) and (2, 11). Determine the coordinates where the paths intersect. Solve algebraically.

3. Irrigation Pumps. A greenhouse uses two pumps to fill a tank. The smaller pump moves 4 L of water per minute, and the larger moves 7 L per minute. They operate one at a time for a combined total of 30 minutes, transferring 150 L altogether. Determine how many minutes each pump operates.

4. Workshop Electricity. A workshop uses 140 kilowatt-hours (kWh) of electricity in one day. A kWh is a unit of electrical energy. Electricity costs $0.12 per kWh during lower-rate hours and $0.24 per kWh during higher-rate hours, plus a fixed $6 daily connection fee. The total bill is $28.80. Determine the number of kilowatt-hours billed at each rate.

5. Trail Snack Packages. Two snack types contain different amounts of protein and fibre per item, as shown below. A collection of seed bars and trail-mix packets contains 48 g of protein and 44 g of fibre altogether. Determine the number of each snack in the collection.

Nutrient	Seed bar	Trail-mix packet
Protein	6 g	3 g
Fiber	4 g	5 g

SPICY

6. Library Membership. At the beginning of the year, Library A has 20 more members than Library B. During the year, Library A increases its membership by 25% and Library B increases its membership by 50%. At the end of the year, the libraries have the same number of members. Determine how many members each library had at the beginning of the year.

7. Community Garden Funding. A community garden receives donations from private donors and funding from the town. The town gives $100 more than half the amount donated privately. A sponsor also contributes an amount equal to 20% of the town's contribution plus 30% of the private donations. The sponsor gives $260 altogether. Determine how much the town and the private donors each contributed.

8. Water-Quality Experiment. Water from Sources A and B contains different, constant concentrations of dissolved minerals. Concentration is measured in grams of minerals per litre of water (g/L). In the first experiment, 3 L from Source A and 2 L from Source B are mixed, containing 90 g of minerals in total. In the second experiment, 2 L from Source A and 5 L from Source B are mixed, then 3 L of mineral-free water are added. The final mixture contains 17 g of minerals per litre. Assume volumes add when mixed; mineral-free water adds no minerals. Determine the mineral concentration in each original source.

EXTRA-SPICY

9. Solar Energy Production. A community centre uses small and large solar arrays. Each type produces electricity at its own constant hourly rate under clear conditions. During a clear morning, 3 small arrays and 2 large arrays operate for 2 hours, producing 76 kWh altogether. During a cloudy afternoon, 5 small arrays operate for 2 hours at 75% of their clear-weather rate. At the same time, 3 large arrays operate for 3 hours at 50% of their clear-weather rate. Together, the arrays produce 90 kWh that afternoon. Determine the clear-weather hourly electricity production of one small array and one large array.

1 27 m long 12 m short	**2** (4, 9)	**3** 20 min smaller 10 min larger
4 90 kWh lower 50 kWh higher	**5** 6 seed bars 4 trail-mix packets	**6** A: 120 B: 100
7 $400 town $600 private	**8** A: 10 g/L B: 30 g/L	**9** Small: 6 kWh/h large: 10 kWh/h