

Question 22 D

$$0 = PR^n - \frac{Q(R^n - 1)}{R - 1}$$

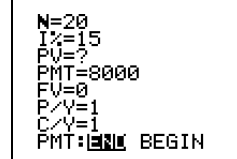
$$= P\left(1 + \frac{15}{100}\right)^{20} - \frac{8000\left(\left(1 + \frac{15}{100}\right)^{20} - 1\right)}{0.15}$$

$$= 16.3665P - 819\,548.66$$

$$P = 50\,074.65$$

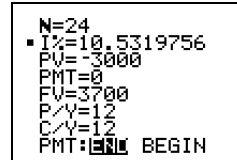
= \$50 075, to the nearest dollar

Alternatively, use the TVM solver.



Question 23 E

On the TI-83, use the TVM solver.



Solving for $I\%$ gives 10.53%.

Alternatively:

$$3700 = 3000\left(1 + \frac{r}{1200}\right)^{24}$$

$$\frac{3700}{3000} = \left(1 + \frac{r}{1200}\right)^{24}$$

$$1 + \frac{r}{1200} = \sqrt[24]{\frac{3700}{3000}}$$

$$\frac{r}{1200} = 0.008776$$

annual rate = 10.53%

Question 24 A

The quarterly interest rate is 2%. Thus the ratio is 1.02. Every quarter, \$8000 is withdrawn after the interest is added.

Module 1: Matrices

Question 1 B

We require the element in the second row and third column. It is -3.

Question 2 E

This is a standard knowledge question. The number of columns of the left-hand matrix must always match the number of rows of the right-hand matrix.

Question 3 E

Transposing a matrix does not alter its determinant. This is just a knowledge question.

Question 4 A

To solve these equations, matrix A^{-1} must be found. If A is singular, A^{-1} will not exist. This problem cannot be fixed by swapping rows or columns. Thus matrix methods cannot be used. However, the non-existence of A^{-1} is due to the fact that the simultaneous equations themselves have a problem. No solutions to these equations exist.

Question 5 E

This question is really just testing comprehension of the matrix. Team 2 retains 80% of points from year to year. Thus it loses 20%. Team 3 also decreases, but by 30%. Team 4 increases by 40%.

Question 6 E

The calculation required is T^4 multiplied by the initial vector. This is best done by calculator and the result is as follows:

$$\begin{bmatrix} 23.4 \\ 4.9 \\ 1.9 \\ 15.4 \end{bmatrix}$$

Team 3 is predicted to have approximately 2 points in 2019.

Question 7 C

It is necessary that each column sums up to 1.0. Otherwise the proportions will not sum up to 1.0. Thus $a = 0.2$.

Question 8 B

$$A^{32} = \begin{bmatrix} 0.5370 & 0.5370 & 0.5370 \\ 0.3519 & 0.3519 & 0.3519 \\ 0.1111 & 0.1111 & 0.1111 \end{bmatrix}$$

This is clearly a steady state as A^{64} is identical.

$$B^{32} = \begin{bmatrix} 282 & 327.7 & 332 \\ 277.9 & 323 & 327.3 \\ 618.3 & 718.6 & 728.1 \end{bmatrix}$$

B^{64} is a matrix bearing no resemblance to this and so it is clear that no steady state will be achieved.

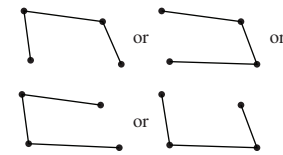
Module 2: Networks and decision mathematics

Question 1 E

The sum of vertices is $3 + 4 + 2 + 4 + 1 + 2 = 16$.

Question 2 D

Four vertices only need three edges.



Three vertices only need two edges



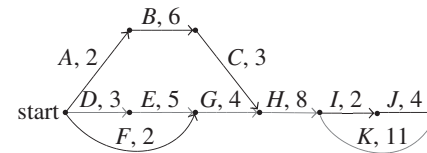
$4 \times 3 = 12$ spanning trees

Question 3 E

Allocate as much as possible to the cheapest route, then the next cheapest and so on. **B** and **E** are feasible. **E** is cheaper than **B**.

Question 4 E

The critical path is that which takes the longest time (*DEGHC*, time = 31).

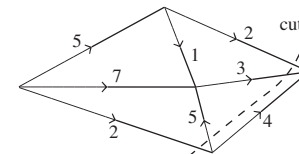


Question 5 D

As F takes 2 units of time, D and E take 8 units of time (and are on the critical path). The latest start time = 6.

Question 6 A

$$2 + 3 + 2 = 7$$



Question 7 B

Two events cannot be scheduled for the same time if one competitor is scheduled to contest both. From the bipartite graph, we see event 1 (Ann and Don) and event 5 (Binh and Con) have different sets of competitors, as do event 2 (Ann and Con) and event 4 (Binh and Don). Either of these pairs of events could be scheduled at the same time. Event 3 has three competitors, each of whom compete in at least one other event.

Question 8 C

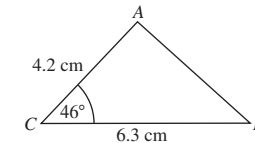
From the previous answer, we see we could schedule events 1 and 5 at the same time (one time slot), events 2 and 4 at the same time (a second time slot) and event 3 by itself (a third time slot). Three time slots is the minimum number required.

Module 3: Geometry and measurement

Question 1 A

1 cm : 100 000 m
1 cm : 1000 m
1 cm : 1 km
So 5 km is represented by 5 cm on the map.

Question 2 B



$$\text{area} = \frac{1}{2}ab \sin(C)$$

$$= \frac{1}{2} \times 6.3 \times 4.2 \times \sin(46^\circ)$$

$$= 9.52 \text{ cm}^2$$