
SECTION A

Core - solutions

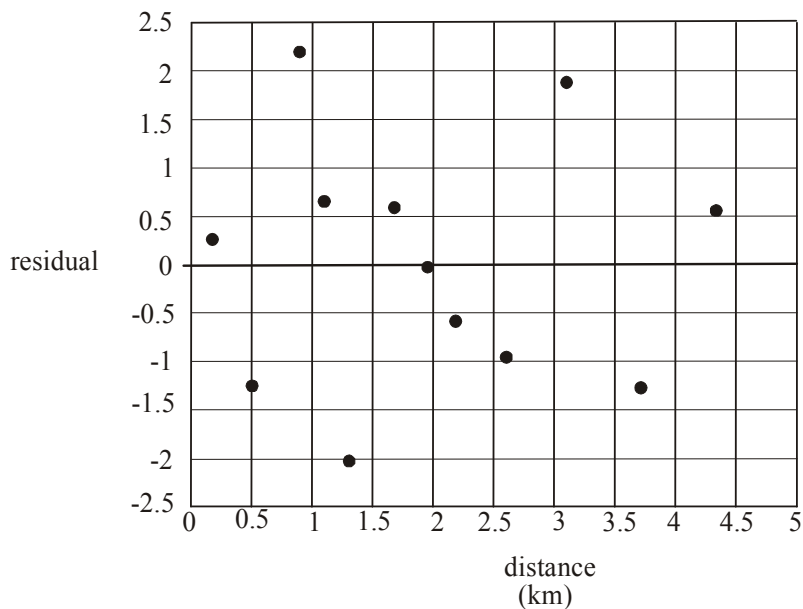
Question 1

- a. 9C has 14 students with a concession card.
Four classes have more than this (8C, 9B, 9D and 10A).
 $\left(\frac{4}{16} \times \frac{100}{1}\right)\% = 25\%$
(1 mark)
- b. The circled value is 19 so 8C is represented by this value.
(1 mark)
- c. Using the ordered stemplot, the 8th value is 7 and the 9th value is 9. The median is 8.
(1 mark)
- d. The shape is positively skewed.
(1 mark)
- e. The median is a better measure of the centre of the distribution because the shape of the distribution is skewed.
(1 mark)

Question 2

- a. $r = -0.842042$
 $r = -0.84$ (correct to 2 decimal places)
(1 mark)
- b. $r^2 = (-0.842042\dots)^2$
 $= 0.709035\dots$
 $= 71\%$ (to the nearest percent)
So 71% of the variation in the number of times a student is late to school can be explained by the variation in the distance between their home and school.
(1 mark)
- c. Use your calculator to find this
 $number\ of\ times\ late = -1.56 \times distance + 13.04$
(1 mark) for -1.56
(1 mark) for 13.04

- d. Using part c, $\text{number of times late} = -1.56 \times 1.9 + 13.04 = 10.076$
 residual = actual value – predicted value
 $= 10 - 10.076$
 $= -0.076$



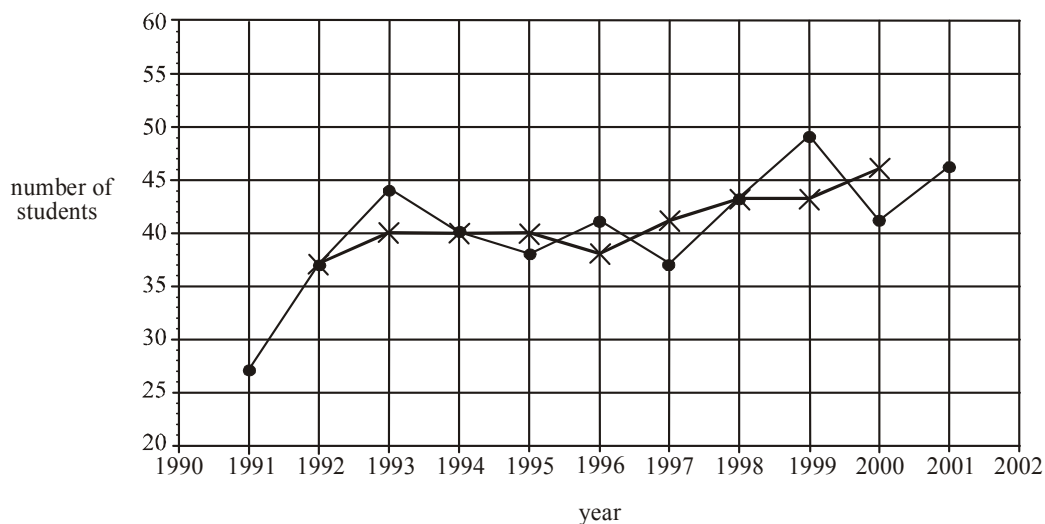
(1 mark)

- e. The residual plot shows a collection of points scattered randomly around the horizontal line with a residual of zero; i.e. there is no clear pattern and hence the assumption of linearity is supported.

(1 mark)

Question 3

a.



(1 mark) 4 correctly placed crosses

(1 mark) correct smoothed time series plot

- b. The year 2010 is referred to as year number 20.

So, number of students = $1.57 \times 20 + 31.62$

$$= 63.02$$

Predicted number of students is 63 (correct to nearest whole number). (1 mark)

- c. Average, annual increase is 1.57 or 2 (correct to nearest whole number).

(1 mark)

Total 15 marks

SECTION B**Module 1: Number patterns****Question 1**

- a. 55, 100, 145, 190, ...

$$t_2 - t_1 = 100 - 55 = 45$$

$$t_3 - t_2 = 145 - 100 = 45$$

$$t_4 - t_3 = 190 - 145 = 45$$

There is a common difference of 45 between successive terms so the sequence is arithmetic.

(1 mark)

- b. Method 1 – using a calculator

Generate the sequence. The 15th term is 685.

(1 mark)

Method 2 – by hand

$$t_n = a + (n-1)d \quad (\text{formula sheet})$$

$$t_{15} = 55 + 14 \times 45$$

$$= 685$$

(1 mark)

- c. Method 1 – using a calculator

Generate the sequence. The 29th term is \$1315 and the 30th term is \$1360.
Keisha can purchase a maximum of 29 tickets.

(1 mark)

Method 2 – by hand

$$t_n = a + (n-1)d \quad (\text{formula sheet})$$

$$1350 = 55 + (n-1) \times 45$$

$$1295 = (n-1) \times 45$$

$$\frac{1295}{45} = n-1$$

$$n-1 = 28.77...$$

$$n = 29.77...$$

Keisha can purchase a maximum of 29 tickets.

(1 mark)

- d. The difference equation defines an arithmetic sequence so $a = 1$ and $b = 45$.

(1 mark) for 1

(1 mark) for 45

Question 2

- a.**
- Method 1
- using a calculator

Generate the sequence.

65, 58.5, 52.65, 47.39, 42.65...

The cost of the 5th ticket is \$42.65.**(1 mark)**Method 2 – by hand

The sequence is geometric so

$$t_n = ar^{n-1}$$

$$t_5 = 65 \times 0.9^4$$

$$= \$42.65$$

(1 mark)

- b.**
- Method 1
- using a calculator

Generate the sequence.

The 12th term is 20.40.The 13th term is 18.36.

So 13 tickets must be purchased before the cost of a ticket drops below \$20.

(1 mark)Method 2 – using CAS

$$t_n = ar^{n-1}$$

$$20 = 65 \times 0.9^{n-1}$$

Solve for n . So $n = 12.1869$.

So 13 tickets must be purchased before the cost drops below \$20.

(1 mark)

- c.**
- The sequence is a decreasing geometric sequence (i.e.
- $r < 1$
-) so

$$S_\infty = \frac{a}{1-r} \quad (\text{formula sheet})$$

$$= \frac{65}{1-0.9}$$

$$= 650$$

The maximum amount that can be spent is \$650.

(1 mark)

- d.**
- From Ticketget, we need to find the 8
- th
- term of the arithmetic sequence because the
- n^{th}
- term gives us the cost of purchasing
- n
- tickets.

$$t_8 = 55 + 7 \times 45$$

$$= \$370$$

(1 mark)From Dodgeybros, we need to find the sum of the first 8 terms since the n^{th} term gives us the cost of the n^{th} ticket.

$$S_n = \frac{a(1-r^n)}{1-r} \quad (\text{formula sheet})$$

$$S_8 = \frac{65(1-0.9^8)}{0.1}$$

$$= \$370.20$$

So Keisha saves \$0.20 by purchasing from the Ticketget website.

(1 mark)

- e.**
- The cost of each ticket on the Ticketget website is \$45. On the Dodgeybros website the cost of the 9
- th
- ticket is
- $t_9 = 65(0.9)^8 = \$27.98$
- .

The cost of subsequent tickets is now cheaper with Dodgeybros so Keisha should purchase them from the Dodgeybros website.

(1 mark)

Question 3

- a.**
- Method 1
- using a calculator

Generate the sequence.

4200, 4204, 4208.08, 4212.24

The number of tickets predicted to be sold in the fourth month is 4212.

(1 mark)Method 2 – by hand

$$S_1 = 4200$$

$$S_2 = 1.02 \times 4200 - 80 = 4204$$

$$S_3 = 1.02 \times 4204 - 80 = 4208.08$$

$$S_4 = 1.02 \times 4208.08 - 80 = 4212.24$$

The number of tickets predicted to be sold in the fourth month is 4212.

(1 mark)

- b.**
- Using the results from either method in part
- a.**
- ,

$$\frac{S_2}{S_1} = \frac{4204}{4200} = 1.00095$$

$$\frac{S_3}{S_2} = \frac{4208.08}{4204} = 1.00097$$

Since $\frac{S_2}{S_1} \neq \frac{S_3}{S_2}$ the sequence does not have a common ratio and is therefore not geometric.

(1 mark)

- c.**
- Method 1
- using a calculator

Generate the sequence.

$$S_{n+1} = 1.02S_n - 80, \quad S_1 = 4000$$

4000, 4000, 4000, ...

The monthly sales remain on 4000 so there is no growth.

(1 mark)

Generate the sequence.

$$S_{n+1} = 1.02S_n - 80, \quad S_1 = 3990$$

(i.e. choose a value less than 4000)

3990, 3989.8, 3989.6, ...

The monthly sales are decreasing so there is no growth.

(1 mark)Method 2 – by hand

If $S_1 = 4000$

$$S_{n+1} = 1.02S_n - 80$$

$$\text{becomes } S_2 = 1.02 \times 4000 - 80$$

$$= 4000$$

So $S_3 = 4000$ and so on.

The monthly sales remain on 4000 so there is no growth.

(1 mark)

If $S_1 = 3990$

$$S_{n+1} = 1.02S_n - 80$$

$$\text{becomes } S_2 = 1.02 \times 3990 - 80$$

$$= 3989.8$$

$$\text{So } S_3 = 1.02 \times 3989.8 - 80$$

$$= 3989.6 \text{ and so on}$$

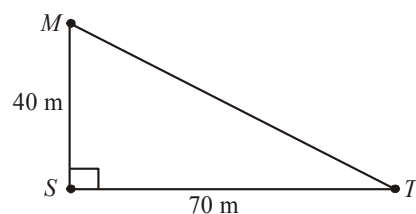
The monthly sales are decreasing so there is no growth.

(1 mark)**Total 15 marks**

Module 2: Geometry and trigonometry

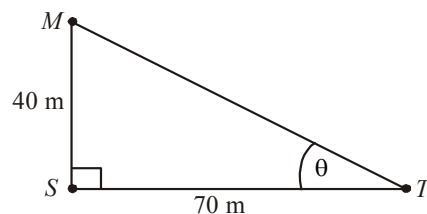
Question 1

- a. In $\triangle MST$,
 $MT = \sqrt{70^2 + 40^2}$ (Pythagoras Theorem)
 $= 80.622\dots$
 The distance is 80.6m correct to 1 decimal place.



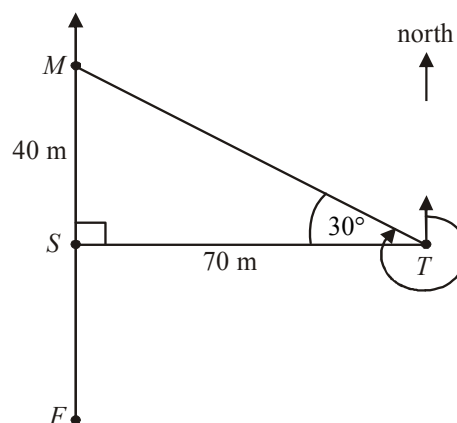
(1 mark)

- b. In $\triangle MST$,
 $\tan \theta = \frac{40}{70}$
 $\theta = 29.7449\dots^\circ$
 So $\angle MTS = 30^\circ$ to the nearest whole degree.



(1 mark)

- c. The bearing of M from T is $270^\circ + 30^\circ = 300^\circ$.



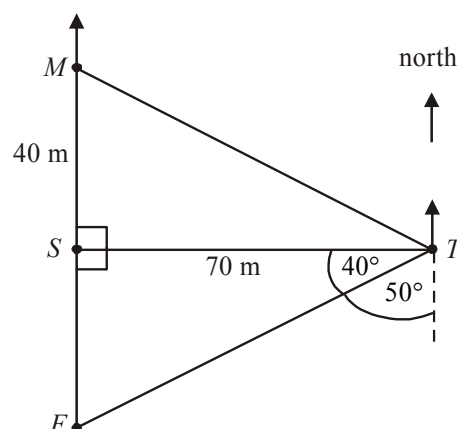
(1 mark)

(1 mark)

- d. Since the bearing of F from T is 230° , $\angle FTS = 40^\circ$.

So in $\triangle FST$,
 $\tan(40^\circ) = \frac{FS}{70}$
 $70 \times \tan 40^\circ = FS$
 $FS = 58.737\dots$
 The distance from F to S is 58.7m correct to 1 decimal place.

(1 mark)



Question 2

a. $\frac{\sin(\angle ACB)}{80} = \frac{\sin 65^\circ}{110}$

$$\sin(\angle ACB) = \frac{\sin 65^\circ}{110} \times 80$$

$$\angle ACB = 41.23^\circ \text{ (correct to 2 decimal places)}$$

(1 mark)

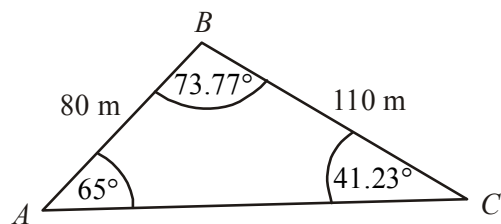
b. Since $\angle ACB = 41.23^\circ$,
 $\angle ABC = 180^\circ - 65^\circ - 41.23^\circ$
 $= 73.77^\circ$

So $(AC)^2 = (AB)^2 + (BC)^2 - 2 \times (AB) \times (BC) \times \cos 73.77^\circ$ (cosine rule)
 $= 13580.9...$

$$AC = \sqrt{13580.9...}$$

$$= 116.537...$$

So $AC = 116.5$ m (correct to 1 decimal place).

**(1 mark)**

c. area of a triangle $= \frac{1}{2} bc \sin A$ (formula sheet)

$$= \frac{1}{2} ac \sin B \text{ (in our case)}$$

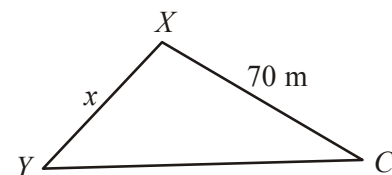
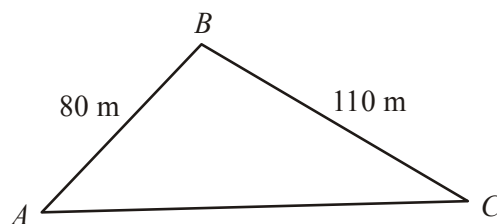
$$= \frac{1}{2} \times 110 \times 80 \times \sin 73.77^\circ$$

$$= 4224.64888...$$

$$= 4224.6 \text{ m}^2 \text{ (correct to one decimal place)}$$

(1 mark)

d. Use similar triangles.



$$\frac{x}{80} = \frac{70}{110}$$

$$x = 50.9090...$$

$XY = 50.9$ metres (correct to one decimal place)

(1 mark) an attempt using similar triangles**(1 mark)** correct answer

Question 3

Volume of prism = area of cross-section $\times$ length

$$\begin{aligned}
 &= \left(\frac{1}{2} \times 1 \times 1 + 3 \times 1 + \frac{1}{2} \times 2 \times 1 \right) \times 5 \\
 &= \left(\frac{1}{2} + 3 + 1 \right) \times 5 \\
 &= \frac{9}{2} \times 5 \\
 &= \frac{45}{2}
 \end{aligned}$$

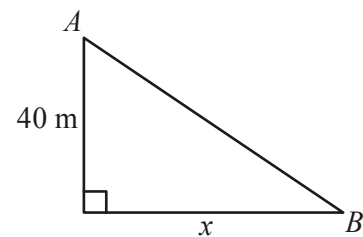
So 22.5 cubic metres of cement is required.

(1 mark) – attempt to find area of cross-section
(1 mark) – correct answer

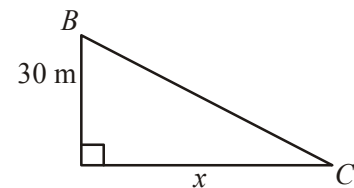
Question 4

- a.** The horizontal distance between the towers (marked as x in the diagrams to the right) is equal. From the contour lines, point A is 40m vertically above point B and point B is 30m vertically above point C .

Since gradient = $\frac{\text{rise}}{\text{run}}$, the section of cable between A and B has the steeper gradient.

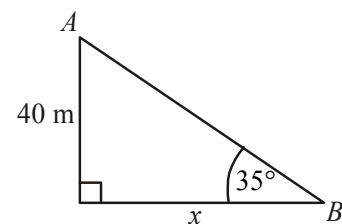


(1 mark)



- b.**

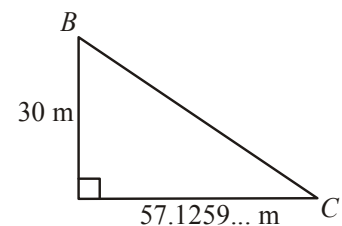
$$\begin{aligned}
 \tan 35^\circ &= \frac{40}{x} \\
 x \times \tan 35^\circ &= 40 \\
 x &= \frac{40}{\tan 35^\circ} \\
 &= 57.1259...
 \end{aligned}$$



(1 mark)

$$\begin{aligned}
 (BC)^2 &= 30^2 + (57.1259...)^2 \\
 &= 4163.37... \\
 BC &= \sqrt{4163.37...} \\
 &= 64.5242...
 \end{aligned}$$

So the length of cable is 64.5m (correct to one decimal place).



(1 mark)

Total 15 marks

Module 3: Graphs and relations**Question 1**

a. 6.1m (1 mark)

b. 6pm (1 mark)

c. Between 12pm and 8pm the height of the river was increasing.
 $\frac{8}{12} = \frac{2}{3}$
 The height of the river was increasing for $\frac{2}{3}$ of the 12 hour period. (1 mark)

d. average decrease = $\frac{6.6 - 6.55}{4}$
 $= \frac{0.05}{4}$
 $= 0.0125$ metres/hour (1 mark)

Question 2

a. $R = 95n$ (1 mark)

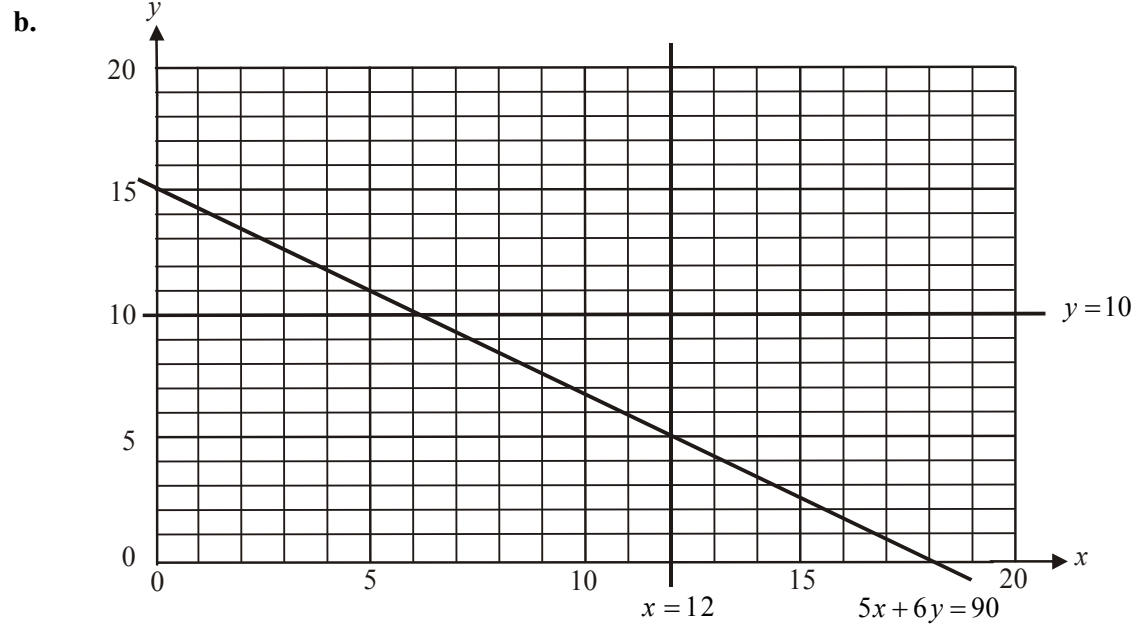
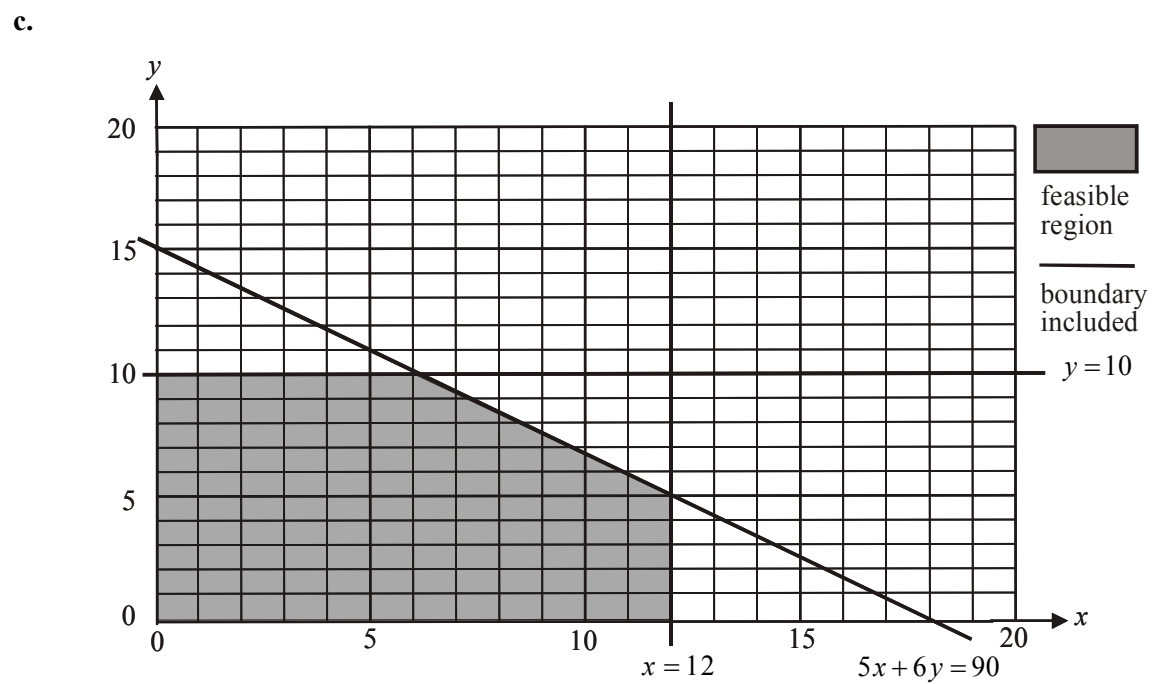
b. $C = 320 + 55n$
 At break-even,
 $R = C$
 $95n = 320 + 55n$
 $40n = 320$
 $n = 8$ (1 mark)

c. When 15 cabins are occupied,
 $R = 95 \times 15 = 1425$
 $C = 320 + 55 \times 15 = 1145$
 Profit = Revenue – Cost
 $= 1425 - 1145 = \$280$ (1 mark)

d. Profit = Revenue – Cost
 $-200 = 95n - (320 + 55n)$
 $-200 = 95n - 320 - 55n$
 $120 = 40n$
 $n = \frac{120}{40}$
 $n = 3$ (1 mark)

Question 3

- a. The inequality $5x + 6y \leq 90$ tells us that for every on-site-van that is rented overnight a maximum of 6 people can stay in it.

(1 mark)**(1 mark)****(1 mark)**

d. $P = 40x + 50y$

(1 mark)

From the graph, the corner points of the feasible region are

$(0, 0)$ where $P = 40 \times 0 + 50 \times 0 = 0$

$(12, 0)$ where $P = 40 \times 12 + 50 \times 0 = 480$

$(12, 5)$ where $P = 40 \times 12 + 50 \times 5 = 730$

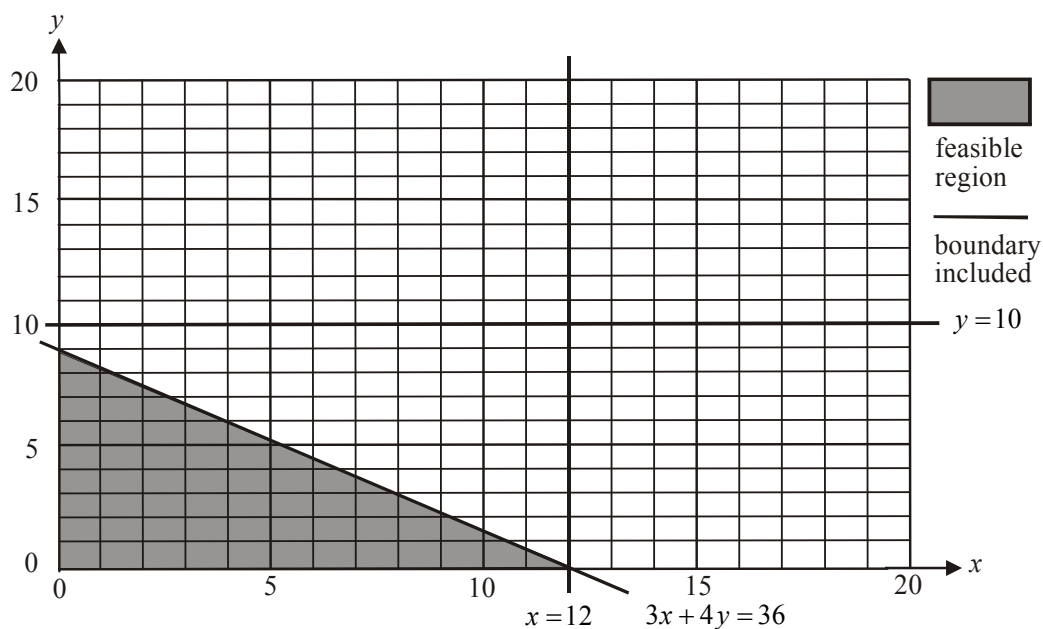
$(6, 10)$ where $P = 40 \times 6 + 50 \times 10 = 740$

$(0, 10)$ where $P = 40 \times 0 + 50 \times 10 = 500$

The maximum profit is \$740.

(1 mark)

- e. The inequality $5x + 6y \leq 90$ is replaced with $3x + 4y \leq 36$. The revised feasible region is shown below.



From part d., $P = 40x + 50y$.

From the graph above, the corner points of the feasible region are

$(0, 0)$ where $P = 40 \times 0 + 50 \times 0 = 0$

$(12, 0)$ where $P = 40 \times 12 + 50 \times 0 = 480$

$(0, 9)$ where $P = 40 \times 0 + 50 \times 9 = 450$

The maximum profit now possible is \$480.

(1 mark) – correct corner points

(1 mark) – correct answer

Total 15 marks

Question 3

a. $SI = \frac{PrT}{100}$ (formula sheet)

$$= \frac{12\,000 \times 4 \times 3}{100}$$

$$= 1\,440$$

The investment is worth $\$12\,000 + \$1\,440 = \$13\,440$ after 3 years.

(1 mark)

b. $A = PR^n$ where $R = 1 + \frac{r}{100}$ (formula sheet)

$$= 12\,000 \times 1.04^3$$

$$= 13\,498.37$$

$$= 1 + \frac{4}{100}$$

$$= 1.04$$

The investment is worth $\$13\,498.37$ after 3 years.

(1 mark)

- c. The interest needs to be calculated over a shorter period of time; for example, quarterly or monthly or weekly in order to add to the value of the investment.

(1 mark)

For example, if interest is calculated quarterly,

$$A = PR^n \quad \text{where} \quad R = 1 + \frac{r}{100}$$

$$= 12\,000 \times 1.01^{12}$$

$$= 13\,521.90$$

$$= 1 + \frac{1}{100}$$

$$= 1.01$$

This amount is greater than 13 498.37 which was found in part b.

(1 mark)**Question 4**

a. Use *TVM*

N ?

$I(\%)$ 6

PV -64 000

PMT 2000

FV 0

P/Y 12

C/Y 12

$$N = 34.9577...$$

The annuity lasts for 35 months (to the nearest whole month).

(1 mark)

b. Use *TVM* – where 5 years is 60 months

N 60

$I(\%)$ 6

PV -64 000

PMT ?

FV 0

P/Y 12

C/Y 12

$PMT = 1237.299...$

The monthly payment would be $\$1237.30$.

(1 mark)

Question 5

- a.** Use *TVM*
 $N: 20$
 $I(\%): 5.2$
 $PV: 180\,000$
 $PMT: -5799.49$
 $FV: ?$
 $P/Y: 4$
 $C/Y: 4$
 After 5 years the principal still owed is \$101 560.35.
(1 mark)
- b.** Use *TVM*.
 $N: 60$
 $I(\%): 5.2$
 $PV: 180\,000$
 $PMT: ?$
 $FV: 0$
 $P/Y: 4$
 $C/Y: 4$
 The quarterly payment will be \$4339.09.
(1 mark)
- c.** Over 10 years, the amount paid back is $40 \times \$5799.49 = \$231\,979.60$
 Interest = $\$231\,979.60 - \$180\,000$
 $= \$51\,979.60$
(1 mark)
- Over 15 years, the amount paid back is $60 \times \$4339.09 = \$260\,345.40$
 Interest = $\$260\,345.40 - \$180\,000$
 $= \$80\,345.40$
 The couple will save $\$80\,345.40 - \$51\,979.60 = \$28\,365.80$ in interest.
(1 mark)
Total 15 marks

Module 5: Networks and decision mathematics

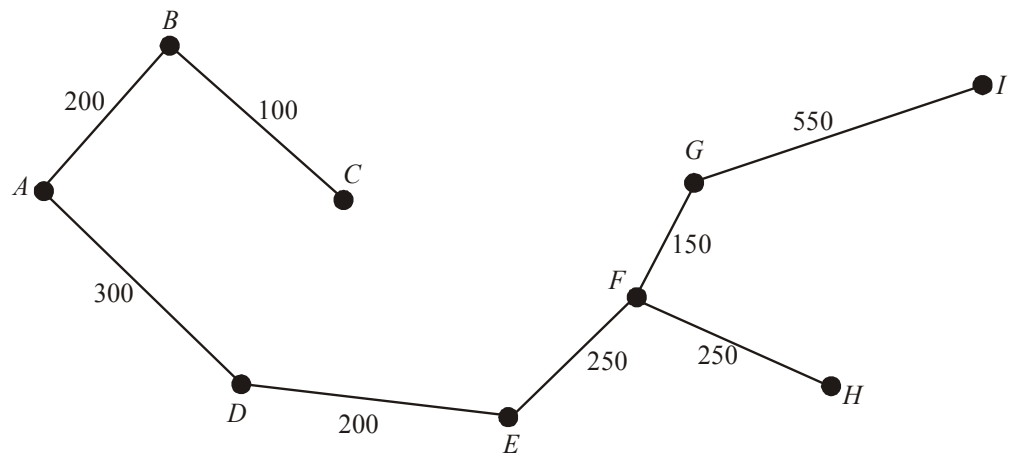
Question 1

- a. Shortest route is 1050 metres. (1 mark)

- b. $A B C D E H F G I$
 or $A B C G F D E H I$
 or $A D C B G F E H I$
 There are others. A Hamiltonian path starts at one vertex, finishes at another and passes through all the other vertices just once. (1 mark)

- c. The vertices that have an odd degree are A and I (which are the start and end points of the path) and E and H . The path between E and H needs to be removed. (1 mark)

- d. We are looking for a minimal spanning tree.



(1 mark)

Question 2

- a. There are no paths that leave a performing area and return to the same performing area, that is, there are no loops. (1 mark)

- b. $m=1, n=0$ (1 mark)

Question 3

a.

	Performing area			
	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
Kev	15	3	15	0
Pete	10	0	13	0
Lucy	20	0	10	2
Kiran	22	4	14	0

Step 1 - Subtract from each element in a row, the minimum value for that row.

(1 mark)

- b. Step 2 – Repeat this process to columns *B* and *D* which have no zeros.

	Performing area			
	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
Kev	5	3	5	0
Pete	0	0	3	0
Lucy	10	0	0	2
Kiran	12	4	4	0

Step 3 – Cover the zeros with as few lines as possible, in this case 3 (ie cover column *E* and Pete and Lucy's rows).

Step 4 – The minimum uncovered entry is 3.

Add this to the covered rows and columns.

	Performing area			
	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
Kev	5	3	5	3
Pete	3	3	6	6
Lucy	13	3	3	8
Kiran	12	4	4	3

Step 5 – Subtract 3 from all entries.

Cover all zeros with as few lines as possible, in this case 4.

	Performing area			
	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
Kev	2	0	2	0
Pete	0	0	3	3
Lucy	10	0	0	5
Kiran	9	1	1	0

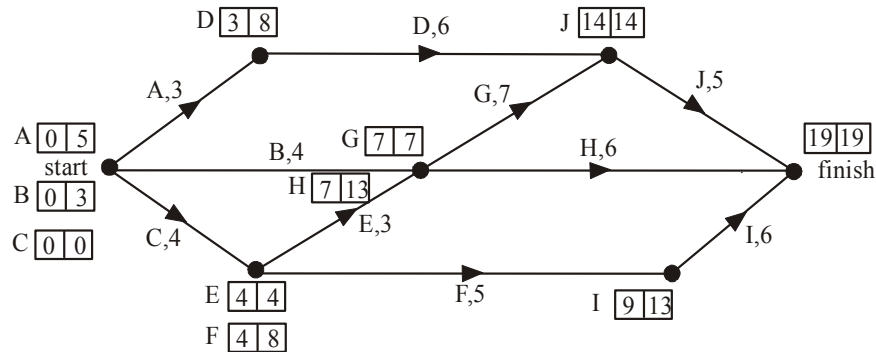
(1 mark)

Because we needed 4 lines to cover all the zeros, we can now allocate.
Kiran can only be allocated to performing area *E*.

(1 mark)

Question 4

The network described by the table is given below.



Note that *A*, *B* and *C* have no immediate predecessors so they appear at the start and *H*, *I* and *J* are not immediate predecessors to any activities so they appear at the finish. The EST and LST for each activity is shown for each activity.

- The EST for activity *G* is 7 days. (1 mark)
- The LST for activity *H* is 13 days. (1 mark)
- The float time for activity *F* is 4 days. (1 mark)
- These activities lie on the critical path and are *C*, *E*, *G*, *J*. (1 mark)
- The shortest time possible is given by the length of the critical path which is $4 + 3 + 7 + 5 = 19$ days. (1 mark)
- Activity *B* had a float time of 3 days. It now becomes a critical activity and extends the shortest time possible to set up the infrastructure by 1 day. It will now take 20 days. (1 mark)

Total 15 marks

Module 6: Matrices**Question 1**

- a. The order of M is 1×4 .

(1 mark)

b.
$$C = \begin{bmatrix} 200 \\ 120 \\ 80 \\ 100 \end{bmatrix}$$

(1 mark)

c.
$$\begin{aligned} MC &= \begin{bmatrix} 140 & 38 & 93 & 42 \end{bmatrix} \begin{bmatrix} 200 \\ 120 \\ 80 \\ 100 \end{bmatrix} \\ &= [140 \times 200 + 38 \times 120 + 93 \times 80 + 42 \times 100] \\ &= [44\,200] \end{aligned}$$

(1 mark)

- d. The matrix product MC represents the revenue for the gym made in a month from membership fees.

(1 mark)**Question 2**

- a. 3 guest passes were sold last month for mainstream zumba classes.

(1 mark)

b.
$$\begin{bmatrix} 7 & 8 & 10 \\ 4 & 5 & 3 \\ 2 & 3 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 440 \\ 209 \\ 103 \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 7 & 8 & 10 \\ 4 & 5 & 3 \\ 2 & 3 & 1 \end{bmatrix}^{-1} \begin{bmatrix} 440 \\ 209 \\ 103 \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 20 \\ 15 \\ 18 \end{bmatrix}$$

(1 mark)

The cost of a guest pass to a cardio class is \$20, to a jump class is \$15 and to a zumba class is \$18.

(1 mark)

Question 3

- a. 30% of people change each week from a lunchtime class to an evening class. **(1 mark)**

b.

$$\begin{aligned}
 S_2 &= TS_1 \\
 &= \begin{bmatrix} 0.6 & 0.2 & 0.1 \\ 0.1 & 0.5 & 0.1 \\ 0.3 & 0.3 & 0.8 \end{bmatrix} \begin{bmatrix} 30 \\ 20 \\ 40 \end{bmatrix} \\
 &= \begin{bmatrix} 26 \\ 17 \\ 47 \end{bmatrix}
 \end{aligned}$$

There will be 47 people in the evening yoga class in week 2.

(1 mark)

c.

$$\begin{aligned}
 S_4 &= T \times T \times T \times S_1 \\
 &= \begin{bmatrix} 22.43 \\ 15.32 \\ 52.25 \end{bmatrix}
 \end{aligned}$$

There will be 15 people (to the nearest whole number) in the lunchtime class in week 4.

(1 mark)

- d. We are looking at the long term so we see if we can find a steady state.

Now, $S_{10} = T^9 \times S_1$

$$\begin{aligned}
 &= \begin{bmatrix} 21.026 \\ 15.0013 \\ 53.9727 \end{bmatrix} \\
 S_{15} &= T^{14} \times S_1 \\
 &= \begin{bmatrix} 21.0008 \\ 15 \\ 53.9991 \end{bmatrix}
 \end{aligned}$$

Correct to 1 decimal place a steady state has been reached.

Over the long term, the minimum class size is 15 so no classes will be discontinued.

(1 mark) finding a steady state
(1 mark) – answering the question

Question 4**a.**

$$\begin{aligned}
 N_2 &= AN_1 + B \\
 &= \begin{bmatrix} 0.5 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 32 \\ 24 \end{bmatrix} + \begin{bmatrix} 4 \\ 2 \end{bmatrix} \\
 &= \begin{bmatrix} 0.5 \times 32 + 0 \times 24 \\ 0 \times 32 + 1 \times 24 \end{bmatrix} + \begin{bmatrix} 4 \\ 2 \end{bmatrix} \\
 &= \begin{bmatrix} 16 \\ 24 \end{bmatrix} + \begin{bmatrix} 4 \\ 2 \end{bmatrix} \\
 &= \begin{bmatrix} 20 \\ 26 \end{bmatrix}
 \end{aligned}$$

(1 mark)**b.**

$$\begin{aligned}
 N_{n+1} &= AN_n + B \\
 \text{So, } N_3 &= AN_2 + B \\
 &= \begin{bmatrix} 0.5 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 20 \\ 26 \end{bmatrix} + \begin{bmatrix} 4 \\ 2 \end{bmatrix} \\
 &= \begin{bmatrix} 0.5 \times 20 + 0 \times 26 \\ 0 \times 20 + 1 \times 26 \end{bmatrix} + \begin{bmatrix} 4 \\ 2 \end{bmatrix} \\
 &= \begin{bmatrix} 10 \\ 26 \end{bmatrix} + \begin{bmatrix} 4 \\ 2 \end{bmatrix} \\
 &= \begin{bmatrix} 14 \\ 28 \end{bmatrix}
 \end{aligned}$$

(1 mark)

$$\begin{aligned}
 N_4 &= AN_3 + B \\
 &= \begin{bmatrix} 0.5 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 14 \\ 28 \end{bmatrix} + \begin{bmatrix} 4 \\ 2 \end{bmatrix} \\
 &= \begin{bmatrix} 0.5 \times 14 + 0 \times 28 \\ 0 \times 14 + 1 \times 28 \end{bmatrix} + \begin{bmatrix} 4 \\ 2 \end{bmatrix} \\
 &= \begin{bmatrix} 7 \\ 28 \end{bmatrix} + \begin{bmatrix} 4 \\ 2 \end{bmatrix} \\
 &= \begin{bmatrix} 11 \\ 30 \end{bmatrix}
 \end{aligned}$$

The difference in the size of the two classes in week 4 is 19.

(1 mark)**Total 15 marks**