VCE Further Mathematics 2 (NHT) examination report

Specific information

This report provides sample answers or an indication of what answers may have included. Unless otherwise stated, these are not intended to be exemplary or complete responses.

Section A – Core

Question 1a.

3 years

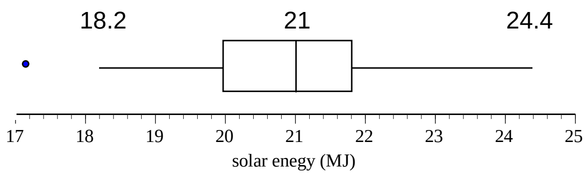
Question 1b.

Lower fence $= Q1 - 1.5 \times IQR$
$= 20 - 1.5 \times 1.8$
$= 17.3$

As $17.1 < 17.3$, then 17.1 is an outlier.

The answer needed to show calculations and values for the IQR and for the lower fence. A conclusion based on comparing the 17.1 data value and the lower fence was then required.

Question 1c.



One mark each was awarded for:

- the correct median at 21
- two correct whiskers ending at 18.2 and 24.4.

Question 1d.

The median amount of solar energy collected differs from month to month as indicated for April (11 MJ), May (7 MJ) and June (5.8 MJ).

Question 2ai.

–0.87

$$r^2 = 0.749$$
$$\therefore r = \pm\sqrt{0.749}$$
$$\therefore r \approx -0.87$$

Since the gradient of the least squares line is negative, the correlation coefficient, *r*, must also be negative.

Question 2aii.

25%

1 – 0.749 = 0.251

Question 2bi.

Relative humidity

Question 2bii.

On average, relative humidity decreases by 4.38% for each 1 °C increase in temperature.

Question 2biii.

–18.9%

Predicted = 136 – (4.38 $\times$ 11.2) = 86.944…
$\therefore$ Residual = actual – predicted
= 68 – 86.944. $\approx$ –18.9%

Question 2biv.

Yes. There is no clear pattern in the residual plot.

Question 3a.

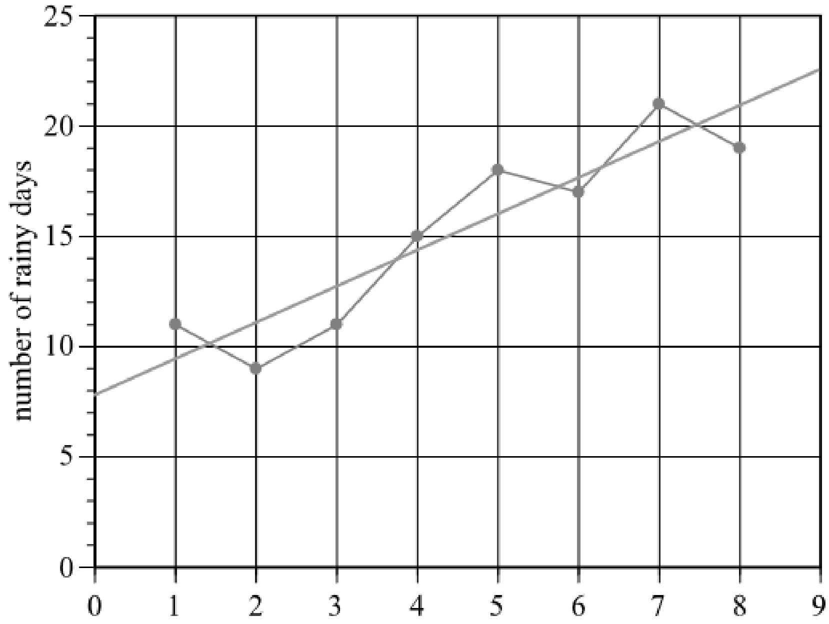
Increasing trend

Question 3b.

number of rainy days = [7.79] + [1.63] × *month number*

Both numbers had to be correctly rounded to three significant figures.

Question 3c.



Question 4a.

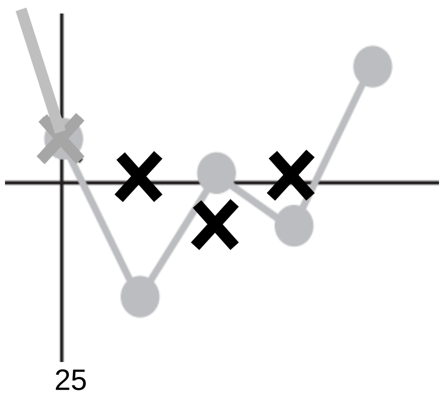
20 °C

Question 4b.

20 °C

The data point for day 15 gives the five-median smoothed value for day 14.

Question 4c.



Core – Recursion and financial modelling

Question 5a.

$180

Question 5b.

$V_0 = 3000$
$V_1 = 3000 - 180 = 2820$
$\therefore \quad V_2 = 2820 - 180 = 2640$

'Using recursion' begins with writing the initial value (i.e. $V_0 = 3000$).

Then, the first calculation using the recurrence rule must be shown and the answer labelled.
($V_1 = 3000 - 180 = 2820$ in this case)

Subsequent calculation(s) must then show the use of the prior answer to calculate the next value.
($V_2 = 2820 - 180 = 2640$ in this case)

Question 5c.

6 years

Question 5di.

$3000 - 2760 = \$240$

$\therefore \quad \frac{240}{3000} = 0.08 = 8\%$

Question 5dii.

$S_0 = 3000$, $S_{n+1} = 0.92\, S_n$

Question 6a.

$1584 = 1.056 \times A$

$\therefore \ A = \frac{1584}{1.056} = 1500$

Question 6b.

$1865.29

$1500 \times 1.056^4 = 1865.292\ldots$

Question 6c.

$Q_n = \boxed{2080.05} \times \boxed{1.0046}^{\,n}$

Question 7a.

6.54%

N= 60
I%= 6.535 16…
PV= –5000
PMT= –100
FV= 14 000
P/Y= C/Y= 12

Question 7b.

$11 276.52

First calculate the FV after three years of 6.2% p.a. interest and paying the additional monthly deposits of $100.

N=	36
I%=	6.2
PV=	–5000
PMT=	–100
FV=	9964.628…
P/Y= C/Y =	12

∴ Balance after 3 years = $9964.628…

Then stop paying the monthly deposits of $100 and find the FV after two more years.

N=	24
I%=	6.2
PV=	–9964.628…
PMT=	0
FV=	**11 276.516…**
P/Y= C/Y =	12

Module 1 – Matrices

Question 1a.

3×1

Question 1bi.

[21 200]

The product of two matrices produces a matrix. The brackets must be included.

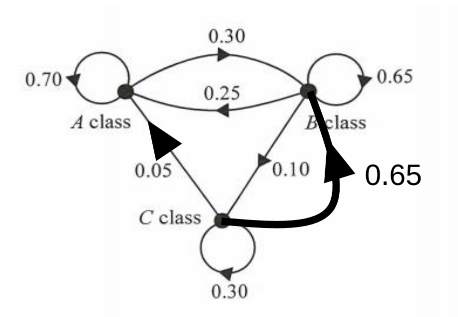
Question 1bii.

Total cost of all seats in the theatre when every seat is sold.

Question 1c.

Total cost of B and C class seats sold.

Question 2a.



One mark each was awarded for:

- arrowhead from C to A
- arrowhead from C to B and labelled with 0.65.

Question 2b.

8%

$$\frac{16}{200} = 0.08 = 8\%$$

Question 2c.

12%

25% × 96 = 24 members from B to A

This is 24/200 = 12% of the 200 members

Question 2d.

$$\begin{bmatrix} 39.6 \\ 124.4 \\ 36.0 \end{bmatrix}$$

Question 2e.

100

$$S_{\infty} = \begin{bmatrix} 85.71... \\ 100.0 \\ 14.28... \end{bmatrix}$$

Question 2f.

84

$$K_3 = T \times K_2 + B$$

$$= \begin{bmatrix} 0.70 & 0.25 & 0.05 \\ 0.30 & 0.65 & 0.65 \\ 0.00 & 0.10 & 0.30 \end{bmatrix} \times \begin{bmatrix} 61 \\ 116 \\ 23 \end{bmatrix} + \begin{bmatrix} 2 \\ 7 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 74.85 \\ 115.65 \\ 19.5 \end{bmatrix}$$

$$K_4 = T \times K_3 + B$$

$$= \begin{bmatrix} 0.70 & 0.25 & 0.05 \\ 0.30 & 0.65 & 0.65 \\ 0.00 & 0.10 & 0.30 \end{bmatrix} \times \begin{bmatrix} 74.85 \\ 115.65 \\ 19.5 \end{bmatrix} + \begin{bmatrix} 2 \\ 7 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 84.2825 \\ 117.3025 \\ 18.415 \end{bmatrix} \begin{matrix} A \\ B \\ C \end{matrix} \leftarrow$$

Module 2 – Networks and decision mathematics

Question 1a.

Activities *C* and *D*

Both of these activities must be completed before activity *G* can start.

Question 1b.

Activity *D* must be on the critical path.

Question 1c.

17 weeks

The critical path, *B* – *D* – *G* – *I* – *J*, is
$4 + 1 + 5 + 3 + 4 = 17$

Question 1d.

3 weeks

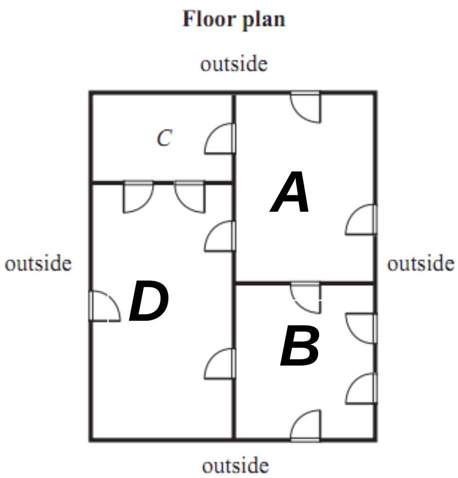
Activities *B* and *D* total 5 weeks and so the earliest starting time of activities *E*, *F* and *G* is 5 weeks.
Activities *A* and *C* take 4 weeks and either one of these activities could be delayed by one week.
Therefore, the latest starting time of activity *C* is 3 weeks when activity *A* starts at 0 weeks.

Question 1e.

Activity *F*

If activity *F* starts at 5 weeks, it would finish at 8 weeks.
But activities *G* and *I* must start at 5 weeks and will, together, finish at 13 weeks.
Activity *F* could start at 10 weeks and still finish at 13 weeks when activity *I* would finish.
The float time of 5 weeks for activity *F* is the longest float time of any activity.

Question 2a.



Question 2b.

Hamiltonian path

Question 2ci.

There is at least one vertex on the graph that is of odd degree.

Question 2cii.

Rooms *B* and *D*

When Simon locked the door between rooms *A* and *C*, the degree of these two vertices on the graph became even, while vertices *B* and *D* were still of odd degree.
Locking the door between rooms *B* and *D* will make the degree of these two vertices even.

Question 3a.

26 trucks

7 + 11 + 0 + 8 = 26
The edge marked 6 is counted as zero since its direction is from the exit side to the entrance side of cut A.

Question 3b.

23 trucks

The minimum cut gives 7 + 0 + 7 + 0 + 0 + 9 = 23

Question 3c.

8 trucks

Module 3 – Geometry and measurement

Question 1a.

$$\sqrt{2.2^2+2.3^2}$$
$$=3.182....\approx 3.2$$

Question 1b.

17.3 km

3.2 + 4 + 3.1 + 6.2 + 0.8 = 17.3

Question 1c.

17 km^2

$$6.2\times 3.1-\frac{1}{2}\times 2.2\times 2.3$$
$$=16.69$$

Question 2a.

80 m

160 × sin30° = 80

Question 2b.

066°

$$90 - \tan^{-1}\left(\frac{400}{900}\right) = 66.04...$$

Bearings in this study should be written with three digits.

Question 3a.

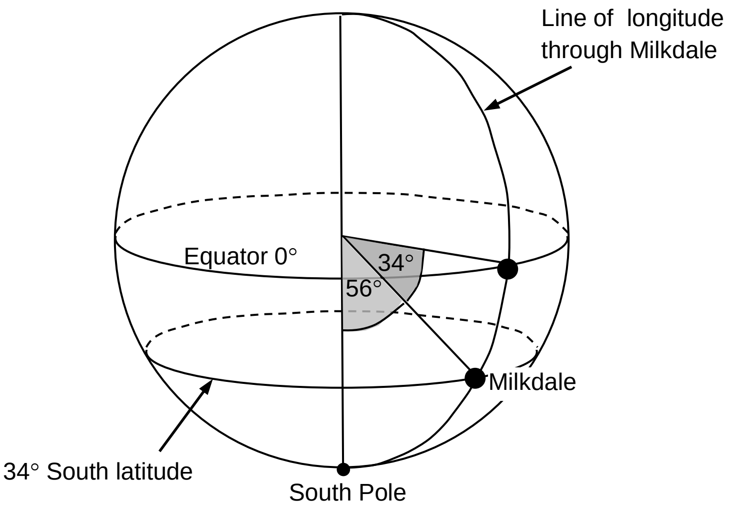
7.06 am

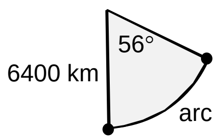
$$\frac{6}{15} \times 60 \text{ minutes} = 24 \text{ minutes}$$

Required time = 6.42 + 0.24 = 7.06

Question 3b.

6255 km





The distance from any point on earth to the South Pole is found by using the angle between the radius through that point and the South Pole.

In this case, the required angle is 90 – 34 = 56°, as shown on the diagram above.

The required distance is along an arc with angle of 56° and radius of 6400 km.
The figures for longitude (east or west) were not relevant to this question.

Length of arc = $\frac{56}{360} \times 2 \times \pi \times 6400 = 6255.2...$

Question 4a.
$22.50

$$\frac{V_L}{V_S} = \frac{75^2 \times h}{55^2 \times h} = 1.859505...$$

$\therefore$ $12.10\times1.859504.... = \$22.50$

Question 4b.

21 mm

TSA = Area of (2 sectors + 2 sides + curved edge)

$$\therefore 12\,200 = 2\times 3534.3 \quad \text{Sectors}$$
$$+ \; 2\times 75\times h \quad \text{Sides}$$
$$+ \; \frac{\pi\times 75\times 2\times h}{5} \quad \text{Curved edge}$$

$\therefore 12\,200 = 7068.6 + 150h + 30\pi h$

$\therefore$ $h = 21.0089\ldots$

Module 4 – Graphs and relations

Question 1a.

30 km/h

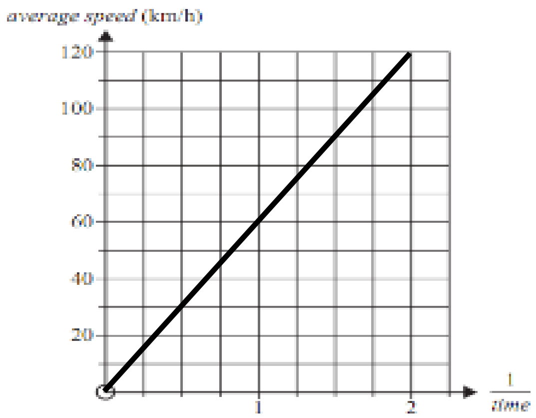
Question 1b.

45 minutes

Question 1ci.

k = 60

Question 1cii.



Question 2a.

$6.50

Question 2b.

15 bottles

Break even point when:

Revenue = Costs
$6.5n = 2.5n + 60$

Question 2c.

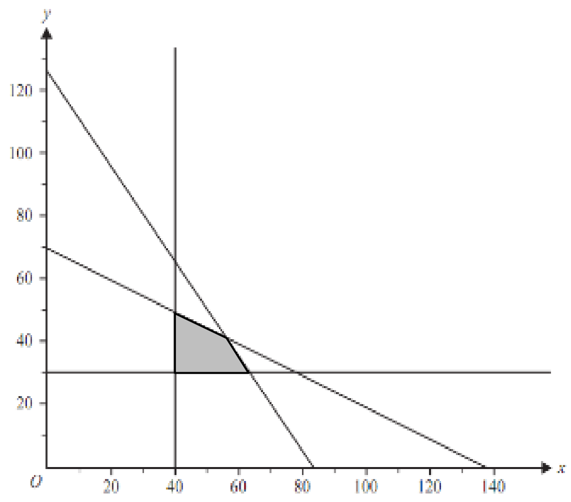
$7.30

Let S = selling price required
Revenue – Costs = 300
$S \times 75 - (2.5 \times 75 + 60) = 300$
$\therefore \quad 75S - 247.50 = 300$
$\therefore S = 7.30$

Question 3a.

138 oranges

Question 3b.



Question 3c.
94 bottles

The profit equation is $P = 4.8x + 3.2y$

This can be written as $y = -\frac{3}{2}x + \frac{P}{3.2}$

In the profit equation, the y intercept has the value $\frac{P}{3.2}$

To maximise the profit P, we must maximise the y-intercept of the profit equation. Slide the profit line up to reach the highest y-intercept while still touching the feasible region.

The profit line has a gradient of -1.5 and is parallel to the line for inequality 3. Therefore, maximum profit is found when the profit line is moved to be on top of the line for inequality 3.

The combination of bottles that will give the maximum profit are integer pairs along the feasible region border that belongs to the line for inequality 3.

Consider the four integer points along this line segment:
(56, 41), (58, 38), (60, 35), (62, 32)

All odd x values along this line segment give fractional values for y. These are not applicable to numbers of bottles.

The minimum total number of bottles occurs at (62, 32)
This number is then 62 + 32 = 94