# Mathematics Standard 2

**Section I    15 marks**

**Questions 1-15** (1 mark each)

| Question | Answer | Content | Outcome Assessed | Targeted Performance Bands |
|---|---|---|---|---|
| 1 | B | MSS1.2 Summary Statistics | MS2-12-7 | 2-3 |
| 2 | C | MS-A2 Linear Relationships | MS2-12-6 | 2-3 |
| 3 | D | MS-N2.1 Networks | MS2-12-8 | 2-3 |
| 4 | D | MS-M2 Working with Time | MS2-12-4 | 3-4 |
| 5 | B | MS-M6 Non-right Trigonometry | MS2-12-4 | 3-4 |
| 6 | B | MS-M7 Rates and Ratios | MS2-12-3 | 3-4 |
| 7 | D | MS-S5 The Normal Distribution | MS2-12-7 | 3-4 |
| 8 | A | MS-A4.1 Simutanous Linear Equations | MS2-12-6 | 3-4 |
| 9 | A | MS-M7 Rates and Ratio | MS2-12-4 | 4-5 |
| 10 | D | MS-S2 Relative Freq and Probability | MS2-12-3 | 3-4 |
| 11 | C | MS-F1.1 Interest and depreciation | MS2-12-5 | 4-5 |
| 12 | B | MS-S4 Bivariate Data Analysis | MS2-12-7 | 4-5 |
| 13 | C | MS-F4.1 Investments | MS2-12-5 | 4-5 |
| 14 | B | MS-A1 Formulae and Equations | MS2-12-1 | 5-6 |
| 15 | A | MS-N3 Crticial Path Analysis | MS2-12-8 | 5-6 |

**Section II** **85 marks**

**Question 16** (2 marks)
*Content: MS-A1*
*Outcomes assessed: MS2-12-1*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct working and solution | 2 |
| • Substitution of correct values of $N$ and $H$ or similar progress | 1 |

*Sample Answer:*

$N = 1.4 \times 5 = 7$ standard drinks
$H = 7.5$ hours
$M = 72$ kg

$$BAC = \frac{10N - 7.5H}{5.5M}$$

$$= \frac{10 \times 7 - 7.5 \times 7.5}{5.5 \times 72}$$
$$= 0.03472 \ldots$$
$$= 0.035$$

**Question 17** (2 marks)
*Content: MS-M7*
*Outcomes assessed:MS1-12-3*
*Targeted Performance Bands: 2-3*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 2 |
| • Calculation of number of tiles required or similar progress | 1 |

*Sample Answer:*

Area of wall $= 270 \times 330 = 89\,100$ cm$^2$

Area of each tile $= 30 \times 30 = 900$ cm$^2$

Number of tiles needed $= 89\,100 \div 900 = 99$

Number of starbursts $= 99 \times 3 = 297$

**Question 18** (2 mark)
*Content: MS-F4.1*
*Outcomes assessed:MS1-12-5*
*Targeted Performance Bands: 2-3*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 2 |
| • Use of correct formula with incorrect value for $n$ or similar progress | 1 |

*Sample Answer:*

$$FV = 88\,(1 + 1.3\%)^{20}$$
$$= \$113.94$$
$$= \$114$$

**Question 19** (3 marks)
(a) (1 mark)
*Content: MS-M7*
*Outcomes assessed: MS2-12-4*
*Targeted Performance Bands: 2-3*

| Criteria | Marks |
|---|---|
| • Correct answer | 1 |

*Sample Answer:*

$$\frac{6}{40} \times 100 = 15\%$$

(b) (2 marks)
*Content: MS-M7*
*Outcomes assessed: MS2-12-4*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 2 |
| • Correct expression linking the two stages or similar progress | 1 |

*Sample Answer:*

$15\% = 36$
$1\% = 2.4$
$100\% = 240$
$\therefore 240$ turtles

**Question 20** (3 marks)
*Content: MS-M7*
*Outcomes assessed:MS1-12-3*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct working and answer given to two significant figures | 3 |
| • Correct working and answer without rounding to two significant figures | 2 |
| • Calculation of number of kilometres per week or similar progress | 1 |

*Sample Answer:*

$75 ÷ 1.79 = 41.89944$ litres of petrol can be purchased per week

$41.89944 ÷ 6.8 × 100 = 616.168$ km per week

Yearly travel $= 616.168 × 52$
$\qquad\qquad = 32\ 040.7$ km
$\qquad\qquad = 32\ 000$ km  (two significant figures)

**Question 21** (6 marks)
**(a)** (3 marks)
*Content: MS-M1.2*
*Outcomes assessed:MS1-12-4*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 3 |
| • Use of r = 7.5 **and** correct surface area formula | 2 |
| • Use of r = 7.5 **or** correct surface area formula | 1 |

*Sample Answer:*

$SA = \pi r^2 + 2\pi r h$

$\quad = \pi × 7.5^2 + 2 × \pi × 7.5 × 12$

$\quad = 742.2$ cm$^2$

**(b)** (3 marks)
*Content: MS-M1.2*
*Outcomes assessed:MS1-12-4*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct calculation of volume, capacity and concluding statement | 3 |
| • Correct calculation of volume and capacity | 2 |
| • Correct calculation of volume | 1 |

*Sample Answer:*

$V = \pi r^2 h$
$\quad = \pi × 7.5^2 × 12$
$\quad = 2120.58$ cm$^3$

Capacity $=\ 2120.58$ mL
$\qquad\qquad =\ 2.12058$ L
The capacity of the pot is $> 2$ L, therefore the container is large enough for use.
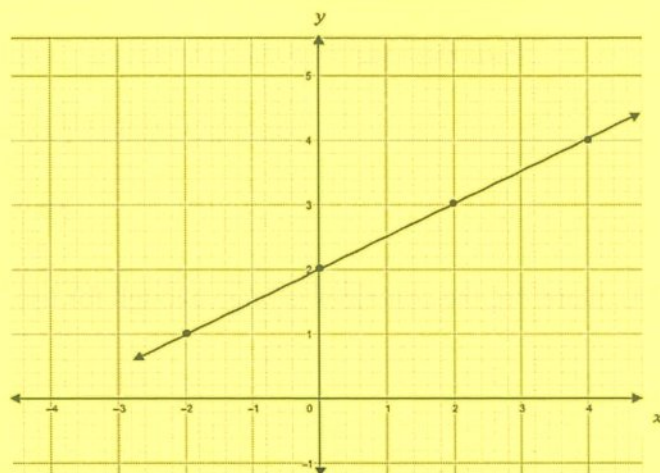
**Question 22** (3 mark)
*Content: MS-F4.1*
*Outcomes assessed:MS1-12-5*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correctly drawn graph and correct equation | 3 |
| • Correctly drawn graph with partly correct equation or similar | 2 |
| • Correctly drawn graph with incorrect equation or similar | 1 |

*Sample Answer:*



Equation of the line: $y = \frac{1}{2}x + 2$

**Question 23** (2 marks)
*Content: MS-M7*
*Outcomes assessed:MS1-12-3*
*Targeted Performance Bands: 2-3*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 2 |
| • Conversion of mL into drops or similar progress | 1 |

*Sample Answer:*

900 ml in 6 hours
= 14 400 drops in 6 hours
= 2400 drops/h
= 40 drops/min

**Question 24** (3 marks)
**(a)** (1 mark)
*Content: MS-S2*
*Outcomes assessed: MS11-8*
*Targeted Performance Bands: 2-3*

| Criteria | Marks |
|---|---|
| • Correct answer | 1 |

*Answer:* $\frac{2}{7}$

**(b)** (2 marks)
*Content: MS-S2*
*Outcomes assessed: MS11-8*
*Targeted Performance Bands: 4-5*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 2 |
| • Partly correct working or progress | 1 |

*Sample Answer:*

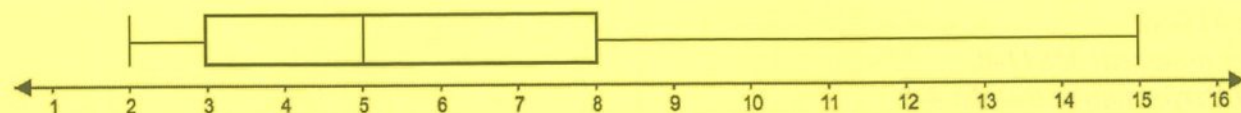$$P = \left(\frac{2}{7} \times \frac{5}{6}\right) + \left(\frac{5}{7} \times \frac{2}{6}\right)$$

$$= \frac{10}{21}$$

**Question 25** (3 mark)
*Content: MS-S1.2*
*Outcomes assessed: MS2-12-7*
*Targeted Performance Bands: 4-5*

| Criteria | Marks |
|---|---|
| • Box plot that shows all five correct values from the five-number summary | 3 |
| • Box plot that shows 4 correct values from the five-number summary | 2 |
| • Box plot that shows 2 or 3 correct values from the five-number summary | 1 |

*Sample Answer:*



**Question 26** (2 marks)
*Content: MS-F4.1*
*Outcomes assessed:MS1-12-5*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 2 |
| • Calculation of value of shares or similar progress | 1 |

*Sample Answer:*

Total value of shares = $17.50 $\times$ 2400 = $42 000

Dividend yield = $\frac{504}{42\,000} \times 100$

$= 1.2\%$

**Question 27** (4 marks)
**(a)** (2 marks)
*Content: MS-S1.2*
*Outcomes assessed: MS2-12-7*
*Targeted Performance Bands: 4-5*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 2 |
| • Calculation of IQR or similar progress | 1 |

*Sample Answer:*

$Q_1 = 511\,000 \qquad Q_3 = 566\,000$

$IQR = 566\,000 - 511\,000 = 55\,000$

$Q_3 + 1.5 \times IQR$
$= 566\,000 + 1.5 \times 55\,000$
$= 648\,500$

$\$980\,000 > \$648\,500$

$\therefore \$980\,000$ is an outlier

**(b)** (2 marks)
*Content: MS-S1.2*
*Outcomes assessed: MS2-12-7*
*Targeted Performance Bands: 4-5*

| Criteria | Marks |
|---|---|
| • Explanation of impact on mean and median with calculations to support | 2 |
| • Explanation of impact on either mean or median or without calculations to support | 1 |

*Sample Answer:*

The outlier:
• Causes an increase in the mean.
  $\bar{x}$(without outlier) = $527 143
  $\bar{x}$(with outlier) = $583 750

• Has no impact on the median. The median is unchanged.
  median = $528 000

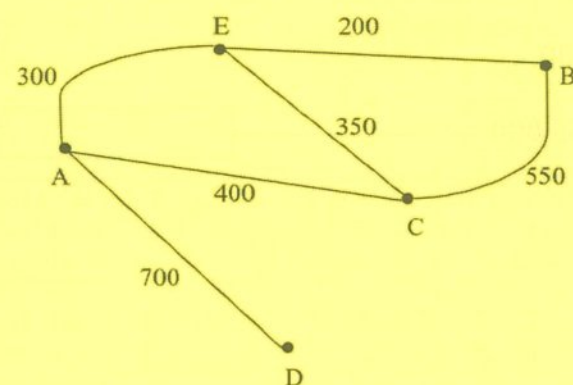**Question 28** (6 marks)
**(a)** (2 marks)
*Content: MS-N2.2*
*Outcomes assessed: MS2-12-8*
*Targeted Performance Bands: 3-4*

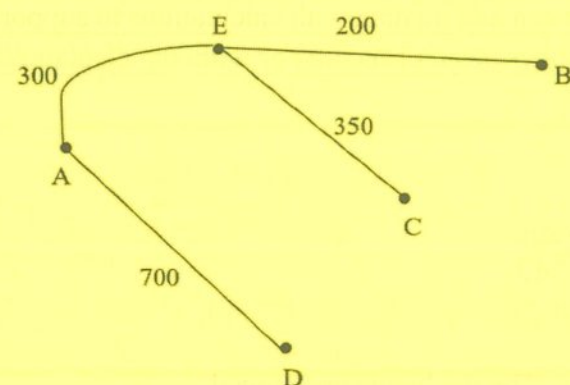| Criteria | Marks |
|---|---|
| • Complete correct network. All edges labelled | 2 |
| • Partly correct or incomplete network. | 1 |

*Sample Answer:*



**(b)** (2 marks)
*Content: MS-N2.2*
*Outcomes assessed: MS2-12-8*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct minimum spanning tree. | 2 |
| • Partly correct or incomplete spanning tree. | 1 |

*Sample Answer:*



**(c)** (1 mark)
*Content: MS-N2.2*
*Outcomes assessed: MS2-12-8*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct length | 1 |

*Sample Answer:*

$300 + 200 + 350 + 700 = 1550$ m

**(d)** (1 mark)
*Content: MS-N2.2*
*Outcomes assessed: MS2-12-8*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct answer | 1 |

*Sample Answer:*

$550 - 200 = 350$ m

**Question 29** (2 marks)
*Content: MS-M7*
*Outcomes assessed:MS1-12-3*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 2 |
| • Conversion of minutes to hours or similar progress | 1 |

*Sample Answer:*

$75 \times 0.275 \times 1.5 = \$30.94$
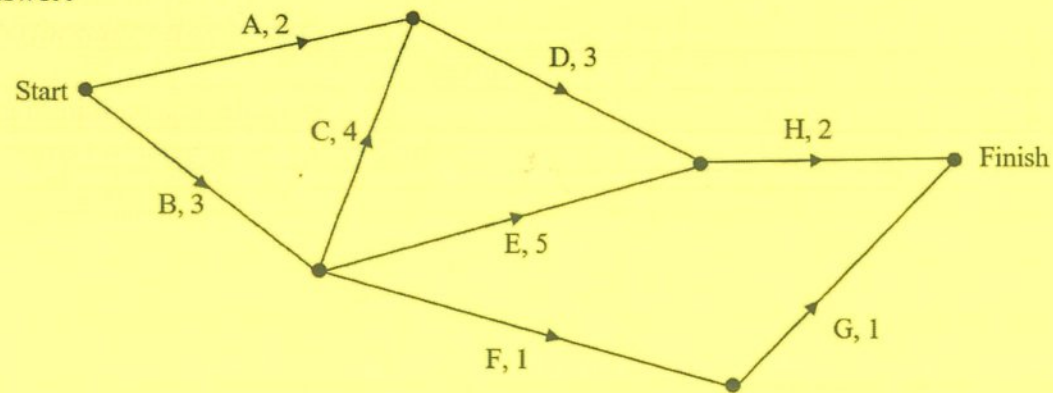
**Question 30** (7 marks)
**(a)** (3 marks)
*Content: MS-N3*
*Outcomes assessed: MS2-12-8*
*Targeted Performance Bands: 4-5*

| Criteria | Marks |
|---|---|
| • Correct directed and labelled network diagram and completion time | 3 |
| • Correct and labelled network diagram or similar progress | 2 |
| • Partly correct or incomplete network diagram or similar progress | 1 |

*Sample Answer:*



Minimum completion time = 12 hours

**(b)** (1 mark)
*Content: MS-N3*
*Outcomes assessed: MS2-12-8*
*Targeted Performance Bands: 4-5*

| Criteria | Marks |
|---|---|
| • Correct answer | 1 |

*Answer:*  B C D H

**(c)** (1 mark)
*Content: MS-N3*
*Outcomes assessed: MS2-12-8*
*Targeted Performance Bands: 4-5*

| Criteria | Marks |
|---|---|
| • Correct answer | 1 |

*Answer:*  5 hours

**(d)** (2 marks)
*Content: MS-N3*
*Outcomes assessed: MS2-12-8*
*Targeted Performance Bands: 4-5*

| Criteria | Marks |
|---|---|
| • A correct explanation that considers increases both less than and more than float time | 2 |
| • A correct explanation that only considers less than or more than float time | 1 |

*Sample Answer:*

An increase of 7 hours or less will have no impact on the completion time. However, an increase of more than 7 hours will delay the completion time of the project.

**Question 31 (3 mark)**
*Content: MS-S5*
*Outcomes assessed: MS2-12-7*
*Targeted Performance Bands: 4-5*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 3 |
| • Correct calculation of the percentage of women or similar progress | 2 |
| • Correct calculation of z-scores of -3 and 2 or similar progress | 1 |

**Sample Answer:**

z-score corresponding to size 5:

$$z = \frac{5-8}{1}$$
$$= -3$$

z-score corresponding to size 10:

$$z = \frac{10-8}{1}$$
$$= 2$$

$$95\% + \frac{1}{2}(99.7\% - 95\%)$$
$$= 97.35\%$$

$$97.35\% \times 4000 = 3894$$
∴ 3894 women in the town can find their shoe size.

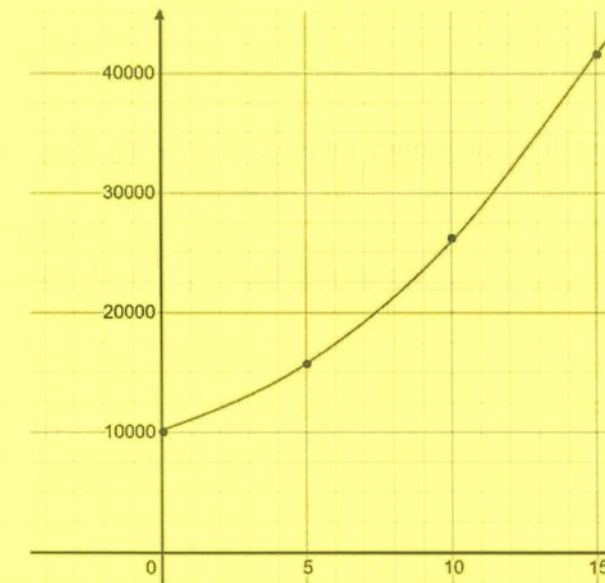**Question 32 (6 marks)**
**(a)** (4 marks)
*Content: MS-A4.2*
*Outcomes assessed: MS2-12-6*
*Targeted Performance Bands: 4-5*

| Criteria | Marks |
|---|---|
| • All correct values in the table and accurate exponential graph starting at 10 000 | 4 |
| • All correct values in the table and an inaccurate graph or similar progress | 3 |
| • Some correct values in the table and/or incorrect graph | 2 |
| • Limited correct values in the table and graph or similar progress | 1 |

**Sample Answer:**

| $n$ | 0 | 5 | 10 | 15 |
|---|---|---|---|---|
| $A$ | 10 000 | 16 105.10 | 25 937.42 | 41 772.48 |

**(b)** (1 mark)
*Content: MS-A4.2*
*Outcomes assessed: MS2-12-6*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct answer | 1 |

*Sample Answer:*

The investment will have doubled from $10 000 to $20 000 in approximately $7\frac{1}{2}$ years.

**(c)** (1 mark)
*Content: MS-A4.2*
*Outcomes assessed: MS2-12-6*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct answer | 1 |

*Sample Answer:*

The investment is exponential growth as the money invested is growing by an increasing amount each year.

**Question 33** (2 marks)
*Content: MS-M6*
*Outcomes assessed:MS1-12-4*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 2 |
| • Use of cosine rule | 1 |

*Sample Answer:*

$c^2 = a^2 + b^2 - 2ab \cos C$
$x^2 = 8.8^2 + 18.4^2 - 2 \times 8.8 \times 18.4 \times \cos 65°$
$x^2 = 279.139 \dots$
$\therefore x = 16.7$ cm

**Question 34** (3 marks)
**(a)** (2 marks)
*Content: MS-M1.2*
*Outcomes assessed: MS2-12-4*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 2 |
| • One application of trapezoidal rule or similar progress | 1 |

*Sample Answer:*

$A \approx \frac{h}{2}\left(d_f + d_l\right) + \frac{h}{2}(d_f + d_l)$

$A \approx \frac{8}{2}(5 + 3) + \frac{8}{2}(3 + 7)$

$A \approx 72 \text{ m}^2$

**(b)** (1 mark)
*Content: MS-M1.2*
*Outcomes assessed: MS2-12-4*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct explanation | 1 |

*Sample Answer:*

The trapezoidal rule calculates the area of a trapezium formed with these dimensions and a straight line. The boundary of the garden is consistently below the trapezium that would be formed so the area calculated is an over-estimation of the area of the garden.

**Question 35** (5 marks)
**(a)** (3 marks)
*Content: MS-F5*
*Outcomes assessed: MS2-12-5*
*Targeted Performance Bands: 4-5*

| Criteria | Marks |
|---|---|
| • Correct calculation of the FV of the annuity and concluding statement | 3 |
| • Correct calculation of the FV of the annuity | 2 |
| • Use of 6.3081 from table or similar progress | 1 |

*Sample Answer:*

$FV = 6.3081 \times 500$
$\quad = \$3154.05$
The future value of the annuity is greater than $3100 so Scarlett will have enough money to pay for her holiday.

**(b)** (2 marks)
*Content: MS-F5*
*Outcomes assessed: MS2-12-5*
*Targeted Performance Bands: 4-5*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 2 |
| • Use of 4.1216 from table | 1 |

*Sample Answer:*

Contribution per period $= 3100 \div 4.1216$
$\quad\quad\quad\quad = \$752.14$

**Question 36** (2 marks)
*Content: MS-S5*
*Outcomes assessed: MS2-12-7*
*Targeted Performance Bands: 4-5*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 2 |
| • Calculation of mean or similar progress | 1 |

*Sample Answer:*

$$z = \frac{x - \mu}{\sigma}$$

$$-1.75 = \frac{62 - \mu}{8}$$

$$\mu = 76$$

Ivan's mark $= 76 + 1.75 \times 8$
$\quad\quad\quad = 90$

**Question 37** (4 marks)
**(a)** (3 marks)
*Content: MS-S4*
*Outcomes assessed: MS2-12-7*
*Targeted Performance Bands: 5-6*

| Criteria | Marks |
|---|---|
| • Correct calculation of the least-squares equation and cost of a 4 year old car | 3 |
| • Correct calculation of the least-squares equation or similar progress | 2 |
| • Partly correct calculation of the equation or similar progress | 1 |

*Sample Answer:*

$m = -2285 \quad c = 28\,460$

$\therefore P = 28\,460 - 2285A$

When $A = 4, \quad P = 28460 - 2285 \times 4$
$\quad\quad\quad\quad\quad = \$19\,320$

**(b)** (1 mark)
*Content: MS-S4*
*Outcomes assessed: MS2-12-7*
*Targeted Performance Bands: 3-4*

| Criteria | Marks |
|---|---|
| • Correct explanation | 1 |

*Sample Answer:*

This is extrapolation - the age of John's car is outside the range of data that was used to form this equation and so the equation is not valid for a car this age.

**Question 38** (5 marks)
**(a)** (3 mark)
*Content: MS-F4.1*
*Outcomes assessed: MS2-12-5*
*Targeted Performance Bands: 4-5*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 3 |
| • Correct calculation of amount of interest earned in month 5 or similar progress | 2 |
| • Correct calculation of principal at start of the month 5 or similar progress | 1 |

*Sample Answer:*

Balance (end of month 4) = 496994 + 1490.98 − 3800
$$= \$494\,684.98$$

Principal (start of month 5) = $494 684.98

Interest (month 5) = $494 684.98 × 0.3%
$$= \$1484.05$$

Withdrawal (month 5) = 494 684.98 − 491 969.03 + 1484.05
$$= \$4200$$

**(b)** (2 marks)
*Content: MS-F4.1*
*Outcomes assessed: MS2-12-5*
*Targeted Performance Bands: 4-5*

| Criteria | Marks |
|---|---|
| • Correct working and answer | 2 |
| • Correct collection of balance after sixth month or similar progress | 1 |

*Sample Answer:*
$$A_6 = A_5 \times 1.003 - 7500$$
$$= 491\,969.03 \times 1.003 - 7500$$
$$= \$485\,944.94$$

$$A_7 = A_6 \times 1.003 - 7500$$
$$= 485\,944.94 \times 1.003 - 7500$$
$$= \$479\,902.77$$