

Review of year 1 [94 marks]

1. [Maximum mark: 6]

SPM.1.SL.TZ0.9

Ms Calhoun measures the heights of students in her mathematics class. She is interested to see if the mean height of male students, μ_1 , is the same as the mean height of female students, μ_2 . The information is recorded in the table.

Male height (cm)	150	148	143	152	151	149	147	
Female height (cm)	148	152	154	147	146	153	152	150

At the 10 % level of significance, a t -test was used to compare the means of the two groups. The data is assumed to be normally distributed and the standard deviations are equal between the two groups.

(a.i) State the null hypothesis.

[1]

Markscheme

$$\mu_1 - \mu_2 = 0 \quad A1$$

Note: Accept equivalent statements in words.

[1 mark]

(a.ii) State the alternative hypothesis.

[1]

Markscheme

$$\mu_1 - \mu_2 \neq 0 \quad A1$$

Note: Accept equivalent statements in words.

[1 mark]

(b) Calculate the p -value for this test.

[2]

Markscheme

0.296 (0.295739...) **A2**

[2 marks]

- (c) State, giving a reason, whether Ms Calhoun should accept the null hypothesis.

[2]

Markscheme

$0.296 > 0.1$ **R1**

fail to reject the null hypothesis, there is no difference between the mean height of male and female students **A1**

Note: Award (**R1**) for a correct comparison of their p -value to the test level, award (**A1**) for the correct interpretation from that comparison. Do not award **ROA1**.

[2 marks]

2. [Maximum mark: 5]

SPM.1.SL.TZ0.6

As part of a study into healthy lifestyles, Jing visited Surrey Hills University. Jing recorded a person's position in the university and how frequently they ate a salad. Results are shown in the table.

	Salad meals per week			
	0	1–2	3–4	>4
Students	45	26	18	6
Professors	15	8	5	12
Staff and Administration	16	13	10	6

Jing conducted a χ^2 test for independence at a 5 % level of significance.

(a) State the null hypothesis.

[1]

Markscheme

number of salad meals per week is independent of a person's position in the university **A1**

Note: Accept "not associated" instead of independent.

[1 mark]

(b) Calculate the p -value for this test.

[2]

Markscheme

0.0201 (0.0201118...) **A2**

[2 marks]

- (c) State, giving a reason, whether the null hypothesis should be accepted.

[2]

Markscheme

$0.0201 < 0.05$ *R1*

the null hypothesis is rejected *A1*

Note: Award (*R1*) for a correct comparison of their p -value to the test level, award (*A1*) for the correct interpretation from that comparison.

Do not award (*R0*)(*A1*).

[2 marks]

3. [Maximum mark: 6]

SPM.1.SL.TZ0.3

At the end of a school day, the Headmaster conducted a survey asking students in how many classes they had used the internet.

The data is shown in the following table.

Number of classes in which the students used the internet	0	1	2	3	4	5	6
Number of students	20	24	30	k	10	3	1

(a) State whether the data is discrete or continuous.

[1]

Markscheme

discrete **A1**

[1 mark]

The mean number of classes in which a student used the internet is 2.

(b) Find the value of k .

[4]

Markscheme

$$\frac{24+60+3k+40+15+6}{88+k} = 2 \quad \mathbf{M1A1}$$

Note: Award **M1** for substitution into the formula for the mean, award **A1** for a correct equation.

attempt to solve their equation **(M1)**

$$k = 31 \quad \mathbf{A1}$$

[4 marks]

- (c) It was not possible to ask every person in the school, so the Headmaster arranged the student names in alphabetical order and then asked every 10th person on the list.

Identify the sampling technique used in the survey.

[1]

Markscheme

systematic **A1**

[1 mark]

4. [Maximum mark: 6]

SPM.1.SL.TZ0.13

Mr Burke teaches a mathematics class with 15 students. In this class there are 6 female students and 9 male students.

Each day Mr Burke randomly chooses one student to answer a homework question.

- (a) Find the probability that on any given day Mr Burke chooses a female student to answer a question.

[1]

Markscheme

$$\frac{6}{15} \left(0.4, \frac{2}{5} \right) \quad \mathbf{A1}$$

[1 mark]

In the first month, Mr Burke will teach his class 20 times.

- (b) Find the probability he will choose a female student 8 times.

[2]

Markscheme

$$P(X = 8) \quad \mathbf{(M1)}$$

Note: Award **(M1)** for evidence of recognizing binomial probability.

$$\text{eg } P(X = 8), X \sim B\left(20, \frac{6}{15}\right).$$

$$0.180 \text{ (0.179705...)} \quad \mathbf{A1}$$

[2 marks]

- (c) Find the probability he will choose a male student at most 9 times.

[3]

Markscheme

$$P(\text{male}) = \frac{9}{15}(0.6) \quad \mathbf{A1}$$

$$P(X \leq 9) = 0.128 \text{ (0.127521...)} \quad \mathbf{(M1)A1}$$

Note: Award **(M1)** for evidence of correct approach eg, $P(X \leq 9)$.

[3 marks]

5. [Maximum mark: 6]

SPM.1.SL.TZ0.12

Jae Hee plays a game involving a biased six-sided die.

The faces of the die are labelled $-3, -1, 0, 1, 2$ and 5 .

The score for the game, X , is the number which lands face up after the die is rolled.

The following table shows the probability distribution for X .

Score x	-3	-1	0	1	2	5
$P(X=x)$	$\frac{1}{18}$	p	$\frac{3}{18}$	$\frac{1}{18}$	$\frac{2}{18}$	$\frac{7}{18}$

(a) Find the exact value of p .

[1]

Markscheme

$$\frac{4}{18} \left(\frac{2}{9} \right) \quad \mathbf{A1}$$

[1 mark]

Jae Hee plays the game once.

(b) Calculate the expected score.

[2]

Markscheme

$$-3 \times \frac{1}{18} + (-1) \times \frac{4}{18} + 0 \times \frac{3}{18} + \dots + 5 \times \frac{7}{18} \quad \mathbf{(M1)}$$

Note: Award **(M1)** for their correct substitution into the formula for expected value.

$$= 1.83 \left(\frac{33}{18}, 1.83333 \dots \right) \quad \mathbf{A1}$$

[2 marks]

- (c) Jae Hee plays the game twice and adds the two scores together.

Find the probability Jae Hee has a **total** score of -3 .

[3]

Markscheme

$$2 \times \frac{1}{18} \times \frac{3}{18} \quad (M1)(M1)$$

Note: Award **(M1)** for $\frac{1}{18} \times \frac{3}{18}$, award **(M1)** for multiplying their product by 2.

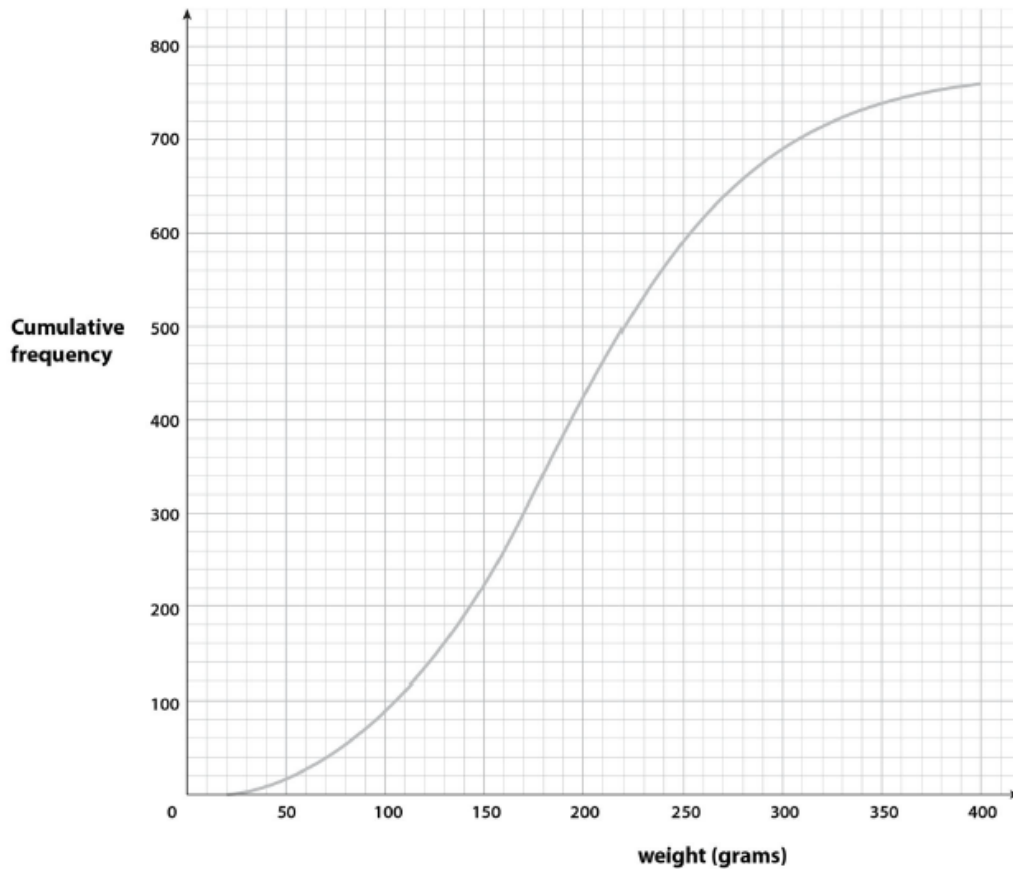
$$= \frac{1}{54} \left(\frac{6}{324}, 0.0185185 \dots, 1.85\% \right) \quad A1$$

[3 marks]

6. [Maximum mark: 7]

EXN.1.SL.TZ0.4

A food scientist measures the weights of 760 potatoes taken from a single field and the distribution of the weights is shown by the cumulative frequency curve below.



- (a) Find the number of potatoes in the sample with a weight of more than 200 grams.

[2]

Markscheme

* This sample question was produced by experienced DP mathematics senior examiners to aid teachers in preparing for external assessment in the new MAA course. There may be minor differences in formatting compared to formal exam papers.

$$760 - 420 = 340 \text{ (g)} \quad \text{(M1)A1}$$

[2 marks]

(b.i) Find the median weight.

[1]

Markscheme

Median = 190 (g) **A1**

[1 mark]

(b.ii) Find the lower quartile.

[1]

Markscheme

Lower quartile = 135 – 140 (g) **A1**

[1 mark]

(b.iii) Find the upper quartile.

[1]

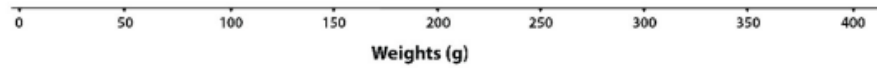
Markscheme

Upper quartile = 242 – 247 (g) **A1**

[1 mark]

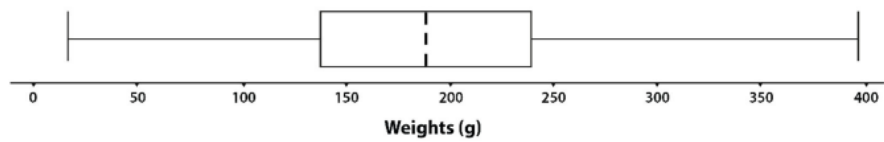
(c) The weight of the smallest potato in the sample is 20 grams and the weight of the largest is 400 grams.

Use the scale shown below to draw a box and whisker diagram showing the distribution of the weights of the potatoes. You may assume there are no outliers.



[2]

Markscheme



M1A1

Note: The **M1** is for a box and whisker plot and the **A1** for all 5 statistics in the right places.

[2 marks]

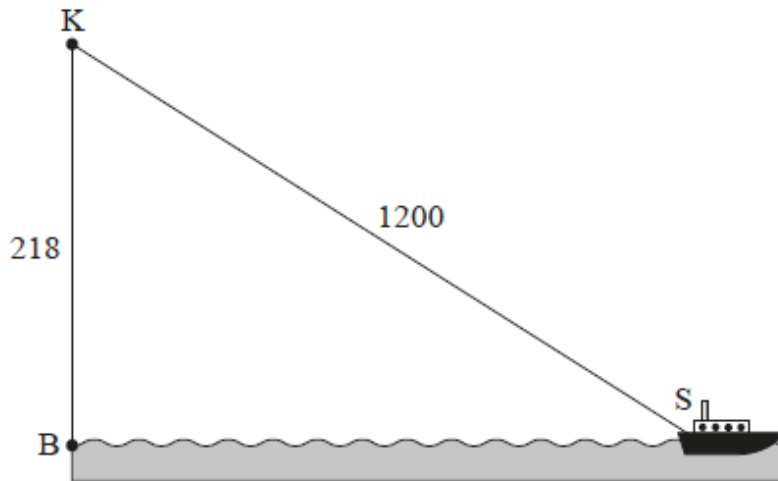
7. [Maximum mark: 6]

22N.1.SL.TZ0.1

Kacheena stands at point K , the top of a 218 m vertical cliff. The base of the cliff is located at point B . A ship is located at point S , 1200 m from Kacheena.

This information is shown in the following diagram.

diagram not to scale



(a) Find the angle of elevation from the ship to Kacheena.

[2]

Markscheme

$$\sin(\widehat{BSK}) = \frac{218}{1200} \quad \text{OR} \quad \frac{\sin(\widehat{BSK})}{218} = \frac{\sin(90^\circ)}{1200} \quad (M1)$$

Note: Award *M1* for a correct trig formula. Accept other variables representing \widehat{BSK} .

$$(\widehat{BSK} =) 10.5^\circ \quad (10.4668\dots) \quad A1$$

Note: Award *A1* for the radian answer, 0.182681... Award *M1A0* if

the candidate finds the correct angle of elevation but then uses it to find a complementary angle as their final answer.

[2 marks]

- (b) Find the horizontal distance from the base of the cliff to the ship. [2]

Markscheme

$$SB^2 + 218^2 = 1200^2 \text{ OR } \cos(10.4468\dots) = \frac{SB}{1200} \text{ OR} \\ \tan(10.4468\dots) = \frac{218}{SB} \text{ OR } \frac{BS}{\sin(79.5331\dots)} = \frac{1200}{\sin(90^\circ)} \quad (M1)$$

$$1800 \text{ (m)} \left(\sqrt{1392476}, 1180.03\dots \right) \quad A1$$

[2 marks]

- (c) Write down your answer to part (b) in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [2]

Markscheme

$$1.18 \times 10^3 \quad A1A1$$

Note: Award **A1** for 1.18

Award **A1** for 10^3

Accept their rounded answer to part (b).

Award **AOA0** for answers of the type: 11.8×10^2

[2 marks]

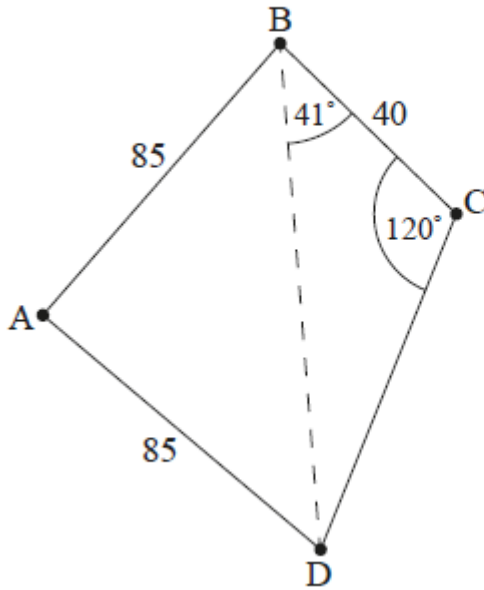
8. [Maximum mark: 17]

22N.2.SL.TZ0.2

The following diagram shows a park bounded by a fence in the shape of a quadrilateral $ABCD$. A straight path crosses through the park from B to D .

$AB = 85$ m, $AD = 85$ m, $BC = 40$ m, $\widehat{CBD} = 41^\circ$, $\widehat{BCD} = 120^\circ$

diagram not to scale



(a.i) Write down the value of angle BDC.

[1]

Markscheme

19° **A1**

[1 mark]

(a.ii) Hence use triangle BDC to find the length of path BD.

[3]

Markscheme

$$\frac{BD}{\sin 120^\circ} = \frac{40}{\sin 19^\circ} \quad (M1)(A1)$$

Note: Award *M1* for substituted sine rule for BCD, *A1* for their correct substitution.

$$(BD =) 106 \text{ m } (106.401\dots) \quad A1$$

[3 marks]

(b) Calculate the size of angle \widehat{BAD} , correct to five significant figures.

[3]

Markscheme

METHOD 1 (cosine rule)

$$\cos \widehat{BAD} = \frac{85^2 + 85^2 - 106.401\dots^2}{2 \times 85 \times 85} \quad (M1)(A1)$$

Note: Award *M1* for substituted cosine rule, *A1* for their correct substitution.

$$77.495 \quad A1$$

Note: Accept an answer of 77.149 from use of 3 sf answer from part (a). The final answer must be correct to five significant figures.

METHOD 2 (right angled trig/isosceles triangles)

$$\sin\left(\frac{\widehat{BAD}}{2}\right) = \frac{53.2008\dots}{85} \quad (A1)(M1)$$

Note: Award **A1** for 53. 2008 . . . seen. Award **M1** for correctly substituted trig ratio. Follow through from part (a).

77. 495 . . . **A1**

Note: Use of 3 sf answer from part (a), results in 77. 149.

[3 marks]

The size of angle \widehat{BAD} rounds to 77° , correct to the nearest degree. Use $\widehat{BAD} = 77^\circ$ for the rest of this question.

(c) Find the area bounded by the path BD, and fences AB and AD.

[3]

Markscheme

EITHER

$$(\text{Area} =) \frac{1}{2} \times 85 \times 85 \times \sin(77^\circ) \qquad \qquad \qquad \mathbf{(M1)(A1)}$$

Note: Award **M1** for substituted area formula, **A1** for correct substitution. Award at most **(M1)(A1)A0** if an angle other than 77° is used.

OR

$$(\text{Area} =) \frac{1}{2} \times (2 \times 85 \times \sin(38.5^\circ)) \times (85 \times \cos(38.5^\circ)) \\ \qquad \qquad \qquad \mathbf{(M1)(A1)}$$

Note: Award *M1* for substituted area formula $A = \frac{1}{2}bh$, *A1* for correct substitution.

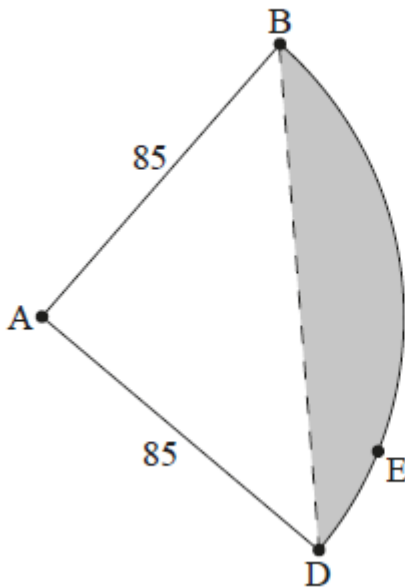
3520 m² (3519.91...)

A1

[3 marks]

A landscaping firm proposes a new design for the park. Fences BC and CD are to be replaced by a fence in the shape of a circular arc BED with center A. This is illustrated in the following diagram.

diagram not to scale



(d) Write down the distance from A to E.

[1]

Markscheme

85 m

A1

[1 mark]

- (e) Find the perimeter of the proposed park, ABED.

[3]

Markscheme

$$85 + 85 + \frac{77}{360} \times 2\pi \times 85 \quad (M1)(M1)$$

Note: Award *M1* for correctly substituted into $\frac{\theta}{360} \times 2\pi \times r$, *M1* for addition of AB and AD.

$$284 \text{ m (284.231...)} \quad A1$$

[3 marks]

- (f) Find the area of the shaded region in the proposed park.

[3]

Markscheme

$$\frac{77}{360} \times \pi \times (85)^2 - 3519.91... \quad (M1)(M1)$$

Note: Award *M1* for correctly substituted area of sector formula, *M1* for subtraction of their area from part (c).

$$1330 \text{ m}^2 \text{ (1334.93...)} \quad A1$$

[3 marks]

9. [Maximum mark: 17]

SPM.2.SL.TZ0.1

In this question, give all answers to two decimal places.

Bryan decides to purchase a new car with a price of €14 000, but cannot afford the full amount. The car dealership offers two options to finance a loan.

Finance option A:

A 6 year loan at a nominal annual interest rate of 14 % **compounded quarterly**. No deposit required and repayments are made each quarter.

(a.i) Find the repayment made each quarter.

[3]

Markscheme
$N = 24$ $I \% = 14$ $PV = -14000$ $FV = 0$ $P/Y = 4$ $C/Y = 4$ (M1)(A1)
Note: Award M1 for an attempt to use a financial app in their technology, award A1 for all entries correct. Accept $PV = 14000$.
$(€)871.82$ A1
[3 marks]

(a.ii) Find the total amount paid for the car.

[2]

Markscheme
$4 \times 6 \times 871.82$ (M1)
$(€) 20923.68$ A1

[2 marks]

(a.iii) Find the interest paid on the loan.

[2]

Markscheme

$$20923.68 - 14000 \quad (M1)$$

$$(\text{€}) 6923.68 \quad A1$$

[2 marks]

Finance option B:

A 6 year loan at a nominal annual interest rate of r % **compounded monthly**.
Terms of the loan require a 10 % deposit and monthly repayments of €250.

(b.i) Find the amount to be borrowed for this option.

[2]

Markscheme

$$0.9 \times 14000 (= 14000 - 0.10 \times 14000) \quad M1$$

$$(\text{€}) 12600.00 \quad A1$$

[2 marks]

(b.ii) Find the annual interest rate, r .

[3]

Markscheme

$$N = 72$$

$$PV = 12600$$

$$PMT = -250$$

$$FV = 0$$

$$P/Y = 12$$

$$C/Y = 12 \quad (M1)(A1)$$

Note: Award *M1* for an attempt to use a financial app in their technology, award *A1* for all entries correct. Accept $PV = -12600$ provided $PMT = 250$.

$$12.56(\%) \quad A1$$

[3 marks]

(c) State which option Bryan should choose. Justify your answer.

[2]

Markscheme

EITHER

Bryan should choose Option A *A1*

no deposit is required *R1*

Note: Award *R1* for stating that no deposit is required. Award *A1* for the correct choice from that fact. Do not award *ROA1*.

OR

Bryan should choose Option B *A1*

cost of Option A (6923.69) > cost of Option B ($72 \times 250 - 12600 = 5400$) *R1*

Note: Award *R1* for a correct comparison of costs. Award *A1* for the correct choice from that comparison. Do not award *ROA1*.

[2 marks]

(d) Bryan's car depreciates at an annual rate of 25 % per year.

Find the value of Bryan's car six years after it is purchased.

[3]

Markscheme

$$14\,000 \left(1 - \frac{25}{100}\right)^6 \quad (M1)(A1)$$

Note: Award *M1* for substitution into compound interest formula.
Award *A1* for correct substitutions.

$$= (\text{€})2491.70 \quad A1$$

OR

$$N = 6$$

$$I\% = -25$$

$$PV = \pm 14\,000$$

$$P/Y = 1$$

$$C/Y = 1 \quad (A1)(M1)$$

Note: Award *A1* for $PV = \pm 14\,000$, *M1* for other entries correct.

$$(\text{€})2491.70 \quad A1$$

[3 marks]

10. [Maximum mark: 5]

EXM.1.SL.TZ0.1

Give your answers to this question correct to two decimal places.

Gen invests \$2400 in a savings account that pays interest at a rate of 4% per year, compounded annually. She leaves the money in her account for 10 years, and she does not invest or withdraw any money during this time.

(a) Calculate the value of her savings after 10 years.

[2]

Markscheme

$$2400(1.04)^{10} = \$3552.59 \quad M1A1$$

[2 marks]

(b) The rate of inflation during this 10 year period is 1.5% per year.

Calculate the real value of her savings after 10 years.

[3]

Markscheme

$$\text{real interest rate} = 4 - 1.5 = 2.5\% \quad A1$$

$$2400(1.025)^{10} = \$3072.20 \quad M1A1$$

[3 marks]

11. [Maximum mark: 6]

EXM.1.SL.TZ0.6

Yejin plans to retire at age 60. She wants to create an annuity fund, which will pay her a monthly allowance of \$4000 during her retirement. She wants to save enough money so that the payments last for 30 years. A financial advisor has told her that she can expect to earn 5% interest on her funds, compounded annually.

- (a) Calculate the amount Yejin needs to have saved into her annuity fund, in order to meet her retirement goal.

[3]

Markscheme

Use of finance solver **M1**

$N = 360, I = 5\%, \text{Pmt} = 4000, \text{FV} = 0, \text{PpY} = 12, \text{CpY} = 1$ **A1**

\$755000 (correct to 3 s.f.) **A1**

[3 marks]

- (b) Yejin has just turned 28 years old. She currently has no retirement savings. She wants to save part of her salary each month into her annuity fund.

Calculate the amount Yejin needs to save each month, to meet her retirement goal.

[3]

Markscheme

$N = 384, I = 5\%, \text{PV} = 0, \text{FV} = 754638, \text{PpY} = 12, \text{CpY} = 1$ **M1A1**

\$817 per month (correct to 3 s.f.) **A1**

[3 marks]

12. [Maximum mark: 7]

22N.1.SL.TZ0.2

In the first month of a reforestation program, the town of Neerim plants 85 trees. Each subsequent month the number of trees planted will increase by an additional 30 trees.

The number of trees to be planted in each of the first three months are shown in the following table.

Month	Trees planted
1	85
2	115
3	145

(a) Find the number of trees to be planted in the 15th month.

[3]

Markscheme

use of the n^{th} term of an arithmetic sequence formula (M1)

$$u_{15} = 85 + (15 - 1) \times 30 \quad (A1)$$

$$505 \quad A1$$

[3 marks]

(b) Find the total number of trees to be planted in the first 15 months.

[2]

Markscheme

use of the sum of n terms of an arithmetic sequence formula (M1)

$$S_{15} = \frac{15}{2}(85 + 505) \text{ OR } \frac{15}{2}(2 \times 85 + (15 - 1) \times 30)$$

4430 (4425) **A1**

[2 marks]

- (c) Find the mean number of trees planted per month during the first 15 months.

[2]

Markscheme

$$\frac{4425}{15} \text{ OR } 85 + (8 - 1) \times 30 \quad \text{(M1)}$$

295 **A1**

Note: Accept 295.333... from use of 3sf value from part (b).

[2 marks]