

APOLLO

Number and algebra SL

Mathematics: applications and interpretation

First assessment 2021

52 questions | mark schemes

$$\begin{aligned}
 1. \quad (a) \quad \pi &\approx 3 + \frac{1}{6 + \frac{13}{16}} \\
 &= 3.14678... \left(\frac{343}{109}, 3\frac{16}{109} \right) & (A1) \\
 &= 3.1468 & A1
 \end{aligned}$$

Note: Award **A1** for correct rounding to 4 decimal places. Follow through within this part.

[2 marks]

$$(b) \quad \left| \frac{3.1468 - \pi}{\pi} \right| \times 100 \quad (M1)$$

Note: Award **M1** for substitution of their final answer in part (a) into the percentage error formula. Candidates should use the exact value of π from their GDC.

$$= 0.166(\%) \quad (0.165754...) \quad A1$$

[2 marks]

Total [4 marks]

8. (a) (i) attempt to find u_{20} using an arithmetic sequence **(M1)**
 e.g. $u_1 = 500$ and $d = 100$ **OR** $u_{20} = 500 + 1900$ **OR** 500, 600, 700, ...

(Charlie ran) 2400 m **A1**

- (ii) ($r =$) 1.02 **(A1)**

attempt to find u_{20} using a geometric sequence **(M1)**

e.g. identifying $u_1 = 500$ and a value for r **OR** $500 \times r^{19}$ **OR** 500, 510, 520.2, ...

(Daniella ran) 728 m (728.405...) **A1**

[5 marks]

- (b) $500 \times 1.02^{n-1} > 500 + (n-1) \times 100$ **(M1)**

attempt to solve inequality **(M1)**

$$n > 184.215...$$

$$n = 185$$

A1
[3 marks]

Total [8 marks]

10. (a) **METHOD 1**

$$N = 5$$

$$I\% = 2.75$$

$$PV = -1500$$

$$PMT = 0$$

$$P/Y = 1$$

$$C/Y = 2$$

OR

$$N = 10$$

$$I\% = 2.75$$

$$PV = -1500$$

$$PMT = 0$$

$$P/Y = 2$$

$$C/Y = 2$$

(M1)(A1)

Note: Award **M1** for an attempt to use a financial app in their technology, **A1** for all entries correct.

METHOD 2

$$1500 \left(1 + \frac{2.75}{2 \times 100} \right)^{2 \times 5}$$

$$1719.49 \text{ euro}$$

(M1)(A1)**A1****[3 marks]**(b) **METHOD 1**

$$N = 5$$

$$PV = \pm 1500$$

$$FV = \mp 2250$$

$$PMT = 0$$

$$P/Y = 1$$

$$C/Y = 4$$

OR

$$N = 20$$

$$PV = \pm 1500$$

$$FV = \mp 2250$$

$$PMT = 0$$

$$P/Y = 4$$

$$C/Y = 4$$

(M1)(A1)

Note: Award **M1** for an attempt to use a financial app in their technology, **A1** for all entries correct. PV and FV must have opposite signs.

METHOD 2

$$1500 \left(1 + \frac{r}{4 \times 100} \right)^{4 \times 5} = 2250 \quad \text{OR} \quad \left(1 + \frac{r}{4 \times 100} \right)^{4 \times 5} = 1.5$$

(M1)(A1)

Note: Award **M1** for substitution in compound interest formula, **A1** for correct substitution and for equating to 2250 (if using LHS equation) or to 1.5 (if using RHS equation).

$$r = 8.19 \text{ (8.19206...)}$$

A1

Note: Accept $r = 8.19\%$.

Accept a trial and error method which leads to $r = 8.19$.

[3 marks]**Total [6 marks]**

3. (a) **EITHER**

$$N = 2$$

$$PV = -37\,000$$

$$I\% = 6.4$$

$$P/Y = 1$$

$$C/Y = 4$$

(M1)(A1)

Note: Award **M1** for an attempt to use a financial app in their technology, award **A1** for all entries correct.

OR

$$N = 8$$

$$PV = -37\,000$$

$$I\% = 6.4$$

$$P/Y = 4$$

$$C/Y = 4$$

(M1)(A1)

Note: Award **M1** for an attempt to use a financial app in their technology, award **A1** for all entries correct.

OR

$$FV = 37\,000 \times \left(1 + \frac{6.4}{100 \times 4}\right)^{4 \times 2}$$

(M1)(A1)

Note: Award **M1** for substitution into compound interest formula, **(A1)** for correct substitution.

$$= 42\,010 \text{ AUD}$$

A1

Note: Award **(M1)(A1)A0** for unsupported 42009.87.

[3 marks](b) **EITHER**

$$PV = -37\,000$$

$$FV = 50\,000$$

$$I\% = 6.4$$

$$P/Y = 1$$

$$C/Y = 4$$

(M1)(A1)

Note: Award **M1** for an attempt to use a financial app in their technology, award **A1** for all entries correct. The final mark can still be awarded for the correct number of months (multiple of 3).

continued...

Question 3 continued

OR

$$PV = -37\,000$$

$$FV = 50\,000$$

$$I\% = 6.4$$

$$P/Y = 4$$

$$C/Y = 4$$

(M1)(A1)

Note: Award **M1** for an attempt to use a financial app in their technology, award **A1** for all entries correct.

OR

$$50\,000 < 37\,000 \times \left(1 + \frac{6.4}{100 \times 4}\right)^{4 \times n} \quad \text{OR} \quad 50\,000 < 37\,000 \times \left(1 + \frac{6.4}{100 \times 4}\right)^n \quad \textbf{(M1)(A1)}$$

Note: Award **M1** for the correct inequality, 50 000 and substituted compound interest formula. Allow an equation. Award **A1** for correct substitution.

THEN

$$N = 4.74 \text{ (years) (4.74230...)} \quad \text{OR} \quad N = 18.9692... \text{ (quarters)} \quad \textbf{(A1)}$$

$$m = 57 \text{ months} \quad \textbf{A1}$$

Note: Award **A1** for rounding their m to the correct number of months. The final answer must be a multiple of 3. Follow through within this part.

[4 marks]

(c) 150 000 AUD

A1**[1 mark]***continued...*

Question 3 continued

$$(d) \quad (i) \quad 120 \times 1700 - 150\,000 \quad (M1)$$

$$= 54\,000 \text{ AUD} \quad A1$$

$$(ii) \quad N = 120$$

$$PV = -150\,000$$

$$PMT = 1700$$

$$FV = 0$$

$$P/Y = 12$$

$$C/Y = 12$$

(M1)(A1)

Note: Award **M1** for an attempt to use a financial app in their technology or an attempt to use an annuity formula or $FV = 0$ seen. If a compound interest formula is equated to zero, award **M1**, otherwise award **M0** for a substituted compound interest formula.
Award **A1** for all entries correct in financial app or correct substitution in annuity formula, but award **A0** for a substituted compound interest formula. Follow through marks in part (d)(ii) are contingent on working seen.

$$r = 6.46 \text{ (\%)} \text{ (6.45779...)} \quad A1$$

[5 marks]

$$(e) \quad N = 60$$

$$I = 6.46 \text{ (6.45779...)}$$

$$PV = -150\,000$$

$$PMT = 1700$$

$$P/Y = 12$$

$$C/Y = 12$$

(M1)(A1)

Note: Award **M1** for an attempt to use a financial app in their technology or an attempt to use an annuity formula. Award **(M0)** for a substituted compound interest formula. Award **A1** for all entries correct. Follow through marks in part (e) are contingent on working seen.

$$FV = 86\,973 \text{ AUD} \quad A1$$

[3 marks]

$$(f) \quad 204\,000 - (60 \times 1700 + 86\,973) \text{ OR } 204\,000 - 188\,973 \quad (M1)(M1)$$

Note: Award **M1** for 60×1700 . Award **M1** for subtracting their $(60 \times 1700 + 86\,973)$ from their $(204\,000)$. Award at most **M1M0** for their $204\,000 - (60 \times 1700)$ or **M0M0** for their $204\,000 - (86\,973)$. Follow through from parts (d)(i) and (e). Follow through marks in part (f) are contingent on working seen.

$$15\,027 \text{ AUD} \quad A1$$

[3 marks]

Total [19 marks]

3. (a) (i) recognition of arithmetic sequence with common difference 2 (M1)
 use of arithmetic sequence formula (M1)
 $14 + 2(20 - 1)$
 52 A1

- (ii) use of arithmetic series formula (M1)
 $\frac{14 + 52}{2} \times 20$
 660 A1

[5 marks]

- (b) $584 + (584 \times 0.012)$ OR $584 \times (1.012)^1$ (M1)
 591 (591.008) A1

Note: Award **M0A0** if incorrect r used in part (b), and **FT** with their r in parts (c) and (d).

[2 marks]

- (c) recognition of geometric sequence (M1)
 equating their n th geometric sequence term to their 660 (M1)

Note: Accept inequality.

METHOD 1**EITHER**

$$660 = 584 \times (1.012)^{x-1} \quad \text{A1}$$

$$(x-1) = 10.3 \quad (10.2559\dots)$$

$$x = 11.3 \quad (11.2559\dots) \quad \text{A1}$$

$$2030 \quad \text{A1}$$

OR

$$660 = 584 \times (1.012)^x \quad \text{A1}$$

$$x = 10.3 \quad (10.2559\dots) \quad \text{A1}$$

$$2030 \quad \text{A1}$$

continued...

*Question 3 continued***METHOD 2**11th term 658 (657.987...)**(M1)A1**12th term 666 (665.883...)**(M1)A1**

2030

A1**Note:** The last mark can be awarded if both their 11th and 12th correct terms are seen.**[5 marks]**

(d) 7 seen

(A1)**EITHER**

$$584 \left(\frac{1.012^7 - 1}{1.012 - 1} \right)$$

(M1)

multiplying their sum by 50

(M1)**OR**sum of the number of visitors for their r and their seven years**(M1)**

multiplying their sum by 50

(M1)**OR**

$$29\,200 \left(\frac{1.012^7 - 1}{1.012 - 1} \right)$$

(M1)(M1)**THEN**

212000 (211907.3...)

A1**Note:** Follow though from their r from part (b).**[4 marks]****Total [16 marks]**

10. (a) $N = 360$
 $I\% = 3.8$
 $PV = (\pm)170\,000$
 $FV = 0$
 $P/Y = 12$
 $C/Y = 12$ **(M1)(A1)**

Note: Award **(M1)** for an attempt to use a financial app in their technology with at least two entries seen, award **A1** for all entries correct. Accept a positive or negative value for PV .

$(PMT =) 792.13 \text{ AUD}$ **A1**

Note: Accept an answer of -792.13 . Do not award final **A1** if answer is not given correct to 2 dp

[3 marks]

- (b) (i) $N = 120$
 $I\% = 3.8$
 $PV = (\pm)170\,000$
 $PMT = (\mp)792.13$
 $P/Y = 12$
 $C/Y = 12$ **(M1)(A1)**

Note: Award **(M1)** for an attempt to use a financial app in their technology with at least two entries seen, award **A1** for all entries correct. PV and PMT must have opposite signs.

$(FV =) 133019.94 \text{ AUD}$ **A1**

Note: Do not award final **A1** if answer is not given correct to 2 dp, unless already penalized in part (a). Accept 133020.30 from use of exact value for PMT .

- (ii) amount of money paid: $120 \times 792.13 (= 95055.60)$ **(M1)**
 loan paid off: $170\,000 - 133019.94 (= 36980.06)$ **(M1)**
 interest paid: $(95\,055.60 - 36\,980.06 =) 58\,075.54 \text{ AUD}$ **A1**

Note: Allow 58075.60 or 58075.90 from use of some exact values from parts (a) and (b)(i). If their answer to part (b)(i) is greater than 170 000 then award at most **(M1)(M1)(A0)** for follow through in part (b)(ii).

[6 marks]

Total: [9 marks]

2. (a) $\frac{12669-12300}{12300} \times 100$ (M1)
3% A1 [2 marks]
- (b) (i) 1.03 A1
- Note: Follow through from part (a).
- (ii) $(u_n =) 12300 \times 1.03^{n-1}$ A1
- (iii) $(u_{11} =) 12300 \times 1.03^{10}$ (M1)
16530 A1
- Note: Answer must be to the nearest integer. Do not accept 16500.
- [4 marks]
- (c) $(v_n =) 10380 + 600(n-1)$ OR $600n + 9780$ M1A1
- Note: Award **M1** for substituting into arithmetic sequence formula, **A1** for correct substitution.
- [2 marks]
- (d) $80 \times \frac{10}{2} (2(10380) + 9(600))$ (M1)(M1)
- Note: Award **(M1)** for multiplying by 80 and **(M1)** for substitution into sum of arithmetic sequence formula.
- \$10500000 (\$10464000) A1 [3 marks]

continued...

Question 2 continued

(e) $12\,300 \times 1.03^{n-1} < 10\,380 + 600(n-1)$ or equivalent**(M1)****Note:** Award **M1** for equating their expressions from parts (b) and (c).**EITHER**graph showing $y = 12\,300 \times 1.03^{n-1}$ and $y = 10\,380 + 600(n-1)$ **(M1)****OR**graph showing $y = 12\,300 \times 1.03^{n-1} - (10\,380 + 600(n-1))$ **(M1)****OR**list of values including, $(u_n =) 17\,537$ and $(v_n =) 17\,580$ **(M1)****OR**

12.4953... from graphical method or solving numerical equality

(M1)**Note:** Award **(M1)** for a valid attempt to solve.**THEN** $(k =) 13$ **A1****[3 marks]**

(f) this will not guarantee enough places.

A1**EITHER**A written statement that $u_n > v_n$, with range of n .**R1***Example:* "when $n = 24$ (or greater), the number of applications will exceed the number of places again" (" $u_n > v_n$, $n \geq 24$ ").**OR**

exponential growth will always exceed linear growth

R1**Note:** Accept an equivalent sketch. Do not award **A1R0**.**[2 marks]****Total: [16 marks]**

2. (a) $(d =) - 250$

A1

[1 mark]

(b) $(u_{16} =) 6800 + (16 - 1)(- 250)$

M1

$(¥)3050$

A1

[2 marks]

(c) $(S_{16} =) \left(\frac{16}{2} \right) (2 \times 6800 + (16 - 1)(- 250)) \times 2$

M1M1

Note: Award **M1** for correct substitution into arithmetic series formula.
Award **M1** for multiplication by 2 seen.

OR

$(S_{16} =) \left(\frac{16}{2} \right) (6800 + 3050) \times 2$

M1M1

Note: Award **M1** for correct substitution into arithmetic series formula.
Award **M1** for multiplication by 2 seen.

$(¥)158000 (157600)$

A1

[3 marks]

Total [6 marks]

1. (a) (i) $N = 24$

$$I\% = 14$$

$$PV = -14000$$

$$FV = 0$$

$$P/Y = 4$$

$$C/Y = 4$$

(M1)(A1)

Note: Award **M1** for an attempt to use a financial app in their technology, award **A1** for all entries correct. Accept $PV = 14000$.

$$(\text{€})871.82$$

A1

(ii) $4 \times 6 \times 871.82$

(M1)

$$(\text{€})20923.68$$

A1

(iii) $20923.68 - 14000$

(M1)

$$(\text{€})6923.68$$

A1

[7 marks]

(b) (i) $0.9 \times 14000 (= 14000 - 0.10 \times 14000)$

M1

$$(\text{€})12600.00$$

A1

(ii) $N = 72$

$$PV = 12600$$

$$PMT = -250$$

$$FV = 0$$

$$P/Y = 12$$

$$C/Y = 12$$

(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 $PMT = 250$.

$$12.56(\%)$$

A1

[5 marks]

continued...

Question 1 continued

(c) **EITHER**

Bryan should choose Option A
no deposit is required

A1
R1

Note: Award **R1** for stating that no deposit is required. Award **A1** for the correct choice from that fact. Do not award **R0A1**.

OR

Bryan should choose Option B
cost of Option A (6923.69) > cost of Option B ($72 \times 250 - 12\,600 = 5400$)

A1
R1

Note: Award **R1** for a correct comparison of costs. Award **A1** for the correct choice from that comparison. Do not award **R0A1**.

[2 marks]

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

(M1)(A1)

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

$$= 2491.70 \text{ (USD)}$$

A1**OR**

$$N = 6$$

$$I\% = -25$$

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

$$P/Y = 1$$

$$C/Y = 1$$

(A1)(M1)

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

$$2491.70 \text{ (USD)}$$

A1**[3 marks]****Total [17 marks]**

5. (a) $x + y + z = 600$ **A1**
 $15x + 10y + 12z = 7816$ **A1**
 $x = 2y$ **A1**

Note: Condone other labelling if clear, e.g. a (adult), c (child) and s (student).
 Accept equivalent, distinct equations e.g. $2y + y + z = 600$.

[3 marks]

- (b) $x = 308, y = 154, z = 138$ **A1A1**

Note: Award **A1** for all three correct values seen, **A1** for correctly labelled as x, y or z .
 Accept answers written in words: e.g. 308 adult tickets.

[2 marks]

[Total 5 marks]

13. (a) use of geometric sequence with $r = 0.85$

M1

EITHER

$$(0.85)^6(1.8) \quad \text{OR} \quad 0.678869\dots \quad \text{OR} \quad (0.85)^5(1.53)$$

A1

$$= 0.68 \text{ m}$$

AG

$$= 68 \text{ cm}$$

OR

$$(0.85)^6(180) \quad \text{OR} \quad (0.85)^5(153)$$

A1

$$= 68 \text{ cm}$$

AG

[2 marks]

continued...

Question 13 continued

(b) **EITHER**

$$(0.85)^n(1.8) > 0.1 \quad \text{OR} \quad (0.85)^{n-1}(1.53) > 0.1 \quad (\text{M1})$$

Note: If 1.8 m (or 180 cm) is used then **(M1)** only awarded for use of n in $(0.85)^n(1.8) > 0.1$.

If 1.53 m (or 153 cm) is used then **(M1)** only awarded for use of $n-1$ in $(0.85)^{n-1}(1.53) > 0.1$.

$$17 \quad \text{A1}$$

OR

$$(0.85)^{17}(1.8) = 0.114 \text{ m and } (0.85)^{18}(1.8) = 0.0966 \text{ m} \quad (\text{M1})$$

$$17 \quad \text{A1}$$

OR

$$\text{solving } (0.85)^n(1.8) = 0.1 \text{ to find } n = 17.8 \quad (\text{M1})$$

$$17 \quad \text{A1}$$

Note: Evidence of solving may be a graph **OR** the “solver” function **OR** use of logs to solve the equation. Working may use cm.

[2 marks](c) **EITHER**

distance (in one direction) travelled between first and fourth bounce

$$= \frac{(1.8 \times 0.85)(1 - 0.85^3)}{1 - 0.85} (= 3.935925) \quad (\text{A1})$$

recognizing distances are travelled twice except first distance **(M1)**

$$1.8 + 2(3.935925) = 9.67 \text{ m } (9.67185... \text{ m}) \quad \text{A1}$$

OR

distance (in one direction) travelled between drop and fourth bounce

$$= \frac{(1.8)(1 - 0.85^4)}{1 - 0.85} (= 5.735925) \quad (\text{A1})$$

recognizing distances are travelled twice except first distance **(M1)**

$$2(5.735925) - 1.8 = 9.67 \text{ m } (9.67185... \text{ m}) \quad \text{A1}$$

OR

distance (in one direction) travelled between first and fourth bounce

$$(0.85)(1.8) + (0.85)^2(1.8) + (0.85)^3(1.8) (= 3.935925...) \quad (\text{A1})$$

recognizing distances are travelled twice except first distance **(M1)**

$$1.8 + 2(0.85)(1.8) + 2(0.85)^2(1.8) + 2(0.85)^3(1.8) = 9.67 \text{ m } (9.67185... \text{ m}) \quad \text{A1}$$

Note: Answers may be given in cm.

[3 marks]**[Total 7 marks]**

13. (a) **METHOD 1** – (with $FV = 4000$)

EITHER

$$N = 10$$

$$I = 1.5$$

$$FV = 4000$$

$$P/Y = 1$$

$$C/Y = 1$$

(A1)(M1)

Note: Award **A1** for $(3.5 - 2 =) 1.5$ seen and **M1** for all other entries correct.

OR

$$4000 = A(1 + 0.015)^{10}$$

(A1)(M1)

Note: Award **A1** for 1.5 or 0.015 seen, **M1** for attempt to substitute into compound interest formula **and** equating to 4000.

THEN

$$(PV =) \$3447$$

A1

Note: Award **A0** if not rounded to a whole number or a negative sign given.

continued...

*Question 13 continued***METHOD 2** – (*With FV including inflation*)

calculate FV with inflation

$$4000 \times 1.02^{10}$$

$$(=4875.977\dots)$$

(A1)**EITHER**

$$4000 \times 1.02^{10} = PV \times 1.035^{10}$$

(A1)**OR**

$$N = 10$$

$$I = 3.5$$

$$FV = 4875.977\dots$$

$$P/Y = 1$$

$$C/Y = 1$$

(M1)

Note: Award **M1** for *their* FV and all other entries correct.

THEN

$$(PV =) \$3457$$

A1

Note: Award **A0** if not rounded to a whole number or a negative sign given.

METHOD 3 – (*Using formula to calculate real rate of return*)

$$(\text{real rate of return} =) 1.47058\dots(\%)$$

(A1)**EITHER**

$$4000 = PV \times 1.0147058\dots^{10}$$

(A1)**OR**

$$N = 10$$

$$I = 1.47058\dots$$

$$FV = 4000$$

$$P/Y = 1$$

$$C/Y = 1$$

(M1)

Note: Award **M1** for all entries correct.

THEN

$$(PV =) \$3457$$

A1**[3 marks]***continued...*

Question 13 continued

- (b)
- METHOD 1**
- (
- Finding the future value of the investment using PV from part (a)*
-)

$$N = 10$$

$$I = 3.5$$

$$PV = 3446.66\dots \text{(from Method 1)} \text{ OR } 3456.67\dots \text{(from Methods 2, 3)}$$

$$P/Y = 1$$

$$C/Y = 1$$

(M1)**Note:** Award **M1** for interest rate 3.5 **and** answer to part (a) as PV.

$$(FV =) \$4861.87 \text{ OR } \$4875.97$$

(A1)so payment required (from TVM) will be \$294 **OR** \$295**A1****Note:** Award **A0** if a negative sign given, unless already penalized in part (a).**METHOD 2** – (*Using FV*)

$$N = 10$$

$$I = 3.5$$

$$PV = -1000$$

$$FV = 4875.977\dots$$

$$P/Y = 1$$

$$C/Y = 1$$

(A1)(M1)**Note:** Award **A1** for $I = 3.5$ **and** $FV = \pm 4875.977\dots$, **M1** for all other entries correct **and** opposite PV and FV signs.

$$(PMT =) \$295 \text{ (295.393)}$$

A1**Note:** Correct 3sf answer is 295, however accept an answer of 296 given that the context supports rounding up. Award **A0** if a negative sign given, unless already penalized in part (a).**[3 marks]****Total [6 marks]**

2. (a) (i) 30 **A1**
- (ii) 40 **A1**
- [2 marks]**
- (b) arithmetic formula chosen **(M1)**
- (i) $w_n = 20 + (n-1)10$ ($= 10 + 10n$) **A1**
- (ii) $l_n = 30 + (n-1)10$ ($= 20 + 10n$) **A1**
- [3 marks]**
- (c) (i) $740 = 30 + (n-1)10$ **OR** $740 = 20 + 10n$ **M1**
 $n = 72$ **A1**
144 tiles **AG**
- Note:** The **AG** line must be stated for the final **A1** to be awarded.
- (ii) $w_{72} = 730$ **A1**
- [3 marks]**
- (d) $(10 \times 20) \times 144$ **(M1)**
 $= 28800$ **(A1)**
 $2.88 \times 10^4 \text{ cm}^2$ **A1**
- Note:** Follow through within the question for correctly converting *their* intermediate value into standard form (but only if the pre-conversion value is seen).
- [3 marks]**
- continued...*

Question 2 continued(e) **EITHER**1 square metre = $100\text{ cm} \times 100\text{ cm}$ **(M1)**

(so, 50 tiles) and hence 10 packs of tiles in a square metre

(A1)(so each pack is $\frac{\$24.50}{10 \text{ packs}}$)**OR**area covered by one pack of tiles is $(0.2\text{ m} \times 0.1\text{ m} \times 5 =) 0.1\text{ m}^2$ **(A1)** 24.5×0.1 **(M1)****THEN**

\$2.45 per pack (of 5 tiles)

A1**[3 marks]**(f) $\frac{1.08 \times 144}{5}$ (= 31.104)**(M1)(M1)****Note:** Award **M1** for correct numerator, **M1** for correct denominator.

32 (packs of tiles)

A1**[3 marks]**(g) $35 + (32 \times 2.45)$ **(M1)**

\$113 (113.4)

A1**[2 marks]****[Total 19 marks]**

2. (a) (i) **EITHER**

$$115.5 = u_1 + (3-1) \times d \quad (115.5 = u_1 + 2d)$$

$$108 = u_1 + (8-1) \times d \quad (108 = u_1 + 7d) \quad \textbf{(M1)(A1)}$$

Note: Award **M1** for attempting to use the arithmetic sequence term formula, **A1** for both equations correct. Working for **M1** and **A1** can be found in parts (i) or (ii).

$$(d = -1.5)$$

$$1.5 \text{ (cups/day)}$$

A1

Note: Answer must be written as a positive value to award **A1**.

OR

$$(d =) \frac{115.5 - 108}{5} \quad \textbf{(M1)(A1)}$$

Note: Award **M1** for attempting a calculation using the difference between term 3 and term 8; **A1** for a correct substitution.

$$(d =) 1.5 \text{ (cups/day)}$$

A1

$$(ii) \quad (u_1 =) 118.5 \text{ (cups)}$$

A1**[4 marks]**

(b) attempting to substitute their values into the term formula for arithmetic sequence equated to zero

(M1)

$$0 = 118.5 + (n-1) \times (-1.5)$$

$$(n =) 80 \text{ days}$$

A1

Note: Follow through from part (a) only if their answer is positive.

[2 marks]

$$(c) \quad (t_5 =) 625 \times 1.064^{(5-1)} \quad \textbf{(M1)(A1)}$$

Note: Award **M1** for attempting to use the geometric sequence term formula; **A1** for a correct substitution

$$\text{\$ } 801$$

A1

Note: The answer must be rounded to a whole number to award the final **A1**.

[3 marks]*continued...*

Question 2 continued(d) (i) $(S_{10} =) (\$) 8390 \quad (8394.39\dots)$ **A1**(ii) **EITHER**

the total cost (of dog food)

R1for 10 years beginning in 2021 **OR** 10 years before 2031**R1****OR**

the total cost (of dog food)

R1from 2021 to 2030 (inclusive) **OR** from 2021 to (the start of) 2031**R1****[3 marks]**(e) **EITHER**

According to the model, the cost of dog food per year will eventually be too high to keep a dog.

OR

The model does not necessarily consider changes in inflation rate.

OR

The model is appropriate as long as inflation increases at a similar rate.

OR

The model does not account for changes in the amount of food the dog eats as it ages/becomes ill/stops growing.

OR

The model is appropriate since dog food bags can only be bought in discrete quantities.

R1

Note: Accept reasonable answers commenting on the appropriateness of the model for the specific scenario. There should be a reference to the given context. A reference to the geometric model must be clear: either “model” is mentioned specifically, or other mathematical terms such as “increasing” or “discrete quantities” are seen. Do not accept a contextual argument in isolation, e.g. “The dog will eventually die”.

[1 mark]**Total [13 marks]**

2. (a) use of the n^{th} term of an arithmetic sequence formula

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

$$505$$

(M1)**(A1)****A1****[3 marks]**

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

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

$$4430 \quad (4425)$$

(M1)**A1****[2 marks]**

- (c) $\frac{4425}{15}$ **OR** $85 + (8 - 1) \times 30$

$$295$$

(M1)**A1**

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

[2 marks]**Total [7 marks]**

7. (a) $I\% = 7.5$
 $PV = \mp 800$
 $PMT = \mp 500$
 $FV = \pm 10\,000$
 $P/Y = 12$
 $C/Y = 12$

(M1)(A1)

Note: Award **M1** for an attempt to use a financial app in their technology (e.g. at least four rows seen, but not necessarily correct), award **A1** for $PMT = -500$ or $PMT = 500$, with same sign to PV and opposite sign to FV.

17.3070...

(A1) $(k =) 18$ **A1**

Note: Award **(M0)(A0)(A0)A0** for a final answer of 17 with no working. The final answer must be an integer.

[4 marks]

- (b) $10389 - (18 \times 500 + 800)$ **OR** $10389 - (9800)$

(A1)(M1)

Note: Award **(A1)** for 10389 (10389.38...) seen. Award **(M1)** for subtraction of their $(18 \times 500 + 800)$ from FV. **FT** from their value of k . Award **A0M1A0** for $10\,000 - (18 \times 500 + 800)$. Do not award the final **A1FT** if their answer is negative.

589 EUR

A1

Note: Final answer must be to the nearest euro.

[3 marks]**Total [7 marks]**

10. (a) $m = 1 - 2.5 \log_{10}(0.0525)$ (M1)
 $= 4.20 \text{ (4.19960...)}$ A1

[2 marks]

(b) attempt to solve $7 = 1 - 2.5 \log_{10}(b)$ (M1)

Note: Accept a sketch from their GDC as an attempt to solve $7 = 1 - 2.5 \log_{10}(b)$.

$b = 0.00398 \text{ (0.00398107...)}$ A1

[2 marks]

(c) $\frac{0.0525}{0.00398107}$ (M1)
 $= 13.2 \text{ (13.1874...)}$ A1

[2 marks]

Total [6 marks]

11. (a) $4.5 = 2(r)^{3-1}$ **M1**
 $r = \pm 1.5$, **R1**
 (Some x -values are negative or direction from house changes each day)
 $r = -1.5$ **AG**

Note: Award **M0R0AG** for a verification approach $4.5 = 2(-1.5)^{3-1}$.

[2 marks]

- (b) $2(-1.5)^{6-1}$ **(M1)**
EITHER
 $(-15.2, 0)$ $(-15.1875..., 0)$ **A1**
OR
 $x = -15.2$ km **A1**
OR
 15.2 km west (of the origin) **A1**

Note: Award **(M1)A0** for an answer of “-15.2 (km)” without indicating that it is the x -value.

[2 marks]

- (c) choosing $r = 1.5$ **(A1)**

$$\frac{2((1.5)^7 - 1)}{1.5 - 1}$$
 (M1)

Note: Award **M1** for an attempt at a substituted GP formula with $n = 7$. Award **A0M1A0** for substitution of $r = -1.5$, with $n = 7$ (this can be implied from a final answer of 14.4687...).

64.3... km (64.3437...) **A1**

[3 marks]

Total [7 marks]

3. (a) $N = 24$

$$I = 4$$

$$PV = \pm 1000$$

$$PMT = \pm 100$$

$$P/Y = 12$$

$$C/Y = 12$$

(M1)(A1)

Note: Award **M1** for an attempt to use a financial app in their technology (i.e. at least three entries seen, but not necessarily correct).

Approaches that use the compound interest formula receive no marks.

Award **A1** for correct values of PV and PMT (signs must be the same) **and** a correct value of N .

$$FV = (\$)3577.43$$

A1

Note: Award at most **(M1)(A1)A0** if the final answer is negative or not rounded to 2 dp.

[3 marks]

(b) $N = 36.5$ (36.4689...)

(A1)

$$N = 37 \text{ (months)}$$

A1

Note: Allow **FT** from incorrect GDC inputs seen in part (a) for the first **A1** providing that PV and FV have opposite signs and the resulting value of N is positive.

[2 marks]

[Total: 5 marks]

8. (a) attempt to substitute 5000 for G (M1)

$$0.301p = \log_{10} 5000$$

$$(p =) 12.3 \text{ (bits)} \quad (12.2889\dots)$$

A1

[2 marks]

- (b) $(G =) 10^{0.301p}$ OR 2^p

A1

[1 mark]

- (c) attempt to substitute 28 for p in given equation or $G(p)$ (M1)

$$0.301 \times 28 = \log_{10} G \quad \text{OR} \quad (G =) 10^{0.301 \times 28}$$

$$(G =) 2.68 \times 10^8 \quad (2.67916\dots \times 10^8)$$

A1A1

Note: Award **A1** for 2.68, **A1** for 10^8 . Award **M1A1A0** for a correct final answer not written in scientific notation or written incorrectly in scientific notation (e.g., 268 000 000 or 26.8×10^7 or 2.68E08).

[3 marks]

- (d) if a password has an **entropy of 0** (bits), then the password
can be **guessed in one try** / then the **password is known**

R1

Note: Reference must be made to both entropy and number of guesses/password known for **R1** to be awarded.
Do not accept "no password" as this contradicts the context.

[1 mark]

Total [7 marks]

1. (a) attempt to substitute into percentage error formula **(M1)**
- $$\left| \frac{53632000 - 55625000}{55625000} \right| \times 100$$
- 3.58 (%) (3.58292...(%)) **A1**

Note: Award **(M1)A0** for a final answer of $-3.58(\%)$ or 0.0358 .

[2 marks]

- (b) (i) 278 000 000 **A1**

- (ii) 2.78×10^8 **A1A1**

Note: Award **A1** for correct mantissa, consistent with their answer in part (b)(i).
 Award **A1** for a correct exponent, consistent with their answer in part (b)(i).
 Award **A0A0** for answers such as 27.8×10^7 .

[3 marks]**Total [5 marks]**

2. (a) **METHOD 1 (use of financial app in GDC)**

$$\begin{array}{ll}
 N = 5 & \text{OR} & N = 20 \\
 I\% = 1.2 & & I\% = 1.2 \\
 PV = \pm 520 & & PV = \pm 520 \\
 P/Y = 1 & & P/Y = 4 \\
 C/Y = 4 & & C/Y = 4
 \end{array}$$

(M1)(A1)

Note: Award **M1** for evidence of using the financial app on the calculator, **A1** for all correct entries.

(\$) 552.11

A1

Note: Award at most **(M1)(A1)A0** if correct answer is not given to two decimal places.

METHOD 2 (use of formula)

attempt to substitute into compound interest formula

(M1)

$$520 \times \left(1 + \frac{1.2}{100 \times 4}\right)^{5 \times 4}$$

(A1)

(\$) 552.11

A1

Note: Award at most **(M1)(A1)A0** if correct answer is not given to two decimal places.

[3 marks](b) **EITHER**

$$\begin{array}{l}
 N = 5 \\
 I\% = 43.5 \text{ (43.4772...(\%))} \\
 PV = \pm 520 \\
 FV = \mp 30
 \end{array}$$

(M1)(A1)A1

Note: Award **M1** for evidence of using the finance app on the calculator, **A1** for all correct entries, **A1** for correct final answer. Condone missing -/+ sign if the correct final answer is seen.

OR

$$30 = 520 \left(1 - \frac{r}{100}\right)^5 \text{ (or equivalent)}$$

(M1)(A1)

$$(r =) 43.5\% \text{ (43.477...(\%))}$$

A1

Note: Award **M1** for using the compound interest formula, **A1** for correct substitutions and for equating to 30, **A1** for correct final answer. Accept $(r =) -43.5\%$. Award **M1A1A0** for a final answer of 56.5%.

[3 marks]**Total [6 marks]**

2. (a) recognizing arithmetic sequence (may be seen in part (b)) (M1)
 $(u_{12} =) 10 + (12 - 1) \times 6$ (A1)

76 A1
 [3 marks]

- (b) correct substitution into either arithmetic series formula (A1)

$$(S_{15} =) \frac{15}{2}(2 \times 10 + (15 - 1) \times 6) \quad \text{OR} \quad (S_{15} =) \frac{15}{2}(10 + 94)$$

780 A1
 [2 marks]

- (c) attempt to use either arithmetic series formula equated to 1000 (M1)

$$\frac{15}{2}(2 \times 10 + (15 - 1) \times x) = 1000 \quad \text{OR} \quad \frac{15}{2}(10 + u_{15}) = 1000$$

$x = 8.09523\dots$ (A1)
 $x = 9$ A1

Note: Follow through within question part for final **A1** for candidates correctly rounding their value of x up to the nearest integer. Award **(M0)(A0)A0** for a response of $x = 8$ with no working shown.

[3 marks]

- (d) recognizing geometric sequence (may be seen in part (e)) (M1)

$$17.1 \times 0.95^{5-1}$$

13.9 (cm)(13.9280...) (A1)
 A1
 [3 marks]

- (e) correct substitution into geometric series formula (A1)

$$\frac{17.1(1 - 0.95^{16})}{1 - 0.95}$$

191 (cm) (191.476...(cm)) A1
 [2 marks]

- (f) correct method to find u_0 (M1)

$$u_0 = 17.1 \times (0.95)^{0-1} \quad \text{OR} \quad 17.1 = 0.95x \quad \text{OR} \quad \frac{17.1}{0.95} \text{ (seen)}$$

Note: Award **(M0)A0** for any attempt to find answer using 0.05 or 1.05.

18 (cm) A1

[2 marks]
 Total [15 marks]

4. (a) (i) attempt to find 25% or 75% of 285000 (M1)
 285000×0.75
 213750 (ZAR) A1

Note: Do not award **A1** if answer is not given exact.

- (ii) $N = 60$
 $I\% = 4.5$
 $PV = (\pm) 213750$
 $FV = 0$
 $P/Y = 12$
 $C/Y = 12$ (M1)(A1)

Note: Award **M1** for an attempt to use a financial app in their technology with at least two entries seen, award **A1** for all entries correct.

$(PMT =) 3984.95$ (ZAR) A1

Note: Do not award final **A1** if answer is not given to 2 dp.

[5 marks]

- (b) 3984.95×60 (M1)
 239097 (ZAR) A1

Note: Do not award **A1** if answer is not given to the nearest rand, unless already penalized in part (a)(ii).

[2 marks]

- (c) $I\% = 4.5$
 $PV = (\pm) 213750$
 $PMT = (\mp) 4600$
 $FV = 0$
 $P/Y = 12$
 $C/Y = 12$ (A1)

Note: Award **A1** for $PMT = (\mp) 4600$.

$(N =) 52$ A1

[2 marks]

(d) **METHOD 1**

$$N = 51$$

$$I\% = 4.5$$

$$PV = (\pm) 213750$$

$$PMT = (\mp) 4600$$

$$P/Y = 12$$

$$F/Y = 12$$

(A1)**Note:** Award **A1** for $N = 51$ seen.

$$(FV \Rightarrow) 704.156\dots$$

A1valid attempt to find interest in final month (e.g. $N = 1$ **OR** $PV = 704.156\dots$) **(M1)**

$$N = 1$$

$$I\% = 4.5$$

$$PV = 704.16 \text{ (704.156\dots)}$$

$$FV = 0$$

$$P/Y = 12$$

$$F/Y = 12$$

$$(PMT \Rightarrow) 706.80 \text{ (ZAR)}$$

A1**Note:** Do not award **A1** if answer is not given correct to 2dp, unless already penalized previously.**[4 marks]****METHOD 2**

$$N = 52$$

$$I\% = 4.5$$

$$PV = (\pm) 213750$$

$$PMT = (\mp) 4600$$

$$P/Y = 12$$

$$F/Y = 12$$

(A1)**Note:** Award **A1** for $N = 52$ seen.

$$(FV \Rightarrow) 3893.20\dots$$

A1

$$4600 - 3893.20\dots$$

(A1)

$$(PMT \Rightarrow) 706.80 \text{ (ZAR)}$$

A1**Note:** Do not award **A1** if answer is not given correct to 2dp, unless already penalized previously.**[4 marks]**

(e) $51 \times 4600 + 706.80$ (M1)

235306.80

attempt to find difference between their value and their part (b) (M1)
(239097 – 235306.80)

3790 (ZAR) A1

Note: Do not penalize for not rounding to nearest rand if this has already been penalized in part (b).

[3 marks]
[Total 16 marks]

4. (a) (i) attempt to find 15% or 85% of 285000 (M1)
 285000×0.85
 242 250 (USD) A1

Note: Do not award **A1** if answer is not given exact.

- (ii) $N = 360$
 $I\% = 4$
 $PV = (\pm) 242\,250$
 $FV = 0$
 $P/Y = 12$
 $C/Y = 12$ (M1)(A1)

Note: Award **M1** for an attempt to use a financial app in their technology with at least two entries seen, award **A1** for all entries correct.

$(PMT =) 1156.54$ (USD) A1

Note: Do not award final **A1** if answer is not given to 2 dp.

[5 marks]

- (b) 1156.54×360 (M1)
 416354 (USD) A1

Note: Do not award **A1** if answer is not given to the nearest dollar, unless already penalized in part (a)(ii).

[2 marks]

- (c) $I\% = 4$
 $PV = (\pm) 242\,250$
 $PMT = (\mp) 1300$
 $FV = 0$
 $P/Y = 12$
 $C/Y = 12$ (A1)

Note: Award **A1** for $PMT = (\mp) 1300$

$(N =) 292$ A1

[2 marks]

(d) **METHOD 1**

$$N = 291$$

$$I\% = 4$$

$$PV = (\pm) 242\,250$$

$$PMT = (\mp) 1300$$

$$P/Y = 12$$

$$F/Y = 12$$

(A1)**Note:** Award **A1** for $N = 291$ seen.

$$(FV \Rightarrow) 871.91 \text{ (871.908...)}$$

A1valid attempt to find interest in final month (e.g. $N = 1$ **OR** $PV = 871.91$) **(M1)**

$$N = 1$$

$$I\% = 4$$

$$PV = 871.91 \text{ (871.908...)}$$

$$FV = 0$$

$$P/Y = 12$$

$$F/Y = 12$$

$$(PMT \Rightarrow) 874.82 \text{ (USD)}$$

A1**Note:** Do not award **A1** if answer is not given correct to 2dp, unless already penalized previously.**METHOD 2**

$$N = 292$$

$$I\% = 4$$

$$PV = (\pm) 242\,250$$

$$PMT = (\mp) 1300$$

$$P/Y = 12$$

$$F/Y = 12$$

(A1)**Note:** Award **A1** for $N = 292$ seen.

$$(FV \Rightarrow) 425.185...$$

A1

$$1300 - 425.185...$$

(A1)

$$(PMT \Rightarrow) 874.82 \text{ (USD)}$$

A1**Note:** Accept 874.81. Do not award **A1** if answer is not given correct to 2dp, unless already penalized previously.**[4 marks]**

(e) $291 \times 1300 + 874.82$ (M1)

379174.82

attempt to find difference between their value and their part (b) (M1)
(416354 – 379174.82)

37179 (USD) A1

Note: Accept 37180 (USD) from using the 2 dp. answer from part (b). Do not penalize for not rounding to nearest dollar if this has already been penalized in part (b).

[3 marks]
[Total 16 marks]

3. (a) attempt to substitute into geometric sequence formula for twelfth term **OR**
at least three correct terms of the sequence **(M1)**

$$u_{12} = 40 \times 1.1^{12-1} \quad \text{OR} \quad 40, 44, 48.4 \dots$$

$$114 \quad (114.124\dots)$$

A1**[2 marks]**

- (b) (i) attempt to substitute into the geometric series formula **OR**
a sum of at least the first three terms **(M1)**

$$S_{12} = \frac{40(1.1^{12} - 1)}{1.1 - 1} \quad \text{OR} \quad \sum_1^{12} (40 \times 1.1^{n-1}) \quad \text{OR} \quad 40 + 44 + 48.4 + \dots$$

Note: Award **M1** for $u_1 = 40$ and $r = 1.1$ seen as part of a geometric series formula, or **M1** for sigma notation and their u_n formula (condone missing limits), or **M1** for the sum of at least the **correct** first three terms of the sequence.

$$S_{12} = 855 \quad (855.371\dots)$$

A1

- (ii) finding $S_{24} = 3539.89\dots$ or attempt to find the sum between u_{13} and u_{24} **(M1)**

Note: Award **M1** for $S_{24} = 3539.89\dots$ or sigma notation that includes correct limits and their u_n formula or a substituted geometric series formula that includes $125.537\dots$ and $n = 12$ or a list of terms that includes at least the 13th term and the 24th term.

$$3539.89\dots - 855.371\dots \quad \text{OR} \quad \sum_{13}^{24} (40 \times 1.1^{n-1}) \quad \text{OR}$$

$$(S_{13 \text{ to } 24} =) \frac{125.537\dots(1.1^{12} - 1)}{1.1 - 1} \quad \text{OR} \quad 125.537 + \dots + 358.172\dots \quad \text{(A1)}$$

Note: Accept a calculation using $u_{13} = 125$ or 126.

$$2680 \quad (2684.52\dots, 2685)$$

A1

Note: For $u_{13} = 125$, the sum is $2673.03\dots$ and for $u_{13} = 126$, the sum is $2694.41\dots$

[5 marks]**[Total: 7 marks]**

5. (a) EITHER

$$N = 96$$

$$PV = \mp 100000$$

$$FV = \pm 150000$$

$$P/Y = 12$$

$$C/Y = 12$$

(M1)(A1)**OR**

$$N = 8$$

$$PV = \mp 100000$$

$$FV = \pm 150000$$

$$P/Y = 1$$

$$C/Y = 12$$

(M1)(A1)**OR**

$$150000 = 100000 \left(1 + \frac{I}{100 \times 12} \right)^{12 \times 8}$$

(M1)(A1)

Note: Award **M1** for an attempt to use a financial app (at least 3 entries, not necessarily correct) or an attempt to use a compound interest formula.
Award **A1** for all entries correct in financial app or correct substitution in compound interest formula.

THEN

$$I = 5.08 \text{ (5.07903...)}$$

A1**[3 marks]****(b) $N = 120$**

$$I\% = 6.1$$

$$PV = \mp 150000$$

$$PMT = \pm 1000$$

$$P/Y = 12$$

$$C/Y = 12$$

(M1)(A1)

Note: Award **M1** for an attempt to use a financial app (at least 3 entries, not necessarily correct). Award **A1** for all entries correct in financial app (condone missing -/+ sign if the correct final answer is seen).

$$FV = (\$) 110867$$

A1

Note: Answer must be correct to nearest dollar to award the final **A1**. Award **(M1)(A1)A0** for an unsupported final answer to a greater degree of accuracy eg. (\$) 110866.70...
Award **M1A1A0** for a truncated answer of 110866 if no working is shown.

[3 marks]**[Total: 6 marks]**

5. (a) **EITHER**

$N = 72$

$N = 6$

$I = 1.25$

$I = 1.25$

$PV = -3000$

OR $PV = -3000$

$P/Y = 12$

$P/Y = 1$

$C/Y = 12$

$C/Y = 12$

(M1)(A1)**Note:** Award **M1** for attempt to use finance app on GDC, **A1** for all entries correct.**OR**

$$3000 \left(1 + \frac{1.25}{1200} \right)^{72}$$

(M1)(A1)**Note:** Award **M1** for using CI formula, **A1** for correct entries.**THEN**

$FV = (\$) 3233.53$

A1**Note:** Answer must be correct to 2 dp for the final **A1** to be awarded.**[3 marks]**(b) **EITHER**

$I = 1.25$

$I = 1.25$

$PV = -3000$

$PV = -3000$

$FV = 3550$

OR $FV = 3550$

$P/Y = 12$

$P/Y = 1$

$C/Y = 12$

$C/Y = 12$

(A1)**Note:** Award **A1** for all entries correct and opposite signs for PV and FV values.**OR**

$$3550 = 3000 \left(1 + \frac{1.25}{1200} \right)^{12N}$$

(A1)**Note:** Award **A1** for all entries correct.**THEN**

$N = 162 \text{ (161.686...)} \text{ (months)}$

A1**[2 marks]**

(c) 18450

A1**[1 mark]**

(d)

N = 96

I = 12.6

PV = −18450

FV = 0

P/Y = 12

C/Y = 12

OR

N = 96

I = 1.05

PV = −18450

FV = 0

P/Y = 1

C/Y = 1

(M1)(A1)

Note: Award **M1** for an attempt to use finance app on GDC, **A1** for N=96 ,
PV=−18450 and FV=0 ,

PMT = (\$) 306

A1

Note: The answer must be correct to the nearest dollar for the final **A1** to be awarded.

[3 marks]
[Total: 9 marks]

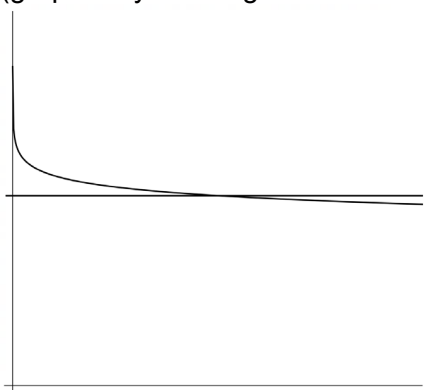
7. (a) correct substitution of 0.0003 into the formula (A1)
 $\text{pH} = -\log_{10}(0.0003)$
 $= 3.52 \quad (3.52287\dots)$ A1

[2 marks]

- (b) EITHER attempt to change to exponential form (M1)
 $[H^+] = 10^{-6.6}$

OR

- attempt to solve $6.6 = -\log_{10}[H^+]$ (M1)
 (graphically or using numerical solver)



THEN

- $[H^+] = 0.000000251$ (moles per litre) $(0.000000251188\dots, 2.51 \times 10^{-7})$ A1

Note: Award **M1A0** for an answer of 2.51 (2.51188...) seen. For an attempt to solve $6.6 = -\log_{10}[H^+]$, award **M0A0** if a substitution of 6.6 into the formula is seen without an answer or some indication of using numerical solver.

[2 marks]

- (c) $2 = -\log_{10}[H^+]$, $4.5 = -\log_{10}[H^+]$
 10^{-2} (0.01) OR $10^{-4.5}$ (0.0000316227...) (A1)

- substitution of their values into correct ratio (M1)

$$\frac{10^{-2}}{10^{-4.5}} \quad \text{OR} \quad \frac{0.01}{0.0000316227\dots}$$

$$= 316.227\dots = 316$$

A1

Note: Some candidates may subtract logs and hence look to solve $\log_{10}[H^+] = 2.5$.

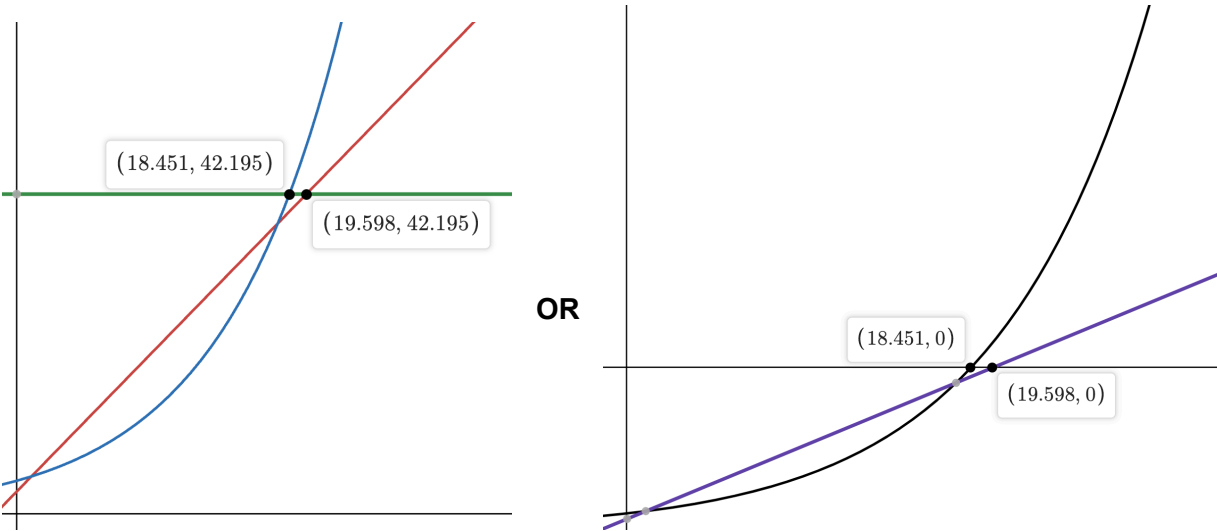
[3 marks]

[Total: 7 marks]

9. EITHER
- recognizing that Eefje's is an AP OR that Shumay's is a GP
- (M1)
- $42.195 = 5 + (n - 1)(2)$
- (A1)
- $n_E = 19.6 \text{ (19.5975...)} \text{ (accept 20)}$
- A1
- $42.195 = 5(1.13)^{n-1}$
- (A1)
- $n_S = 18.5 \text{ (18.4513...)} \text{ (accept 19)}$
- A1

OR (Graphical method)

e.g



Sketching a straight line (Eefje's) OR an exponential curve (Shumay's)

Note: The horizontal line (marathon length) does not need to be seen to be awarded the **M1**.

Horizontal line (marathon length) and Eefje's linear drawn
 x -coordinate of the point of intersection 19.6 (19.5975....)

(A1)
A1

Horizontal line (marathon length) and Shumay's curved drawn
 x -coordinate of the point of intersection 18.5 (18.4513....)

(A1)
A1

Note: A ruler does not need to be used for the lines.

THENso Shumay (will be the first to run the distance of a marathon) on day 19**A1**

Note: Award the final **A** mark for a correctly rounded-up integer value. **FT** from their n_E and n_s values. Award **A0** for a final result of “Shumay, day 19” if it is clear that Eefje/the AP has not been considered (either by finding the 19.5975, or by substituting $n = 19$ into AP and showing distance is less than marathon). Accept lists showing recognition that Eefje’s is an AP **OR** that Shumay’s is a GP **If trial and error method is used:** Award **A1A1** for finding the distance for Eefje on day $20 = 43$ and **A1A1** for finding the distance for Shumay on day $19 = 45.12$.

[Total: 6 marks]

3. (a) $7a + 60c = 832$ **A1**
 $3a + 5c = 108$ **A1**

Note: Award **A0A1FT** for correct equations but different variables such as x & y .

[2 marks]

- (b) (i) $(a =) 16$ **A1**

- (ii) $(c =) 12$ **A1**

[2 marks]

- (c) 202500 **A1**

[1 mark]

[Total 5 marks]

8. (a) recognition that % increase gives the common difference (M1)
 $18000 \times 0.04 = 720$ A1
 [2 marks]
- (b) $18000 + 720n > 32000$ OR $18000 + 720(n-1) > 32000$ (accept equality) (A1)
 attempt to solve their inequality OR equality (sketch OR cross-over values OR
 algebraic manipulation) (M1)
 $k = 20$ A1

Note: Award (A1)(M1)A0 for 19.4, 20.4 or 21 seen.
--

[3 marks]
 [Total: 5 marks]

10. (a) $N = 96, I = 3.8, PV = +300\,000, PMT = -2800, P/Y = 12, C/Y = 12$ (M1)(A1)

Note: Award **M1** for use of Finance solver with any 2 entries correct, Award **A1** for all correct.

$FV = \$92\,800 \text{ } (\$92\,828.2\dots)$ **A1**
[3 marks]

(b) $I = 3.8, PV = +300\,000, PMT = -2800, FV = 0, P/Y = 12, C/Y = 12$ (A1)(A1)

Note: Award **A1** for $FV = 0$, award **A1** for all correct.

$N = 131 \text{ (months)}$ **A1**
[3 marks]
[Total 6 marks]

13. (a)

recognizing sequence is geometric (e.g. $r = 2$ seen anywhere)

(M1)
- $u_9 = 1250 \times 2^{9-1}$
- 320000

A1
- $1250 \times 2^{k-1}$

A1

n	1	2	3	9	k
Time in minutes	10	20	30	90	$10k$
Number of bacteria u_n	1250	2500	5000	320000	$1250 \times 2^{k-1}$

[3 marks]

- (b) (i)

$(n =) 11$

A1
- (ii)

METHOD 1

recognition of summation of sequence

(M1)

$(S_{10} =) \frac{1250(2^{10} - 1)}{2 - 1} (= 1278750)$

(A1)

1279000

A1
- METHOD 2

all of the bacteria must come from divisions, apart from initial

(M1)

$1.28 \times 10^6 - 1250$

(A1)

1279000

A1

Note: Final answer must be to the nearest thousand to earn the final **A1**.

Award **(M1)(A1)A0** for a final answer of 1280000 without working.

[4 marks]
[Total 7 marks]

3.

(a)

$6a + 50c = 1292$
 $2a + 3c = 130$

A1
A1

Note: Award **A0A1FT** for correct equations but different variables such as x & y .

[2 marks]

- (b)

(i)

$(a =) 32$

A1
- (ii)

$(c =) 22$

A1

[2 marks]

- (c)

100500

A1
[1 mark]
- Total 5 marks

8.

(a)

recognition that % increase gives the common difference
 $25000 \times 0.05 = 1250$
- (M1)

A1

[2 marks]
- (b)

$25000 + 1250n > 44000$ **OR** $25000 + 1250(n - 1) > 44000$ (accept equality)
attempt to solve their inequality **OR** equality (sketch **OR** cross-over values
OR algebraic manipulation)
 $k = 16$
- (M1)

A1

Note: Award (A1)(M1)A0 for 15.2, 16.2 or 17 seen.

[3 marks]

[Total: 5 marks]

10. (a) $N = 60, I = 4.5, PV = +400\,000, PMT = -3600, P/Y = 12, C/Y = 12$ (M1)(A1)

Note: Award **M1** for use of Finance solver with any 2 entries correct.

$FV = \$259\,000 (\$258\,994)$ **A1**
[3 marks]

(b) $I = 4.5, PV = +400\,000, PMT = -3600, FV = 0, P/Y = 12, C/Y = 12$ (A1)(A1)

Note: Award **A1** for $FV = 0$, award **A1** for all correct.

$N = 144$ **A1**
[3 marks]
[Total 6 marks]

13. (a) recognizing sequence is geometric (e.g. $r = 2$ seen anywhere) (M1)
- $u_9 = 1250 \times 2^{9-1}$
- 320000 A1
- $1250 \times 2^{k-1}$ A1

n	1	2	3	9	k
Time in minutes	10	20	30	90	$10k$
Number of bacteria u_n	1250	2500	5000	320000	$1250 \times 2^{k-1}$

[3 marks]

- (b) (i) ($n =$) 11 A1
- (ii) METHOD 1
- recognition of summation of sequence (M1)
- $(S_{10} =) \frac{1250(2^{10} - 1)}{2 - 1} (= 1278750)$ (A1)
- 1279000 A1
- METHOD 2
- all of the bacteria must come from divisions, apart from initial (M1)
- $1.28 \times 10^6 - 1250$ (A1)
- 1279000 A1

Note: Final answer must be to the nearest thousand to earn the final **A1**.

Award **(M1)(A1)A0** for a final answer of 1280000 without working.

[4 marks]
[Total 7 marks]

3. (a) (i) $x + 6y + 12z = 383$

M1A1

Note: Award **M1** for at least one correct term other than x **and** equating to 383, **A1** for correct equation.

(ii) $4.50x + 23.50y + 44.75z = 1486$

A1

Note: If no marks were awarded for part (i), award **M1** for at least one correct term **and** equating to 1486, **A1** for correct equation.

[3 marks]

- (b) **EITHER**
 attempt to solve the simultaneous equations
 e.g., $(x =) 53$ or $(y =) 15$ or $(z =) 20$

(M1)

OR
 elimination of a variable using algebraic method

(M1)

THEN
 15 (boxes)

A1

Note: The answer 15 must be identified as the final answer to award **A1**. Award **M1A0** if all 3 values are shown as the final answer.

[2 marks]

[Total: 5 marks]

– – / – \

1. (a) after 10 years

 N : 120 $I\%$: 3.6 PV : 0 PMT : (-)1500 P/Y : 12 C/Y : 12**(M1)(A1)**

Note: Award **(M1)** for an attempt to use a financial app in their technology with at least two entries seen, award **A1** for all entries correct except PV.

 FV : 216 278.58 (euros)**A1**

Note: Award **A0** for a negative answer or answer not given to 2 decimal places.

[3 marks](b) **METHOD 1 (C.I. formula)**

invests: 116 278.58

(M1)after 15 years: $116278.58 \times \left(1 + \frac{4.5}{400}\right)^{60}$ **(M1)(A1)** FV : 227 515.92 (euros)**A1**

Note: Award the first **M1** for subtracting *their* FV from part (a) even if the value of the investment is negative.

Award the second **M1** for use of the C.I. formula.Award first **A1** for all entries correct except PV.

Allow full follow through from part (a).

Award final **A0** for FV not given to 2 decimal places unless this has already been penalized in (a).

Accept 227 515.93 from use of unrounded value.

METHOD 2 (financial app)

invests: 116 278.58

(M1)**THEN****EITHER** N : 60 $I\%$: 4.5 PV : 116 278.58 PMT : 0 P/Y : 4 C/Y : 4**OR** N : 15 $I\%$: 4.5 PV : 116 278.58 PMT : 0 P/Y : 1 C/Y : 4**OR** N : 180 $I\%$: 4.5 PV : 116 278.58 PMT : 0 P/Y : 12 C/Y : 4**(M1)(A1)**

continued...

Question 1 continued

Note: Award the first **M1** for subtracting *their FV* from part (a) even if the value of the investment is negative.
Award **(M1)** for an attempt to use a financial app in their technology with a least two entries seen, award **A1** for all entries correct except *PV*.

THEN

FV: 227 515.92 (euros)

A1

Note: Award **A0** for a negative answer or answer not given to 2 decimal places unless already penalized in part (a).
Accept 227 515.93 from use of unrounded value.

[4 marks]
Total [7 marks]

3. (a) attempt to use geometric sequence formula (M1)
 200×1.15^{10} (A1)
 809.111
 809 (accept 810) A1
[3 marks]

Note: Award **M1A0A1** for 703 or 704 seen.
 If list used award **M1** for list of at least 5 geometric terms; award **A1** for at least 5 correct terms.

- (b) $200 \times 1.15^{n-1} > 3000$ (accept as equation) (A1)

Note: Accept 3001 instead of 3000.
 The $200 \times 1.15^{n-1} > 3000$ may be seen as a graph sketch.

$n = 20.3761...$ (A1)
 20th week (of observation) A1

OR

use of table
 $200 \times 1.15^{n-1} > 3000$ (accept as equation) (A1)
 $200 \times 1.15^{19} = 2846.35...$ **AND** $200 \times 1.15^{20} = 3273.30...$ (A1)
 20th week (of observation) A1

[3 marks]

Total [6 marks]

6. use of $\text{speed} = \frac{\text{distance}}{\text{time}}$ **OR** $\text{speed} \times \text{time} = \text{distance}$ **OR** $\text{time} = \frac{\text{distance}}{\text{speed}}$

seen anywhere

(M1)

attempt to find a bounding value of t (**OR** use appropriate values of t that support and contradict the statement that the car is speeding)

(M1)

$(t =) 1.25(\text{s})$ **OR** $(t =) 1.15(\text{s})$

(A1)

THEN

EITHER

use of their upper bound for t to find minimum speed (**OR** of any value of t where $1.20481... < t \leq 1.25$ to find speed)

$(\text{speed} =) \frac{10}{1.25}$ (or $\frac{10}{\text{their time}}$)

A1

$(\text{speed} =) 8(\text{ms}^{-1})$ (or a value where $8 \leq \text{speed} < 8.3$) seen

hence $\text{speed} < 8.3(\text{ms}^{-1})$

A1

OR

use of their upper bound for t to find maximum distance (**OR** of any value of t where $1.20481... < t \leq 1.25$ to find distance)

$(\text{distance} =) 8.3 \times 1.25$ (or $8.3 \times \text{their time}$)

A1

$(\text{distance} =) 10.375 \text{ m}$ (or a value where $10 < \text{distance} \leq 10.375$) seen

hence $\text{distance} > 10(\text{m})$

A1

OR

time taken at speed limit $(\text{time} =) \frac{10}{8.3}$

A1

$(\text{time} =) 1.20481...(\text{s})$

hence time of $1.2(\text{s})$ to the nearest $0.1(\text{s})$ could be greater than or less than this

A1

THEN

conclusion: it is not certain that the car was exceeding the speed limit.

A1

Note: The conclusion must have been justified by further showing that for some appropriate value of t the car is speeding

Award at most **M1M1A0A1A0A1** for the use of a value of t where $t > 1.25$

Award at most **M1M0A0A0A0A1** for $t = 1.2$ used with a corresponding justified conclusion.

Total [6 marks]

Q7.**(a)** attempt to substitute the given values in the function**(M1)**

$$(L =) 10 \log_{10} \left(\frac{10^{-5}}{10^{-12}} \right)$$

$$= 70(\text{dB})$$

A1**[2 marks]**

$$(b) \quad 185 = 10 \log_{10} \left(\frac{I}{10^{-12}} \right)$$

(A1)

attempt to solve their logarithmic equation using graph, solver or analytically

(M1)

$$I = 3160000 (\text{Wm}^{-2}) (3162277.66)$$

$$I = 3.16 \times 10^6 (3.16227... \times 10^6)$$

A1

Note: Award at most **A1M1A0** or **A0M1A1FT** for an incorrect answer written correctly in the required form.

[3 marks]**Total [5 marks]**

Q11.

(a) evidence of correct method

(M1)

$$N = 300, I\% = 4.2, PV = \mp 50000, FV = 0, P/Y = 12, C/Y = 12 \text{ OR } 269.4711 \text{ seen}$$

Note: Award **M1** for using the financial app on their GDC with at least 2 correct entries.

269.47(euros)

A1

Note: Award at most **(M1)A0** for -269.47 . Accept 269.48.

[2 marks](b) (i) evidence of correct method $N = 96$ **(M1)**

$$N = 96, I\% = 4.2, PV = \mp 50000, PMT = \pm 269.47, P/Y = 12, C/Y = 12$$

OR

$$N = 96, I\% = 0.35, PV = \mp 50000, PMT = \pm 269.47, P/Y = 1, C/Y = 1$$

Note: Award **M1** for using the financial app on their GDC with at least 2 correct entries.

39, 243.42

A1

Note: Accept 39,243.29 which results from the full calculator value for the payment in part (a). Accept 39,243.28 which results from the use of 269.48.

Note: If two decimal place accuracy was penalised in part (a) do not penalise again.

(ii) **METHOD 1**

$$\text{full payment } 12 \times 25 \times 269.47 = 80,841.00$$

(A1)

$$\text{actual payment } 12 \times 8 \times 269.47 + 39243.42$$

(M1)

$$= 65, 112.54$$

(A1)

$$\text{money saved} = 15,700 \text{ (15,728.46) (euros)}$$

A1

Note: Accept 15,728.59 from using 269.47 from part (a) and 39,243.29 from part (b)(i).
Accept 15,730.64 from using 269.48 from part (a) and 39,243.28 from part b(i).

continued

*Question 11 continued***METHOD 2**

if Sophie did not pay back the loan early her subsequent payments
would be $269.47 \times 12 \times 17$

(M1)

Note: Award **M1** for attempting to find the remaining amount to pay if loan not paid back.

$= 54971.88$ (euros)

(A1)

money saved is therefore
 $54971.88 - 39243.42$

(M1)

$= 15,700(15,728.46)$ (euros)

A1**[6 marks]****Total [8 marks]**

2. (a) **EITHER**

$$N = 72$$

(M1)(A1)

$$I\% = 3.4$$

$$PV = \pm 10\,000$$

$$P/Y = 12$$

$$C/Y = 12$$

Note: Award **M1** for an attempt to use a financial app in their technology (i.e., at least three entries seen, but not necessarily correct), **A1** for all entries correct.

OR

$$N = 72$$

(M1)(A1)

$$I\% = 3.4/12$$

$$PV = \pm 10\,000$$

$$P/Y = 1$$

$$C/Y = 1$$

Note: Award **M1** for an attempt to use a financial app in their technology (i.e., at least three entries seen, but not necessarily correct), **A1** for all entries correct.

OR

attempt to substitute into the compound interest formula

(M1)

$$FV = 10\,000 \times \left(1 + \frac{3.4}{100 \times 12}\right)^{6 \times 12}$$

(A1)**THEN**

$$(FV =) 12\,259 \text{ (CAD)}$$

A1
[3 marks]

(b) 212 741 (CAD)

A1
[1 mark]

– 10 –

2225 – 7310M

- (c) $N = 180$ (M1)(A1)(A1)(A1)
 $FV = 0$
 $I\% = 6.4$
 $PV = \pm 212\,741$
 $P/Y = 12$
 $C/Y = 2$

Note: Award **M1** for attempt to use a financial app with at least three entries seen, but not necessarily correct, **A1** for N and I , **A1** for P/Y and C/Y , **A1** for their PV from (b) and $FV = 0$. Approaches that use the compound interest formula receive no marks.

$(PMT =) 1832$ (CAD)

A1

Note: Accept -1832 (CAD).

[5 marks]

- (d) (i) $N = 36$ (M1)(A1)
 $PV = \pm 194\,572$
 $PMT = 2200$

Note: Award **M1** for adjusting at least one of N , PV , or PMT ; **A1** for correct entries (PV and PMT must have opposite signs). Allow **FT** from incorrect entries for P/Y and/or C/Y from part (c).

$(FV =) 148\,099$ (CAD)
 $(194\,572 - 148\,099)$

(A1)

$46\,473$ (CAD)

A1

- (ii) $2200 \times 12 \times 3 (= 79\,200)$ (A1)
 $(79\,200 - 46\,473 =)$

$32\,727$ (CAD)

A1**[6 marks]****Total [15 marks]**

3. (a) **EITHER**

The ratio of consecutive terms is constant.

R1**OR**

Each term of the sequence is found by multiplying the previous term by a constant.

R1

Note: Do not accept “it has a common ratio” unless it is stated or illustrated that the ratio is between consecutive terms. Do not accept “because $r = 1.05$ ” or “because each subsequent day that he runs he increases his distance by 5%” for the explanation. The explanation must refer to a constant ratio or repeated multiplication by a constant.

THEN

$$r = 1.05$$

A1

Note: Award **R0A1** for $r = 1.05$ seen with incorrect or no explanation.

[2 marks]

- (b) attempt to substitute into the sum formula for geometric sequence **OR**
 attempt to write the sum in sigma notation using the term formula **OR** a sum of geometric sequence terms **(M1)**

$$(S_{15} =) \frac{2(1.05^{15} - 1)}{1.05 - 1} \quad \text{OR} \quad \sum_1^{15} (2 \times 1.05^{n-1}) \quad \text{OR} \quad 2 + 2 \times 1.05 + 2 \times 1.05^2 + \dots$$

$$43.2 \text{ (km)} \quad (43.1571\dots \text{ (km)})$$

A1
[2 marks]

- (c) choosing $n = 36$ **(A1)**

attempt to substitute into term formula for geometric sequence **(M1)**

$$(u_{36} =) 2 \times 1.05^{36-1}$$

$$11.0 \text{ (11.0320\dots)} > 5 \times 2 \quad \text{OR} \quad 11.0 \text{ verbally compared to } 5 \times 2$$

A1

Note: Award at most **A1M1A0** if a final distance (11.0 or 11) is not given or if the comparison to 10 (5×2) is not shown. Accept 11 for u_{36} (correct 2sf answer).

[3 marks]

- (d) (i) recognition of swimming out and back **AND/OR** swimming two times per week (M1)
 $(u_1 =) 80 \times 2 \times 2$

$$(u_1 =) 320 \text{ (m)} \quad \text{A1}$$

- (ii) attempt to substitute into term formula of arithmetic sequence (M1)

$$704 = 320 + (4 - 1) d \quad \text{OR} \quad \frac{704 - 320}{3} \quad \text{(A1)}$$

Note: Equating to 704 must be seen to award the (A1).

$$(d =) 128 \text{ (m)} \quad \text{A1}$$

- (iii) **METHOD 1: Using increased swimming distance**
 $(128 \div 2 \div 2 =) 32 \text{ (m) (further each week)}$ (A1)

$$(80 + 32 =) 112 \text{ (m) (from the shore in week 2)} \quad \text{A1}$$

- METHOD 2: Using total swimming distance for week 2**
 $(320 + 128 =) 448 \text{ (m) (swam in week 2)}$ (A1)

$$(448 \div 2 \div 2 =) 112 \text{ (m) (from the shore in week 2)} \quad \text{A1}$$

[7 marks]

- (e) **METHOD 1: Using sequence for distance swam per week (i.e. 320, 448, 576...)**
 attempt to substitute *their* answers from (d)(i) and (d)(ii) into term formula (M1)

$$(u_{12} =) 320 + (12 - 1) \times 128$$

$$1728 \text{ (m) (for the week)} \quad \text{(A1)}$$

$$864 \text{ (m) (on a day in week 12)} \quad \text{A1}$$

- METHOD 2: Using a sequence (t_n) for distance swam per day each week**
(i.e. 160, 224, 288...)

$$\text{recognizing } t_1 = 160 \text{ and } d = 64 \quad \text{(A1)}$$

$$\text{attempt to substitute 160 and 64 into term formula} \quad \text{(M1)}$$

$$(t_{12} =) 160 + (12 - 1) \times 64$$

$$864 \text{ (m) (on a day in week 12)} \quad \text{A1}$$

- METHOD 3: Using a sequence (v_n) for distance of marker from shore each week**
(i.e. 80, 112, 144...)

$$\text{attempt to substitute 80 and 32 into term formula} \quad \text{(M1)}$$

$$(v_{12} =) 80 + (12 - 1) \times 32$$

$$\text{(marker is) } 432 \text{ (m) (from shore)} \quad \text{(A1)}$$

$$(432 \times 2 =) 864 \text{ (m) (on a day in week 12)} \quad \text{A1}$$

[3 marks]

[Total: 17 marks]

1. (a) (i) 7 A1
 (ii) 9 A1
[2 marks]
 (b) (i) 2 A1
 (ii) $1 + 2(n-1) (= 2n-1)$ (M1)A1

Note: (M1) for substituting their (b)(i) into the arithmetic sequence formula.

- (c) (i) 17 [3 marks] A1
 (ii) $\frac{9}{2}(1+17)$ OR $\frac{9}{2}(2 \times 1 + (9-1) \times 2)$ OR $1 + 3 + \dots + 15 + 17$ (M1)
 $= 81$ A1

- (d) $\frac{n}{2}(1 + (2n-1))$ OR $\frac{n}{2}(2 \times 1 + (n-1) \times 2)$ [3 marks] (M1)
 $= n^2$ A1

- (e) 10 [2 marks] A1

- (f) $1 + 2 + 3 + \dots + n$ [1 mark] (M1)
 $= \frac{n}{2}(1 + n)$ A1

Note: Award (M1) for attempt for use of sum to n terms of an arithmetic sequence.

- (g) $\frac{n(1+n)}{2} + \frac{n(n-1)}{2}$ [2 marks] M1

Note: Award M1 for addition of answers to parts (f) and given expression.

$$= \frac{n}{2}[(1+n) + (n-1)] \quad \text{OR} \quad \frac{n + n^2 + n^2 - n}{2} \quad \text{M1}$$

Note: Award M1 for valid non-trivial attempt at further simplification of their sum.

$$= \frac{n}{2}(2n) \quad \text{OR} \quad \frac{2n^2}{2} \\ = n^2 \quad \text{A1}$$

Note: Award a maximum of M1M1A0 for ft from an incorrect part (f).

[3 marks]
Total [16 marks]

Q1.

- (a) (i) 60 (USD) **A1**
- (ii) attempt to substitute into the arithmetic sequence formula **(M1)**
 $(u_{10} =)(200 + 9 \times 60)$
 740 (USD) **A1**

[3 marks]

- (b) attempt to substitute into the sum of an arithmetic sequence formula **M1**

$$\frac{n}{2}(2 \times 200 + (n-1) \times 60) \quad \mathbf{A1}$$

$$5000 + \frac{n}{2}(400 + 60n - 60) \quad \mathbf{A1}$$

$$5000 + \frac{n}{2}(340 + 60n) \quad \mathbf{AG}$$

Note: Award **A1** for adding 5000 and a correct step in simplifying the expression which leads to the given answer. The final line need not be seen. Award **MOA0A0** if the student works backwards, i.e. $5000 + \frac{10}{2}(340 + 60 \times 10)$.

[3 marks]

- (c) attempt to substitute $n = 10$ into $5000 + \frac{n}{2}(340 + 60n)$ **(M1)**

$$5000 + \frac{10}{2}(340 + 60 \times 10) \\ = 9700 \text{ (USD)} \quad \mathbf{A1}$$

[2 marks]

- (d) (i) $B = 1.065$ **A1**
- (ii) **EITHER**

use of their B from part (i), in given formula **(M1)**

$$(u_{11} =) 5000 \times 1.065^{10} \quad \mathbf{(A1)}$$

OR

$$N = 10, I\% = 6.5, PV = \pm 5000, P/Y = 1, C/Y = 1 \quad \mathbf{(M1)(A1)}$$

Note: Award **M1** for using the finance app on the GDC, **A1** for all correct entries.

continued...

Question 1 continued.

THEN

9390 (USD) (9385.68...)

A1

hence Account 1 > Account 2 (after 10 years) OR $9700 > 9390$

AG

Note: The given answer (Account 1 > Account 2) or numerical comparison must be seen to award final **A1**. Rounding of B to 1.07 (7% in TVM) will lead to Account 2 > Account 1. Award at most **M1A1A0**.
If $B = 6.5$, the final answer is 6.73×10^{11} . If $B = 0.065$, the final answer is 6.73×10^{-9} . These answers are unrealistic, award at most **M1A1A0**.

[4 marks]

(e) attempt at comparing the accounts after m years (e.g. graph, table, solver, etc..) **(M1)**

$$5000 \times 1.065^m > 5000 + \frac{m}{2}(340 + 60 \times m) \quad \textbf{(A1)}$$

$$(m =) 38.0462 \dots$$

$$(m =) 39 \text{ (years)}$$

A1

Note: Follow through in (e) for their equation (account 2), if explicitly seen in d(ii).

[3 marks]

(f) $FV = 58\,291.42 \dots$ after their 39 years **(A1)**

attempt to find the interest by subtracting 5000 from their FV after 39 years **(M1)**

$$58\,291.42 \dots - 5000$$

$$53\,291 \text{ (USD)}$$

A1

Note: Award at most **(A1)(M1)A0** if the final answer is not rounded to the nearest dollar.
Award at most **A0M1A0** for a non-integer exponent, even if it follows through from part (e).

[3 marks]

Total [18 marks]

1. (a) $(r =) 3$

A1
[1 mark]

(b) $(u_8 =) 2 \times 3^7$
4374 (accept 4370)

(A1)
A1
[2 marks]

(c) $(S_{10} =) \frac{2(3^{10}-1)}{3-1}$
59 048 (accept 59000)

(A1)
A1
[2 marks]
Total [5 marks]

2. (a) (i) 8.35 (cm)

A1

(ii) $\frac{4\pi(4.175)^3}{3}$

(A1)(M1)

Note: Award **A1** for their correct radius or a correct calculation of the radius (i.e., $\frac{8.35}{2}$) seen.
Award **M1** for an attempt to substitute into the volume of sphere formula.

$305 \text{ (cm}^3\text{)} (304.830\dots, 97.0304\dots\pi)$

A1**[4 marks]**

(b) $\left| \frac{8.4 - 8.38}{8.38} \right| \times 100$

(M1)

0.239 (%) (0.238663...)

A1

Note: Award **M1** for an attempt to substitute both 8.4 and 8.38 into the percentage error formula.

[2 marks]**Total [6 marks]**

5. (a) $N = 120$
 $PV = \mp 10\,000$
 $PMT = \mp 800$
 $FV = \pm 160\,000$
 $P/Y = 12$
 $C/Y = 12$ **(M1)(A1)**

Note: Award **M1** for an attempt to use a financial app. Award **A1** for all entries correct in financial app. Approaches that use the compound interest formula receive no marks.

$(r =) 7.15\% \quad (7.14842\dots)$ **A1**
[3 marks]

(b) $160\,000 - 10\,000 - 10 \times 12 \times 800$ **(A1)(M1)**

Note: Award **A1** for $10 \times 12 \times 800 (= 96\,000)$ seen. Award **M1** for subtracting 10 000 **and** their total payments from 160 000.

$(\$)\,54\,000$ **A1**
[3 marks]
Total [6 marks]

1. (a) (i) 42 (km) A1

(ii) $(\varepsilon =) \left| \frac{42 - 42.19}{42.19} \right| \times 100\%$ (M1)

0.450 (%) (0.450343...(%)) A1

Note: Award (M1) for correct substitution of their part (a)(i) into percentage error formula.

[3 marks]

(b) **METHOD 1**

attempt to substitute into arithmetic sequence formula (M1)

$42 = 6 + (n - 1) \times 2$ **OR** $42 = 2n + 4$ (A1)

$(n =) 19$ A1

METHOD 2

list of any consecutive terms ending on/above 42 (M1)

at least two correct terms (not including 6, 8 and 10) (A1)

$(n =) 19$ A1

[3 marks]

(c) **METHOD 1**

$(S_{10} =) \frac{10}{2} (2 \times 6 + (10 - 1) 2)$ (A1)

150 (km) A1

METHOD 2

summing (some) correct terms up to 24 **OR** list of correct cumulative values (A1)

$6 + 8 + 10 + \dots + 24$ **OR** 6, 14, 24, 36....

150 (km) A1

[2 marks]

(d) METHOD 1

$$3(1.2)^{n-1} \quad (A1)$$

Note: Award **(A1)** for correct substitution into geometric sequence formula.

comparing their geometric expression to 42 **(M1)**

e.g. $3(1.2)^{n-1} > 42$ **OR** $3(1.2)^{n-1} = 42$

$(n =) 15.4747\dots$ seen **OR** $38.5175\dots$ and $46.2210\dots$ seen (from table) **(A1)**

16 (weeks) **A1**

METHOD 2

List of values see. At least 3, 3.6, 4.32 etc **(M1)(A1)**

$38.5175\dots$ and $46.2210\dots$ seen **(A1)**

16 (weeks) **A1**

[4 marks]

(e) METHOD 1

attempt to substitute into geometric series formula **(M1)**

Note: **FT** their r from (d).

$$150 < \frac{3(1-1.2^n)}{1-1.2} \quad \text{OR} \quad 150 = \frac{3(1-1.2^n)}{1-1.2} \quad \text{OR} \quad 13.1520\dots \quad (A1)$$

14 (weeks) **A1**

METHOD 2

evidence using tables in GDC or adding the first 14 terms **(M1)**

both crossover values seen, e.g $145.589\dots$ and $177.587\dots$ **(A1)**

14 (weeks) **A1**

[3 marks]

Total [15 marks]

