

Subject - Math AI(Standard Level)
Topic - Number and Algebra
Year - May 2021 - Nov 2024
Paper -1
Answers

Question 1

- (a) (i) $N = 24$
 $I\% = 14$
 $PV = -14000$
 $FV = 0$
 $P/Y = 4$
 $C/Y = 4$ **(M1)(A1)**
 $(€)871.82$ **A1**
- (ii) $4 \times 6 \times 871.82$ **(M1)**
 $(€)20923.68$ **A1**
- (iii) $20923.68 - 14000$ **(M1)**
 $(€)6923.68$ **A1**
- [7 marks]**
- (b) (i) $0.9 \times 14000 (= 14000 - 0.10 \times 14000)$ **M1**
 $(€)12600.00$ **A1**
- (ii) $N = 72$
 $PV = 12600$
 $PMT = -250$
 $FV = 0$
 $P/Y = 12$
 $C/Y = 12$ **(M1)(A1)**
 $12.56(\%)$ **A1**
- [5 marks]**

(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 ($72 \times 250 - 12600 = 5400$)

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) $14000 \left(1 - \frac{25}{100}\right)^6$

(M1)(A1)

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

= 2491.70 (USD)

A1

OR

N = 6

I% = -25

PV = ±14000

P/Y = 1

C/Y = 1

(A1)(M1)

Note: Award **A1** for PV = ±14000, **M1** for other entries correct.

2491.70 (USD)

A1

[3 marks]

Total [17 marks]

Question 2

(a) EITHER

$$N = 2$$

$$PV = -37000$$

$$I\% = 6.4$$

$$P/Y = 1$$

$$C/Y = 4$$

(M1)(A1)

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

OR

$$N = 8$$

$$PV = -37000$$

$$I\% = 6.4$$

$$P/Y = 4$$

$$C/Y = 4$$

(M1)(A1)

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

OR

$$FV = 37000 \times \left(1 + \frac{6.4}{100 \times 4}\right)^{4 \times 2}$$

(M1)(A1)

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

$$= 42010 \text{ AUD}$$

A1

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

[3 marks]

(b) EITHER

$$PV = -37000$$

$$FV = 50000$$

$$I\% = 6.4$$

$$P/Y = 1$$

$$C/Y = 4$$

(M1)(A1)

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

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

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

THEN

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

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

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]

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

$= 54\,000$ AUD A1

(ii) $N = 120$
 $PV = -150\,000$
 $PMT = 1700$
 $FV = 0$
 $P/Y = 12$
 $C/Y = 12$

(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.

$r = 6.46$ (%) (6.45779...) A1

[5 marks]

(e) $N = 60$
 $I = 6.46$ (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.

$FV = 86\,973$ AUD A1

[3 marks]

(f) $204\,000 - (60 \times 1700 + 86\,973)$ OR $204\,000 - 188\,973$ (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.

$15\,027$ AUD A1

[3 marks]

Total [19 marks]

Question 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 **MOA0** 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

$660 = 584 \times (1.012)^{x-1}$ A1
 $(x-1) = 10.3$ (10.2559...) A1
 $x = 11.3$ (11.2559...) A1
2030 A1

OR

$660 = 584 \times (1.012)^x$ A1
 $x = 10.3$ (10.2559...) A1
2030 A1

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
multiplying their sum by 50

(M1)

(M1)

OR

$$29200 \left(\frac{1.012^7 - 1}{1.012 - 1} \right)$$

(M1)(M1)

THEN

212000 (211907.3...)

A1

Note: Follow though from their r from part (b).

[4 marks]

Total [16 marks]

Question 4

(a) $\frac{12\,669 - 12\,300}{12\,300} \times 100$

3%

(M1)

A1

[2 marks]

(b) (i) 1.03

Note: Follow through from part (a).

A1

(ii) $(u_n =) 12\,300 \times 1.03^{n-1}$

A1

(iii) $(u_{11} =) 12\,300 \times 1.03^{10}$
16530

(M1)

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]

(e) $12300 \times 1.03^{n-1} < 10380 + 600(n-1)$ or equivalent (M1)

Note: Award **M1** for equating their expressions from parts (b) and (c).

EITHER

graph showing $y = 12300 \times 1.03^{n-1}$ and $y = 10380 + 600(n-1)$ (M1)

OR

graph showing $y = 12300 \times 1.03^{n-1} - (10380 + 600(n-1))$ (M1)

OR

list of values including, $(u_n =) 17537$ and $(v_n =) 17580$ (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]

Question 5

- (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]

- (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]

Question 6

(a) (i) **EITHER**

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

$$108 = u_1 + (8-1) \times d \quad (108 = u_1 + 7d)$$

(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 (cups/day)

A1

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

OR

$$(d =) \frac{115.5 - 108}{5}$$

(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) $(u_1 =) 118.5$ (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) $(t_5 =) 625 \times 1.064^{(5-1)}$

(M1)(A1)

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

\$ 801

A1

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

[3 marks]

(d) (i) ($S_{10} =$) (\$) 8390 (8394.39...) **A1**

(ii) **EITHER**

the total cost (of dog food)
for 10 years beginning in 2021 **OR** 10 years before 2031 **R1**
R1

OR

the total cost (of dog food)
from 2021 to 2030 (inclusive) **OR** from 2021 to (the start of) 2031 **R1**
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]

Question 7

- (a) recognizing arithmetic sequence (may be seen in part (b))

$$(u_{12} =) 10 + (12 - 1) \times 6$$

76

(M1)

(A1)

A1

[3 marks]

- (b) correct substitution into either arithmetic series formula

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

780

(A1)

A1

[2 marks]

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

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

$$x = 8.09523\dots$$

$$x = 9$$

(M1)

(A1)

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))

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

$$13.9 \text{ (cm)} (13.9280\dots)$$

(M1)

(A1)

A1

[3 marks]

- (e) correct substitution into geometric series formula

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

$$191 \text{ (cm)} (191.476\dots \text{(cm)})$$

(A1)

A1

[2 marks]

- (f) correct method to find u_0

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

(M1)

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

18 (cm)

A1

[2 marks]

Total [15 marks]

Question 8

- (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.

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

A1

valid 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]



Question 9

- (a) (i) attempt to find 15% or 85% of 285000 (M1)
 285000×0.85
242250 (USD) A1

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

- (ii) $N = 360$
 $I\% = 4$
 $PV = (\pm) 242250$
 $FV = 0$
 $P/Y = 12$
 $C/Y = 12$ (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) $I\% = 4$
 $PV = (\pm) 242250$
 $PMT = (\mp) 1300$
 $FV = 0$
 $P/Y = 12$
 $C/Y = 12$ (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.

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

A1

valid 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]

