**1.** (a) evidence of choosing the formula for 20th term (M1)

*e.g. u*20 = *u*1 + 19*d*

correct equation A1

*e.g. *

 *d* = 3 A1 N2 3

(b) correct substitution into formula for *un* A1

*e.g.* 3709 = 7 + 3(*n* – 1), 3709 = 3*n* + 4

*n* = 1235 A1 N1 2

[5]

**2.** (a) combining 2 terms (A1)

*e.g.* log3 8*x* – log3 4, log3*x* + log3 4

expression which clearly leads to answer given A1

*e.g.* 

*f*(*x*) = log3 2*x* AG N02

(b) attempt to substitute either value into *f* (M1)

*e.g.* log3 1, log3 9

*f*(0.5) = 0, *f*(4.5) = 2 A1A1 N33

(c) (i) *a* = 2, *b* = 3 A1A1 N1N1

(ii)


 A1A1A1 N3

**Note:** Award A1for sketch approximately through
 (0.5 ± 0.1, 0 ± 0.1)
 A1for approximately correct shape,
 A1for sketch asymptotic to the y-axis.

(iii) *x* = 0 (must be an equation) A1 N1

[6]

(d) *f*–1(0) = 0.5 A1 N1 1

(e)


 A1A1A1A1N44

**Note:** Award A1for sketch approximately through (0 ± 0.1,
 0.5 ± 0.1),
 A1for approximately correct shape of the graph
 reflected over y = x,
 A1for sketch asymptotic to x-axis,
 A1for point (2 ± 0.1, 4.5 ± 0.1) clearly marked **and** on curve.

[16]

**3.** (a) 12 terms A1 N1 1

(b) evidence of binomial expansion (M1)

*e.g.* , an attempt to expand, Pascal’s triangle

evidence of choosing correct term (A1)

*e.g.* 10th term, *r* = 9, (*x*)2 (2)9

correct working A1

*e.g.*  (*x*)2 (2)9, 55× 29

28160*x*2 A1N2 4

[5]

**4.** (a) common difference is 6 A1 N1

(b) evidence of appropriate approach (M1)
*e.g. un* = 1353

 correct working A1
*e.g.* 1353 = 3 + (*n* – 1)6, 
*n* = 226 A1 N2

(c) evidence of correct substitution A1
*e.g.* *S*226 = (2 × 3 + 225 × 6)
*S*226 = 153 228(accept 153 000) A1 N1

[6]

**5.** (a) evidence of equation for *u*27 M1
*e.g.* 263 = *u*1 + 26 × 11, *u*27 = *u*1 + (*n* – 1) × 11, 263 – (11 × 26)
*u*1 = –23 A1 N1

(b) (i) correct equation A1
*e.g.* 516 = –23 + (*n* – 1) × 11, 539 = (*n* – 1) × 11
*n* = 50 A1 N1

(ii) correct substitution into sum formula A1*e.g.* *S*50 = 
*S*50 = 12325 (accept 12300) A1 N1

[6]

**6.** evidence of substituting into binomial expansion (M1)
*e.g.* *a*5 + 
identifying correct term for *x*4 (M1)
evidence of calculating the factors, in any order A1A1A1 *e.g.* 

**Note:** AwardA1for each correct factor.

 term = 1080*x*4 A1 N2

**Note:** Award M1M1A1A1A1A0 for 1080 with working shown.

[6]

**7.** (a) *d* = 2 A1 N1

(b) (i) 5 + 2*n* = 115 (A1)

 *n* = 55 A1 N2

(ii) *u*1 = 7 (may be seen in above) (A1)

 correct substitution into formula for sum of arithmetic series (A1)*e.g. S*55 = 
*S*55 = 3355 (accept 3360) A1 N3

[6]

**8.** (a) attempt to substitute into sum formula for AP (accept term formula) (M1)*e.g.* *S*20 = 
setting up correct equation using sum formula A1
*e.g.* {2(–7) + 19*d*} = 620 A1 N2

(b) correct substitution *u*78 = –7 + 77(4) (A1)
= 301 A1 N2

[5]

**9.** (a) evidence of substituting into formula for *n*th term of GP (M1)
*e.g.* *u*4 = 
setting up correct equation  A1
*r* = 3 A1 N2

(b) **METHOD 1**

 setting up an inequality (accept an equation) M1*e.g.* 

 evidence of solving M1
*e.g.* graph, taking logs

 *n* > 7.9888... (A1)*n* = 8 A1 N2

 **METHOD 2**

 if *n* = 7, sum = 13.49...; if *n* = 8, sum = 40.49... A2

 *n* = 8 (is the smallest value) A2 N2

[7]

**10.** (a)  (accept 16 + 32 + 64 + 128) A1 N1

(b) (i) **METHOD 1**

 recognizing a GP (M1)*u*1 = 24, *r* = 2, *n* = 27 (A1)
correct substitution into formula for sum (A1)
*e.g.* *S*27 = 
*S*27 = 2147483632 A1 N4

 **METHOD 2**

 recognizing  (M1)
recognizing GP with *u*1 = 2, *r* = 2, *n* = 30 (A1)
correct substitution into formula for sum
*S*30 =  (A1)
= 2147483646
 = 2147483646 – (2 + 4 + 8)
= 2147483632 A1 N4

(ii) valid reason (*e.g.* **infinite** GP, diverging series), **and** *r* ≥ 1 (accept *r* > 1) R1R1 N2

[7]

**11.** **METHOD 1**

 substituting into formula for *S*40 (M1)correct substitution A1*e.g.* 1900 = 
*u*1 = –11 A1 N2

 substituting into formula for *u*40or *S*40 (M1)correct substitution A1*e.g.* 106 = –11 + 39*d*, 1900 = 20(–22 + 39*d*)
*d* = 3 A1 N2

 **METHOD 2**

 substituting into formula for *S*40 (M1)

 correct substitution A1*e.g.* 20(2*u*1 + 39*d*) = 1900
substituting into formula for *u*40 (M1)correct substitution A1
*e.g.* 106 = *u*1 + 39*d*
*u*1 = –11, *d* = 3 A1A1 N2N2

[6]

**12.** (a) evidence of dividing two terms (M1)

*e.g.* 

*r =*  0.6 A1 N2

(b) evidence of substituting into the formula for the 10th term (M1)

*e.g.* *u*10 = 3000( 0.6)9

*u*10 = 30.2 (accept the exact value 30.233088) A1 N2

(c) evidence of substituting into the formula for the infinite sum (M1)



*S* = 1875 A1 N2

[6]

**13.** evidence of using binomial expansion (M1)

*e.g.* selecting correct term, 

evidence of calculating the factors, in any order A1A1A1

*e.g.* 56, 

4032*x*3 (accept = 4030*x* 3 to 3 s.f.) A1 N2

[5]

**14.** (a) evidence of expanding M1*e.g.* (*x* – 2)4 = *x*4 + 4*x*3(–2) + 6*x*2(–2)2 + 4*x*(–2)3 + (–2)4

 (*x* – 2)4 = *x*4 – 8*x*3 + 24*x*2 – 32*x* + 16 A2 N2

(b) finding coefficients, 3 × 24 (= 72),4 × (–8)(= –32) (A1)(A1)term is 40*x*3 A1 N3

[6]

**15.** (a) Recognizing an AP (M1)
*u*1= 15 *d* = 2 *n* = 20 (A1)substitutinginto *u*20= 15 + (20 – 1) × 2 M1
= 53 (that is, 53 seats in the 20th row) A1 N2

(b) Substitutinginto *S*20 = (2(15) + (20 – 1)2) (or into (15 + 53)) M1
= 680 (that is, 680 seats in total) A1 N2

[6]

**16.** (a) 5000(1.063)*n* A1 N1

(b) Value = $ 5000(1.063)5 (= $ 6786.3511...)
= $ 6790 to 3 s.f. (accept $ 6786, or $ 6786.35) A1 N1

(c) (i) 5000(1.063)*n* > 10 000 or (1.063)*n* > 2 A1 N1

(ii) Attempting to solve the inequality *n*log(1.063) > log2 (M1)
*n* > 11.345 (A1)
12 years A1 N3

**Note:** Candidates are likely to use TABLE or LIST on a
 GDC to find n.
 A good way of communicating this is suggested below.

 Let *y* = 1.063*x* (M1)
When *x* = 11, *y* = 1.9582, when *x* = 12, *y* = 2.0816 (A1)*x* = 12 *i.e.* 12 years A1 N3

[6]

**17.** (a) (i) *r* = 2 A1 N1

(ii) *u*15 = 3 (2)14 (A1)

 = 49152 (accept 49200) A1 N2

(b) (i) 2, 6, 18 A1 N1

(ii) *r* = 3 A1 N1

(c) Setting up equation (or a sketch) M1

 (or correct sketch with relevant information) A1

*x*2 + 2*x* + 1 = 2*x*2 + 2*x*  24 (A1)

 *x*2 = 25

*x* = 5 or *x* = 5

 *x* = 5 A1 N2

**Notes**: If “trial and error” is used, work must be
 documented with several trials shown.
 Award full marks for a correct answer with this
 approach.
 If the work is **not** documented, award N2 for a
 correct answer.

(d) (i) *r* =  A1 N1

(ii) For attempting to use infinite sum formula for a GP (M1)

S = 

S = 16 A1 N2

**Note:** Award M0A0 if candidates use a value of r
 where r > 1, or r < 1.

[12]

**18.** ***Note:*** *Throughout this question, the first and last terms are
interchangeable.*

(a) For recognizing the arithmetic sequence (M1)

*u*1 = 1, *n* = 20, *u*20 = 20 (*u*1 = 1, *n* = 20, *d* = 1) (A1)

Evidence of using sum of an AP M1

*S*20 =  A1

*S*20 = 210 AG N0

(b) Let there be *n* cans in bottom row

Evidence of using *S*n = 3240 (M1)

*eg *

*n*2 + *n*  6480 = 0 A1

*n* = 80 or *n* = 81 (A1)

*n* = 80 A1 N2

(c) (i) Evidence of using *S = * (M1)

 2*S* = *n*2 + *n* A1

 *n*2 + *n*  2*S* = 0 AG N0

(ii) **METHOD 1**

Substituting *S* = 2100

*eg* *n*2 + *n*  4200 = 0, 2100 =  A1

**EITHER**

*n* = 64.3, *n* = 65.3 A1

Any valid reason which includes reference to integer being needed, R1

and pointing out that integer not possible here. R1 N1

 *eg* *n* must be a (positive) integer, this equation does not have
integer solutions.

**OR**

Discriminant = 16 801 A1

Valid reason which includes reference to integer being needed, R1

and pointing out that integer not possible here. R1 N1

 *eg* this discriminant is not a perfect square, therefore no
integer solution as needed.

**METHOD 2**

Trial and error

*S*64 = 2080, *S*65 = 2145 A1A1

 Any valid reason which includes reference to integer
being needed, R1

and pointing out that integer not possible here. R1 N1

[14]

**19.** (a) (i) $11400, $11800 (A1) 1

(ii) Total salary  (A1)

 = $128000 (A1) (N2) 2

(b) (i) $10700, $11449 (A1)(A1)

(ii) 10th year salary  (A1)

 = $18384.59 or $18400 or $18385 (A1) (N2) 4

(c) **EITHER**

Scheme A  (A1)

Scheme B  (A1)

Solving  (accept , giving **) (may be implied) (M1)

Minimum value of *n* is 7 years. (A1) (N2)

**OR**

Using trial and error (M1)

|  |  |  |
| --- | --- | --- |
|  | Arturo | Bill |
| 6 years | $72 000 | $71532.91 |
| 7 years | $85 400 | $86 540.21 |

(A1)(A1)

**Note:** Award (A1)for **bot**h values for 6 years, and (A1) for **both** values for 7 years.

Therefore, minimum number of years is 7. (A1) (N2) 4

[11]

**20.** (a) (i) Area B = , area C =  (A1)(A1)

(ii)  (Ratio is the same.) (M1)(R1)

(iii) Common ratio =  (A1) 5

(b) (i) Total area (*S*2) =  = (= 0.3125) (0.313, 3 sf) (A1)

(ii) Required area = *S*8 =  (M1)
 = 0.333328 2(471...) (A1)
 = 0.333328 (6 sf) (A1) 4

**Note:** Accept result of adding together eight areas correctly.

(c) Sum to infinity =  (A1)
 =  (A1) 2

[11]

**21.** (a) Ashley
 AP 12 + 14 + 16 + ... to 15 terms (M1)
 *S*15 = [2(12) + 14(2)] (M1)
 = 15 × 26
 = 390 hours (A1) 3

(b) Billie
 GP 12, 12(1.1), 12(1.1)2… (M1)

(i) In week 3, 12(1.1)2 (A1)
 = 14.52 hours (AG)

(ii) *S*15 =  (M1)
 = 381 hours (3 sf) (A1) 4

(c) 12 (1.1)*n*–1 > 50 (M1)
 (1.1)*n*–1 >  (A1)
(*n* – 1) ln 1.1 > ln
*n* – 1 >  (A1)
*n* – 1 > 14.97
 *n* > 15.97
 Week 16 (A1)

 **OR**12(1.1)*n*–1 > 50 (M1)
By trial and error
12(1.1)14 = 45.6, 12(1.1)15 = 50.1 (A1)
 *n* – l = 15 (A1)
 *n* = 16 (Week 16) (A1) 4

[11]

**22.** (a) (i) PQ =  (M1)
 =  =  = 2 cm (A1)(AG)

(ii) Area of PQRS = (2)(2) = 8 cm2 (A1) 3

(b) (i) Side of third square = = 4 = 2 cm
Area of third square = 4 cm2 (A1)

(ii)  (M1)
 Geometric progression, *r* =  (A1) 3

(c) (i) *u*11 = *u*1*r*10 = 16=  (M1)
 = ( = 0.015625 = 0.0156, 3 sf) (A1)

(ii) *S* =  =  (M1)
 = 32 (A1) 4

[10]

**23.** (a) *r* =  = 1.5 (A1) 1

(b) 2002 is the 13th year. (M1)
*u*13 = 160(1.5)13–1 (M1)
= 20759 (Accept 20760 or 20800.) (A1) 3

(c) 5000 = 160(1.5)*n*–1
 = (1.5)*n*–1(M1)
log = (*n* – 1)log1.5 (M1)
*n* – 1 =  = 8.49 (A1)
 *n* = 9.49  10th year
  1999 (A1)

 **OR**

 Using a gdc with *u*1 = 160, *uk*+1 = *uk*, *u*9 = 4100, *u*10 = 6150 (M2)
1999 (G2) 4

(d) *S*13 = 160 (M1)
= 61958 (Accept 61960 or 62000.) (A1) 2

(e) Nearly everyone would have bought a portable telephone so there
would be fewer people left wanting to buy one. (R1)

 **OR**

 Sales would saturate. (R1) 1

[11]

**24.** (a) Plan A: 1000, 1080, 1160... Plan B: 1000, 1000(1.06), 1000(1.06)2…
2nd month: $1060, 3rd month: $1123.60 (A1)(A1) 2

(b) For Plan A, T12 = *a* + 11*d*
 = 1000 + 11(80) (M1)
 = $1880 (A1)

 For Plan B, T12 = 1000(1.06)11 (M1)
 = $1898 (to the nearest dollar) (A1) 4

(c) (i) For Plan A, S12 = [2000 + 11(80)] (M1)
 = 6(2880)
 = $17280 (to the nearest dollar) (A1)

(ii) For Plan B, S12 =  (M1)
 = $16870 (to the nearest dollar) (A1) 4

[10]