Answers

Page 4

1. 33, 40, 47

2. $^{-}6, ^{-}15, ^{-}24$

3. 1215, 3645, 10 935

4. $\frac{1}{2}, \frac{^{-}1}{4}, \frac{1}{8}$ $(0.5, {}^{-}0.25, 0.125)$

5. 74, 107, 146

6. 125, 216, 343

7. 54, 27, 81

8. 972, 729, 546.75

9. $16a^5b, 32a^6b, 64a^7b$

10. $^{-}3, ^{-}1, 1$

11. $^{-}4, ^{-}1, 4$

12. 4, 16, 64

13. 6, 12, 20

14. 0, 4, 18

15. $^{-}4, 8, ^{-}12$

16. 1, 16, 49

17. $\frac{^{-}1}{2}, \frac{2}{3}, \frac{7}{4}$ $(^{-}0.5, 0.\dot{6}, 1.75)$

18. $\frac{^{-}5}{2}, \frac{^{-}11}{4}, \frac{^{-}17}{6}$

$(^{-}2.5, ^{-}2.75, ^{-}2.833)$

19. 6, 10, 14

20. 0, 3, 6

21. 11, 7, 3

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22. $a = 8, d = 5$

23. $a = 9, d = ^{-}6$

24. $a = 4.6, d = 1.2$

25. $a = 13, d = ^{-}9$

26. $a = ^{-}24, d = 6$

27. $a = ^{-}1.3, d = 2.4$

28. $^{-}2, 7, 16, 25$

29. $^{-}13, ^{-}17, ^{-}21, ^{-}25$

30. 3.8, 5.2, 6.6, 8.0

31. 42, 27, 12, $^{-}3$

32. $^{-}2.4, ^{-}1.7, ^{-}1.0, ^{-}0.3$

33. $^{-}15, ^{-}7, 1, 9$

34. $t_n = 9n - 7$

35. $t_n = ^{-}5n + 1$

Page 7 cont...

36. $t_n = 1.2n + 5.3$

37. $t_n = 7 + (n - 1)3$

$t_n = 3n + 4$

$t_{20} = 64$

38. $t_n = 18 + (n - 1)^{-}5$

$t_n = ^{-}5n + 23$

$t_{20} = ^{-}77$

39. $t_n = 19n + 28$

$t_{20} = 408$

40. $t_n = 4n - 10, t_{20} = 70$

41. $t_n = 18 - 7n, t_{20} = ^{-}122$

42. $t_n = \frac{n}{3} - \frac{1}{6}$

$t_{20} = \frac{13}{2}$ (6.5)

Page 8

43. $t_n = 3n + 8$

$3n + 8 = 116$

$n = 36$

44. $t_n = 2n + 29$

$2n + 29 = 55$

$n = 13$

45. $t_n = 4n + 11$

$4n + 11 = 231$

$n = 55$

46. $t_n = ^{-}9n + 97$

$^{-}9n + 97 = ^{-}119$

$n = 24$

47. $t_n = ^{-}6n - 37$

$^{-}6n - 37 = ^{-}337$

$n = 50$

48. $t_n = 2n + 3$

$2n + 3 = 1957$

$n = 977$

49. $6 + 7d = 34$

$d = 4$

Sequence $= 6, 10, 14, 18$

50. $12 + 14d = 124$

$d = 8$

Sequence $= 12, 20, 28, 36$

Page 8 cont...

51. $15 + 6d = 27$

$d = 2$

Sequence $= 5, 7, 9, 11$

52. $d = 10$

Sequence $= ^{-}40, ^{-}30, ^{-}20, ^{-}10$

53. $d = 3$

Sequence $= 23, 26, 29, 32$

54. $d = ^{-}15$

Sequence $= 120, 105, 90, 75$

55. $d = 20$

$a = 330$

$n = 20.5$

$n = 21$

(to be greater than 720)

56. $T_{13} = 2860$

$T_{14} = 2905$

Total $= 5765$

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57. a) $d = 120$

$a = 840$

b) $n = 11$

58. a) $d = 0.75$

$T_n = 26.75 + (n - 1)0.75$

$T_n = 0.75n + 26$

b) $T_{120} = \$116$

59. a) $T_n = 8 + (n - 1)1.5$

$T_n = 1.5n + 6.5$

b) $n = 33$

60. a) $d = ^{-}16$, $a = 256$ trees

b) $T_n = ^{-}16n + 272$

$n = 17$, $T = 0$ so

Last year is 2016.

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61. $S_{30} = \frac{30}{2}[2(6) + (30 - 1)5]$

$S_{30} = 2355$

62. $S_{25} = \frac{25}{2}[2(54) + (25 - 1)^{-}4]$

$S_{25} = 150$

63. $S_{50} = \frac{50}{2}[2(5.6) + (50 - 1)0.9]$

$S_{50} = 1382.5$

Page 11 cont...

64. $S_{101} = 26\,563$

65. $231 = 7n + 7$

$n = 32$

$S_{32} = 3920$

66. $^{-}581 = {}^{-}18n + 265$

$n = 47$

$S_{47} = {}^{-}7849$

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67. $n = 100$

$S_{100} = 5050$

68. $n = 1\,000\,000$

$S_{1\,000\,000} = 500\,000\,500\,000$

69. $n = 500$

$S_{500} = 250\,500$

70. $820 = \frac{n}{2}[6 + (n-1)4]$

$n = 20$

71. $n = 15$

72. $n = 177$

73. $n = 42$

74. $n = 30$

75. $n = 49$

76. $n = 5$ or 7

77. $n = 5$ or 17

Page 15

78. a) $t_n = 0.5n + 0.5$

$t_{10} = 5.5$ km

b) $42 = 0.5n + 0.5$

$n = 83$ (i.e. 83rd day)

c) $S_{83} = 1784.5$ km

d) 22nd August

79. a) \$182

b) $t_n = 0.1n + 0.9$

$t_{40} = \$4.90$

c) $S_{52} = \$184.60$. The best option is the AP by \$2.60.

d) Fixed = \$91, $S_{26} = \$58.50$ so fixed is best by \$32.50.

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80. $S_8 = 8760$

81. $n = 16$ years

82. $S_{20} = 6100$ g

$S_{20} = 6.1$ kg

83. $d = \frac{(304 - 220)}{7}$

$d = 12$ g

$S_{20} = \frac{20}{2}[2(172) + (20-1)12]$

$S_{20} = 5.72$ kg

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84. a) $t_n = {}^{-}400n + 23400$

$t_{12} = \$18\,600$

b) $15\,800 = {}^{-}400n + 23400$

$n = 19$ (i.e. day 19)

c) $12\,500 = {}^{-}400n + 23400$

$n = 27.25$ (i.e. day 28)

d) $0 = {}^{-}400n + 23400$

$n = 58.5$ (i.e. day 59)

85. a) $t_n = {}^{-}2n + 27$

When n = 1 represents 1-leaflets, n = 2 represents 501- leaflets etc.

$t_7 = 13$ cents

b) $5 = {}^{-}2n + 27$

$n = 11$ so 5001 leaflets

c) $S_7 = \$665$

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86. $3210 = a + 9d$

$89\,640 = 12(2a + 23d)$

$7470 = 2a + 23d$

Simultaneous eqns.

$d = 210$
$a = 1320$

First year \$1320

Page 18 cont...

87. $9650 = 500V + F$

$15\,837.5 = 1250V + F$

Simultaneous eqns.

$V = \$8.25$
$F = \$5525$

$15n = 8.25n + 5525$

$n = 818.51$

$n \geq 819$ units

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88. $a = 96$, $r = 0.5$

89. $a = {}^{-}4$, $r = {}^{-}1.5$

90. $a = 1.5$, $r = 2.5$

91. $\frac{1}{4}, \frac{1}{12}, \frac{1}{36}, \frac{1}{108}$

$t_n = \frac{1}{4} \times \left(\frac{1}{3}\right)^{n-1}$

92. $12, {}^{-}3, \frac{3}{4}, \frac{{}^{-}3}{16}$

$t_n = 12 \times \left(\frac{{}^{-}1}{4}\right)^{n-1}$

93. 10, 12, 14.4, 17.28

$t_n = 10 \times 1.2^{n-1}$

94. $t_n = 5 \times 2^{n-1}$

$t_{15} = 81\,920$

95. $t_n = 27 \times \left(\frac{1}{3}\right)^{(n-1)}$

$t_{15} = 0.000\,005\,645$

96. $t_n = 5 \times ({}^{-}3)^{n-1}$

$t_{15} = 23\,914\,845$

97. $t_n = 0.5 \times 6^{n-1}$

$t_{15} = 3.918208205 \times 10^{10}$

98. $t_n = 1024 \times (0.5)^{n-1}$

$t_{15} = 0.0625$

99. $t_n = {}^{-}36 \times \left(\frac{{}^{-}1}{4}\right)^{(n-1)}$

$t_{15} = {}^{-}0.000\,000\,134$
$({}^{-}1.34 \times 10^{-7})$

100. $8192 = 2 \times 2^{n-1}$

$n = 13$

101. $524\,288 = 8 \times 4^{n-1}$

$n = 9$

Page 21 cont...

102. $157\,837\,977 = 11 \times 3^{n-1}$
$n = 16$

103. $n = 7$

104. $n = 8$

105. $n = 6$

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106. $7r^3 = 189$
$r = 3$ Seq. <7, 21, 63, ...>

107. $256r^3 = 2048$
$r = 2$ Seq. <64, 128, 256, ...>

108. $r = \pm\frac{1}{4}$ (±0.25) and
$a = \pm 81\,920$
Seq. < $^{-}$81 920, $^{-}$20 480, $^{-}$5120, ..>
Seq. < $^{-}$81 920, 20 480, $^{-}$5120, ..>

109. $r = \frac{1}{9}$ Seq. <129 140 163, 14 348 907, 1 594 323, ...>

110. $r = \frac{2}{3}$ $(0.66\dot{6})$
Seq. <9, 6, 4, ...>

111. $r = ab$
Seq. <a, a^2b, a^3b^2, ...>

112. $t_{12} = 4.00 \times (1.15)^{12-1}$
$t_{12} = 18.61$ km

113. $t_{20} = 21.0 \times (1.18)^{20-1}$
$t_{20} = 487.5$ g

114. $t_n = 850 \times (0.95)^{n-1}$
$100 = 850 \times (0.95)^{n-1}$
$n - 1 = 41.7$, $n = 42.7$
Answer = 43.

115. If the wage increases by 3% per year then the hourly rate must increase by 3%. A 3% increase is the same as multiplying by a common ratio of 1.03.

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116. Over 21 years ago means he has had 20 increases at the constant ratio of 1.03.
$t_1 = 16.00 \div (1.03)^{20}$
$t_1 = \$8.86$ per hour

Page 23 cont...

117. $t_n = 8.86 \times (1.03)^{n-1}$

118. $30 \le 8.86 \times (1.03)^{n-1}$
$n \ge 42.3$
$n = 43$
Started work at 15 so he will retire at 58 years.

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119. $S_{10} = 5115$

120. $S_{16} = {}^{-}109\,225$

121. $S_8 = 1\frac{127}{128}$ (1.992 187 5)

122. $S_{20} = 67.50$ (4 sf)

123. $S_{16} = 5247$ (4 sf)

124. $S_{18} = 13.33$ (2 dp)

125. $S_{10} = 4.50$ (2 dp)

126. $S_{13} = 8.27$ (2 dp)

127. $S_{5001} = 1$

128. $n = 13$
$S_{13} = 2730\frac{1}{3}$ $(2730.\dot{3})$

129. $n = 7$
$S_7 = 64.00$ (2 dp)

130. $n = 8$
$S_8 = 1.275$

131. $S_5 = 15\,620$ words

132. $S_{10} = \$1\,432.91$

133. $S_{20} = 1\,373$ (0 dp) minutes

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134. $a = \$28\,656$
$S_{15} = \$642\,000$ (3 sf)

135. $a = 1320$
$t_{10} = 2639$

136. $t_n = 20 \times (1.1)^{n-1}$
$n = 11$
$S_{11} = 371$ km

137. $r = 0.794$
$a = 5.04$ kg
$S_8 = 20.6$ kg (3 sf)

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138. $S_\infty = 20$

139. $S_\infty = 6$

140. $S_\infty = 50$

Page 28 cont...

141. $S_\infty = \frac{189}{\left(1 - \frac{1}{3}\right)}$
$S_\infty = 283.5$

142. $S_\infty = 0.4$

143. $S_\infty = 14.29$ (2 dp)

144. $S_\infty = 56.89$ (2 dp)

145. $S_\infty = 0.\dot{3}\left(\frac{1}{3}\right)$

146. $S_\infty = 347.\dot{2}\left(347\frac{2}{9}\right)$

147. $r = \frac{2}{3}$, Seq. < 9, 6, 4, $\frac{8}{3}$, ...>

148. $r = \frac{^{-}5}{7}$,
Seq. <14, $^{-}$10, $7\frac{1}{7}$, $^{-}5\frac{5}{49}$, ...>
<14, $^{-}$10, 7.14, $^{-}$5.10, ...>

149. < 28.8, $^{-}$5.76, 1.152, $^{-}$0.2304, ...>

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150. $r = 0.4$, $a = 125$, $S_\infty = 208.\dot{3}$

151. $r = \frac{1}{4}$, $a = 16\,384$, $S_\infty = 21\,845.\dot{3}$

152. $r^2 = \frac{4}{9}$, $r = {}^{\pm}\frac{2}{3}$, $a = \pm 54$
when $r = \frac{2}{3}$, $S_\infty = 162$
when $r = \frac{^{-}2}{3}$, $S_\infty = {}^{-}32.4$

153. $r^6 = \frac{1}{4096}$, $r = {}^{\pm}\frac{1}{4}$, $a = 64$
when $r = \frac{1}{4}$, $S_\infty = 85.\dot{3}$
when $r = \frac{^{-}1}{4}$, $S_\infty = 51.2$

154. $a + ar = 40$
$a(1 + r) = 40$
$72 = \frac{a}{(1 - r)}$
$72 = \frac{40}{(1 + r)(1 - r)}$
$1 - r^2 = \frac{40}{72}$
$r^2 = \frac{4}{9}$
$r = {}^{\pm}\frac{2}{3}$
when $r = \frac{2}{3}$, $a = 24$
when $r = \frac{^{-}2}{3}$, $a = 120$

Page 29 cont...

155. $ar = 48$

$a = \frac{48}{r}$

$256 = \frac{a}{(1-r)}$

$256 = \frac{48}{(r-r^2)}$

$r - r^2 = \frac{3}{16}$

$0 = 16r^2 - 16r + 3$

$0 = (4r - 3)(4r - 1)$

$r = \frac{1}{4}$ or $\frac{3}{4}$

when $r = \frac{1}{4}$, $a = 192$

when $r = \frac{3}{4}$, $a = 64$

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156.a) 800 mm, 600 mm, 450 mm, 337.5 mm

b) Common ratio of $\frac{3}{4}$ (0.75)

c) 60 mm (2 sf)

d) $S_{10} = 3019.8$

Height = 1.5 m + 3.0198 m

= 4.520 m (4 sf)

e) $S_\infty = \frac{800}{1-0.75}$

$S_\infty = 3200$ mm

Max ht. = 1.5 m + 3.2 m

= 4.7 m

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157.a) 2000 m, 1600 m, 1280 m, 1024 m

b) 419 m (to the nearest m)

c) $S_{15} = 9648$ (4 sf)

Alt. = 9648 (nearest m)

d) $S_\infty = 10\,000$ m

Max = 10 000 m

Page 32 cont...

158.a) $S_n = \frac{a(1-r^n)}{1-r}$

$37\,000 < \frac{8000(1-0.8^n)}{1-0.8}$

$x < 11.6$ years

Answer keep it 11 years.

b) $S_\infty = 42\,000 - \frac{8000}{(1-0.8)}$

$= \$2\,000$

159.a) light = 112 000 + 448 000

= 560 000

b) $t_{10} = 448\,000 \times 0.25^9$

$t_{10} = 1.7$

= 2 (rounding up)

c) $S_\infty = 597\,333$

Total = 597 333

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160.a) $r = 0.700$ (3 sf)

b) $t_1 = 150\,000 \div 0.7^5$

$t_1 = 892\,500$ (4 sf)

c) $S_\infty = 2\,975\,000$ (4 sf)

161.a) $t_1 = \$1500$

b) $3000 = 1500r^4$

$r = 1.189\,2$ (4 sf)

1, 1.189 2, 1.414 2, 1.681 8, 2, ...

or \$1500, \$1784, \$2121, \$2523, \$3000 ...

A constant ratio of 1.189

c) $t_{47} = 1500 \times 1.1892^{46}$

= \$4 340 000 (3 sf)

162.a) $r^2 = \frac{246}{384}$

$r = 0.800$ (3 sf)

b) $t_1 = 384 \div 0.8^2$

$t_1 = 600$

c) $S_\infty = 3000$ (3 sf)

163.a) $r^4 = 0.5$

$r = 0.840\,896$

$T_1 = 14.14$ cm^2

b) $S_\infty = \frac{14.14}{(1-0.8409)}$

= 88.9 cm^2 (3 sf)

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164.a) $r = 0.320$ (3 sf)

$70 = 20120 \times 0.32^{n-1}$

$n = 6$

$S_6 = 29\,556$ (0 dp)

b) $S_\infty = 29\,588$

Left $= S_\infty - S_6$

Left = 32

165.a) $4000 = \frac{a}{(1-r)}$

$a = 4000(1 - r)$

$3212.5 = \frac{a(1-r^{10})}{1-r}$

Substitute for a.

$3212.5 = 4000(1 - r^{10})$

$r = 0.85$

b) $a = 600$ litres

166. $0.05 = 1 \times 0.65^n$

$n = 6.95$

Must use 7 mixes as you can have part of a mix.

Paint $= 2^7$

= 128 litres

167.

$\frac{20(1-1.04^n)}{1-1.04} < \frac{15(1-1.06^n)}{1-1.06}$

$n > 25.9$ sessions

Answer $n \geq 26$ sessions

Page 36

168. $^-1 + 3 + 7 + 11 + 15$

= 35

169. $2 + 5 + 10 + 17 + 26 + 37 + 50 + 65$

= 212

170. $3 + 4 + 5 + 6$

= 18

171. $^-1 + 1 + ^-1 + 1 + ^-1$

$= ^-1$

172. $^-5 + 10 - 15 + 20 - 25$

$= ^-15$

173. $0 - 4 - 6 - 6 - 4 + 0 + 6 + 14$

= 0

174. $7 + 7 + 7 + 7 + 7 + 7$

= 42

175. $6 + 12 + 24 + 48 + 96$

= 186

176. $\frac{9}{4} + \frac{16}{5} + \frac{25}{6} + \frac{36}{7} + \frac{49}{8} + \frac{64}{9} + \frac{81}{10}$

= 36.1 (1dp)

Page 36 cont...

For questions 177 to 185 other answers are possible. Check last term.

177. $\sum_{n=1}^{6}(2n+4)$

178. $\sum_{n=1}^{6}7n$

179. $\sum_{n=1}^{7}2^n$

180. $\sum_{n=1}^{15}(3n+11)$

181. $\sum_{n=1}^{20}(20-5n)$

182. $\sum_{n=1}^{12}(4\times3^{n-1})$

183. $\sum_{n=1}^{7}(3\times2^{n-1})$

184. $\sum_{n=1}^{7}\left(32\times\left(\frac{1}{2}\right)^{n-1}\right)$

$=\sum_{n=1}^{7}\left(64\times\left(\frac{1}{2}\right)^{n}\right)$

185. $\sum_{n=1}^{6}(4+n)(2+n)$

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186. $A = 500\left(1+\frac{5}{100}\right)^{10}$

$= \$814$ (0 dp)

187. $A = 12\,000\left(1+\frac{2}{100}\right)^{36}$

$= \$24\,479$ (0 dp)

188. $A = 20\,000\left(1+\frac{4.5}{100}\right)^{15}$

$= \$38\,706$ (0 dp)

189. 6% pa compounded is 1.5% per 3 months.

$A = 1250\left(1+\frac{1.5}{100}\right)^{100}$

$= \$5\,540$ (0 dp)

190. $12\,000 = P\left(1+\frac{8}{100}\right)^{5}$

$P = \$8\,167$ (0 dp)

191. $65\,000 = P\left(1+\frac{1.5}{100}\right)^{60}$

$P = \$26\,604$ (0 dp)

192. $200\,000 = 50\,000\left(1+\frac{r}{100}\right)^{20}$

r = 7.2% (1 dp)

193. $12\,000 = 8\,000\left(1+\frac{i}{100}\right)^{20}$

i = 2.048%

r = 4.1% (1 dp)

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194. $230\,000 = 150\,000\left(1+\frac{i}{100}\right)^{24}$

i = 1.8%

r = 3.6% (1 dp)

195. $9\,500 = 450\left(1+\frac{r}{100}\right)^{40}$

r = 7.9% (1 dp)

196. $48\,300 = 6\,000\left(1+\frac{7.2}{100}\right)^{n}$

n = 30 years

197. $150\,000 = 79\,500\left(1+\frac{i}{100}\right)^{40}$

i = 1.6% every 3 months

r = 6.4% pa (1 dp)

198. Plan 1 $= 50\,000\left(1+\frac{1.25}{100}\right)^{80}$

Plan 1 = $135 074

$135\,074 = 50\,000\left(1+\frac{r}{100}\right)^{20}$

r = 5.1%

Interest rate would have to be 5.1% (1 dp) or higher.

199. Bank $= 5000\left(1+\frac{5}{100}\right)^{n}$

Antq. $= 5000\left(1+\frac{8}{100}\right)^{n} - 2000$

n ≥ 9 years (Rounding up)

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200. $269\,000 = O\left(1+\frac{4}{100}\right)^{30}$

O = $82 900 (3 sf)

201. $3.65 = 1.2\left(1+\frac{r}{100}\right)^{15}$

r = 7.7% (1 dp)

202. $I = 760\,000\left(1+\frac{3.25}{100}\right)^{10}$

$= \$1\,046\,440$

$= \$1\,050\,000$ (to 3 sf))

203. $I = 2.7\left(1+\frac{1.8}{100}\right)^{40}$

= 5.5 million (2 sf)

204. $37\,000 = 12\,000\left(1+\frac{r}{100}\right)^{8}$

r = 15.1% (1 dp)

205. $58\,000 = Org.\left(1+\frac{7.5}{100}\right)^{12}$

Org. = $24 352

= $24 000 (2 sf)

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206. $7.45 = Org.\left(1+\frac{10.5}{100}\right)^{5}$

Org. = $4.52

207. $500000 = 120\,000\left(1+\frac{2.4}{100}\right)^{n}$

n = 61 days (rounding up)

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208. $D = 12.7\left(1-\frac{1.7}{100}\right)^{10}$

D = 10.7 (1 dp)

209. $D = 1.85\left(1-\frac{3.25}{100}\right)^{5}$

D = $1.57 million pa (2 dp)

210. $D = 470\left(1-\frac{5.7}{100}\right)^{12}$

D = 233 (rounding up)

211. $D = 8.35\left(1-\frac{6.75}{100}\right)^{3}$

D = $6.77

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212. $850 = Org.\left(1-\frac{25}{100}\right)^{3}$

Org. = $2015 (0 dp)

213. $34\,000 = Org.\left(1-\frac{5.9}{100}\right)^{7}$

Org. = $52 000 (2 sf)

214. $0.5 = 1.2\left(1-\frac{5.0}{100}\right)^{n}$

n = 17.06

= 18 (rounding up

215. $1.0 = 11.4\left(1-\frac{15}{100}\right)^{n}$

n = 15 days (rounding up)

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216. $50 = 100\times\left(1-\frac{r}{100}\right)^{270/365}$

r = 60.8% pa (1 dp)

217. $50 = 100\left(1-\frac{6.3}{100}\right)^{n}$

n = 10.7 years (1 dp)

218. $50 = 100\times\left(1-\frac{r}{100}\right)^{28.5}$

r = 2.4%

n = 199 years (0 dp)

219. $18.5 = 22.2\times\left(1-\frac{r}{100}\right)^{1}$

r = 16.67%

half-life = 3.8 years (1 dp)

220. r = 60.8%

n = 4.2 years (2 sf)

Page 47 cont...

221. $50 = 100\left(1-\frac{r}{100}\right)^{5730}$

$r = 0.012\,09\%$

$O = 2.07 \times 10^{-3}$ grams (3 sf)

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222. a) and b)
Use the formula in cell B2
=750000*1.08^A2
and in cell C2
=750000*1.08^A2–32000*A2

	A	B	C
1	Year	Value at 8%	Value – rates
2	1	810 000	778 000
3	2	874 800	810 800
4	3	944 784	848 784
5	4	1 020 367	892 367
6	5	1 101 996	941 996
7	6	1 190 156	998 156
8	7	1 285 368	1 061 368
9	8	1 388 198	1 132 198
10	9	1 499 253	1 211 253
11	10	1 619 194	1 299 194
12	11	1 748 729	1 396 729
13	12	1 888 628	1 504 628

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223. Use the formula in cell B2
=320*1.03^(A2–1)
in cell C2, 320,
in cell C3,=C2*1.03 and copy to C5, C7, C9 etc.
and in cell C4, =C3*1.03–20
and copy to C6, C8, C10 etc.

	A	B	C
1	Year	Kiwi	Kiwi – 20/2y
2	1	320	320
3	2	330	330
4	3	339	319
5	4	350	329
6	5	360	319
7	6	371	329
8	7	382	318
9	8	394	328
10	9	405	318
11	10	418	327
12	11	430	317
13	12	443	327
14	13	456	316
15	14	470	326

a) 470

b) 326

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224. a) and b)
Use the formula in cell B3
=42000*1.035^(A3–1)
and in cell C3
=42000*1.02^(A3–1)+1500

	A	B	C
1	Year	Basic 3.5%	Basic 2% + 1500
2	1	42 000	42 000
3	2	43 470	44 340
4	3	44 991	45 197
5	4	46 566	46 071
6	5	48 196	46 962
7	6	49 883	47 871
8	7	51 629	48 799
9	8	53 436	49 745
10	9	55 306	50 710
11	10	57 242	51 694
12	11	59 245	52 698
13	12	61 319	53 722
14	13	63 465	54 766
15	14	65 686	55 831
16	15	67 985	56 918
17	Total	810 419	747 324

c) Total at 3.5% = \$810 419
and at 2%+ 1500 = \$747 324

225. a) and b)
Use the formula in cell B2
=240*1.03^(A2–1)*0.7+42
and in cell C2
=(330+2*(A2–1))*0.7

	A	B	C
1	Year	Option 1 \$000	Option 2 \$000
2	1	210	231
3	2	215	232
4	3	220	234
5	4	226	235
6	5	231	237
7	6	237	238
8	7	243	239
9	8	249	241
10	9	255	242
11	10	261	244
12			
13	Total	2346	2373

c) Total Option 1 = \$2 346 000
Total Option 2 = \$2 373 000

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226. a) $Y1 = 20\,000\left(1+\frac{0.5}{100}\right)^{12}$

$Y1_{end} = 21\,234 - 6\,000$

$Y1_{end} = \$15\,234$

$Y2_{end} = \$10\,173$

$Y3_{end} = \$4\,800$

b) Must end up with \$6000

$6\,000 = Y3_{start}\left(1+\frac{0.5}{100}\right)^{12}$

$Y3_{start} = \$5\,651$

$Y2_{end} = \$11\,651$

$Y2_{start} = \$10\,975$

$Y1_{end} = \$16\,975$

$Y1_{start} = \$15\,989$

227. Calculate r and a for GP

$r^4 = \frac{1507}{1150}$

$r = 1.070$ (4 sf)

$a = 1004$ (0 dp)

Sum of 17 Saturdays

$S_{17} = 30\,964$ (0 dp)

Which is just > 30 000

Last Saturday before Xmas

$t_{17} = 2964$

$= 247$ per hour

Which is just less than 250 but maybe if they did not come evenly, 250 would be exceeded.

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228. Ben's ranking = 480×0.92^n
n in months.

Tama's ranking = 405×0.94^n

$480 \times 0.92^n = 405 \times 0.94^n$

$1.185 \times 0.92^n = 0.94^n$

$1.185 = 1.0217^n$

$n = 7.89$

$n = 8$ (0 dp)

229. $a = 398$, $d = -4$

$19\,352 = \frac{n}{2}(2x398 - (n-1)4)$

$n^2 - 200n + 9676 = 0$

$n = 82$ and 118 hours

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230. a) $D = O\left(1 - \frac{r}{100}\right)^t$

$0.5 = \left(1 - \frac{r}{100}\right)^{5570}$

$r = 0.0124\ \%$

$D = O\left(1 - \frac{0.01244}{100}\right)^t$

b) $t = 7069$ years

231. First model is 1st, commentator's model is 2nd.

	Start	2	3	4	5
1st	108	104.2	100.8	97.7	94.9
2nd	108	104.2	100.6	97.1	93.7

- Similar for first 3 days
- After the first 3 days the commentator's model is lower and continues to drop by 3.5%
- The decline of the first model slows down quicker. This model is 1.2 kg heavier after 5 days.
- Commentator's drops to 0 kg.
- Real model drops to 70 kg as 0.9*70 + 7 = 70.

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Practice Internal Assessment Task Sequences and Series 2.3

Expected evidence for Achievement

For Achieved, the requirements include selecting and using methods. To be used as evidence, a 'method' must be relevant to the solution of the problem. The 'methods' also need to be at the appropriate curriculum level for the standard. Applying sequences and series means that the method selected is used in the solution of the problem, for example, if a general term is found there needs to be evidence of its use as part of solving the problem.

Relational Thinking

In forming and using t_n and S_n as part of the solution of the overall problem students are likely to demonstrate relational thinking.

Extended Abstract Thinking

In making a generalisation or considering different options students are likely to demonstrate extended abstract thinking.

Communicating Solutions

At all grades there is a requirement relating to the communication of the solutions.

At Achieved, the result of a numerical calculation only is insufficient, working is expected and students need to indicate what the calculated answers represent.

At Merit, students need to clearly indicate what they are calculating and their solutions need to be linked to the context.

At Excellence, the response needs to be clearly communicated with correct mathematical statements and students need to explain any decisions they make in the solution of the problem.

Source: NZQA Level 2 Clarifications

Answers to the Practice Assessment are on the next page.

Pages 54 – 56 Practice Internal Assessment Task – Sequences and Series 2.3

Specific answers need to be for years beyond year 5 as palm oil has no production for 5 years so a comparison is irrelevant over this period. Working throughout these answers is in thousands.
Years are taken as year end so year 1 is the end of year 1.

Concepts	Achieved	Merit	Excellence
	You will need to show a range of methods, demonstrating knowledge of concepts and terms, and communication. This must be in at least FOUR areas.	In addition to achievement you will need to form and use a model. Achievement in at least FOUR areas and use at least ONE type of relational thinking in the solutions. For relational thinking a formula must be seen in general terms.	This will mean forming a generalisation to solve problems while using correct mathematical statements. You will need to show extended abstract thinking (show and use general solutions) across at least THREE areas and achievement in ONE area.
Solar - Yearly production	Example for year 6 $= 800 \times 0.95 \times 0.95 \times 0.95 \times 0.95 \times 0.95 \times 0.95 - 20$ **A** = \$599 000 (4 sf)	Example for year 6 or N. $= 800 \times 0.95^{(6-1)} - 20$ **M** **OR** general term $= 800 \times 0.95^{(N-1)} - 20$	Example for year N. $= 800 \times 0.95^{(N-1)} - 20$ **E**
Solar - Total return	Example for year 6 = 780 + 740 + 702 + 666 + 632 + 599 = \$4 119 000 (5 sf) **A**	Example for year 6 or N $= 800\left(\frac{1-.95^6}{1-.95}\right) - 20\times 6$ OR **M** $= 800\left(\frac{1-.95^N}{1-.95}\right) - 20N$	Example for year N $= 800\left(\frac{1-.95^N}{1-.95}\right) - 20N$ **E**
Palm oil - Yearly production	Example for year 6 $= 30 - 80 = {}^{-}\$50\,000$ **A**	Example for year 6 or N $= 30 \times (6-5) - 80$ **M** $= 30 \times (N-5) - 80$	Example for year N $= 30 \times (N-5) - 80$ **E**
Palm oil - Total return	Example for year 6 $= {}^{-}80 \times 5 + {}^{-}50$ $= {}^{-}\$450\,000$ **A**	Example for year N or specific year. **M** $= \frac{(N-5)}{2}[2\times 30 + (N-6)30] - 80N$	Example for year N $= \frac{(N-5)}{2}[2\times 30 + (N-6)30] - 80N$ **E**
Life of solar panels	30% of \$800 000 = \$240 000 In **Year 25** production \$233 600. **A** CAO okay. If use 30% of Return then answer = 23.	Evidence of numerically solving $240 = 800 \times 0.95^{(N-1)}$ getting N = 24.5 and rounding to 25 year. **M**	Evidence of solving using logs $240 = 800 \times 0.95^{(N-1)}$ getting N = 24.5 and rounding to 25 year. **E**
Time for palm oil to = Solar	Return in 23 years = \$10 622 000 and time for palm oil = 35 years CAO okay. **A**	Using 25 years in general sum formula and getting \$11 062 000 and then getting answer of 35 years correct. **M**	Using 25 years in general sum formula and getting \$11 062 000 and then getting answer of 35 years correct. **E**

The use of spreadsheets is acceptable but the formulae used in the spreadsheet must be given or the equivalent 'Achievement' formula is to be assumed. Examples are:
Achievement: Formula will use previous results e.g. RETURN = SUM(B2:B30)
Merit: Formula will use the general solution e.g. RETURN = 800*(1 – 0.95^A10)/0.05 – A10*20
Excellence: Formula will use the general solution and pick up a value for the years from one cell and calculate from this. e.g. Year is placed in A1 and RETURN = 800*(1 – 0.95^A1)/0.05 – A1*20
The final grade is found by combining the results of the three questions.

Level	Achieved	Merit	Excellence
Judgement	Requires four **A**s or better.	Requires three **A**s and one **M** or better.	Requires one **A** and three **E**s or better.