1. $17 + 27 + 37 + ... + 417$

$17 + (n - 1)10 = 417$ (M1)

$10(n - 1) = 400$

$n = 41$ (A1)

$S_{41} = \frac{41}{2}(2(17) + 40(10))$ (M1)

$= 41(17 + 200)$

$= 8897$ (A1)

OR

$S_{41} = \frac{41}{2}(17 + 417)$ (M1)

$= \frac{41}{2}(434)$

$= 8897$ (A1) (C4)

[4]

2. (a) 3, 6, 9 A1 N1

(b) (i) Evidence of using the sum of an AP — M1

eg $\frac{20}{2}\ 2\times3+(20-1)\times3$

$\sum_{n=1}^{20} 3n = 630$ — A1 N1

(ii) **METHOD 1**

Correct calculation for $\sum_{n=1}^{100} 3n$ — (A1)

eg $\frac{100}{2}(2\times3+99\times3), 15150$

Evidence of subtraction — (M1)

eg 15150 − 630

$\sum_{n=21}^{100} 3n = 14520$ — A1 N2

METHOD 2

Recognising that first term is 63, the number of terms is 80 — (A1)(A1)

eg $\frac{80}{2}(63+300),\ \frac{80}{2}(126+79\times3)$

$\sum_{n=21}^{100} 3n = 14520$ — A1 N2

[6]

3. $S = \frac{u_1}{1-r} = \frac{\frac{2}{3}}{1-\left(-\frac{2}{3}\right)}$ — (M1)(A1)

$= \frac{2}{3}\times\frac{3}{5}$ — (A1)

$= \frac{2}{5}$ — (A1) (C4)

[4]

4. (a) $u_4 = u_1 + 3d$ or $16 = -2 + 3d$ (M1)

$d = \dfrac{16-(-2)}{3}$ (M1)

$= 6$ (A1) (C3)

(b) $u_n = u_1 + (n-1)6$ or $11998 = -2 + (n-1)6$ (M1)

$n = \dfrac{11998+2}{6} + 1$ (A1)

$= 2001$ (A1) (C3)

[6]

5. (a) (i) Area B $= \dfrac{1}{16}$, area C $= \dfrac{1}{64}$ (A1)(A1)

(ii) $\dfrac{\frac{1}{16}}{\frac{1}{4}} = \dfrac{1}{4}$ $\dfrac{\frac{1}{64}}{\frac{1}{16}} = \dfrac{1}{4}$ (Ratio is the same.) (M1)(R1)

(iii) Common ratio $= \dfrac{1}{4}$ (A1) 5

(b) (i) Total area $(S_2) = \dfrac{1}{4} + \dfrac{1}{16} = \dfrac{5}{16}$ = (= 0.3125) (0.313, 3 sf) (A1)

(ii) Required area $= S_8 = \dfrac{\frac{1}{4}\left(1-\left(\frac{1}{4}\right)^8\right)}{1-\frac{1}{4}}$ (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 = $\dfrac{\frac{1}{4}}{1-\frac{1}{4}}$ (A1)

$= \dfrac{1}{3}$ (A1) 2

[11]

6. For using $u_3 = u_1 r^2 = 8$ (M1)

$8 = 18r^2$ (A1)

$r^2 = \dfrac{8}{18}\left(=\dfrac{4}{9}\right)$

$r = \pm\dfrac{2}{3}$ (A1)(A1)

$S_\infty = \dfrac{u_1}{1-r}$,

$S_\infty = 54, \dfrac{54}{5}$ (=10.8) (A1)(A1)(C3)(C3)

[6]

7. (a) evidence of dividing two terms (M1)

eg $-\dfrac{1800}{3000}, -\dfrac{1800}{1080}$

$\boldsymbol{r} = -0.6$ A1 N2

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

eg $u_{10} = 3000(-0.6)^9$

$u_{10} = -30.2$ (accept the exact value −30.233088) A1 N2

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

$e.g.\ S = \dfrac{3000}{1.6}$

$S = 1875$ A1 N2

[6]

8. $\binom{10}{3}2^7(ax)^3$ $\left(\text{accept}\binom{10}{7}\right)$ (A1)(A1)(A1)

$\binom{10}{3} = 120$ (A1)

$120 \times 2^7\, a^3 = 414\,720$ (M1)

$a^3 = 27$

$a = 3$ (A1) (C6)

Note: *Award (A1)(A1)(A0) for* $\binom{10}{3}2^7\, ax^3$*. If this leads to the answer a = 27, do not award the final (A1).*

[6]

9. The constant term will be the term independent of the variable *x*. (R1)

$\left(x - \frac{2}{x^2}\right)^9 = x^9 + 9x^8\left(\frac{-2}{x^2}\right) + \ldots + \binom{9}{3}x^6\left(\frac{-2}{x^2}\right)^3 + \ldots + \left(\frac{-2}{x^2}\right)^9$ (M1)

$\binom{9}{3}x^6\left(\frac{-2}{x^2}\right)^3 = 84x^6\left(\frac{-8}{x^6}\right)$ (A1)

$= -672$ (A1)

[4]

10. Required term is $\binom{8}{5}(3x)^5(-2)^3$ (A1)(A1)(A1)

Therefore the coefficient of x^5 is $56 \times 243 \times -8$

$= -108864$ (A1) (C4)

[4]

11. (a) Ashley

AP 12 + 14 + 16 + ... to 15 terms (M1)

$S_{15} = \frac{15}{2}[2(12) + 14(2)]$ (M1)

$= 15 \times 26$

$= 390$ hours (A1) 3

(b) Billie

GP 12, 12(1.1), $12(1.1)^2\ldots$ (M1)

(i) In week 3, $12(1.1)^2$ (A1)

$= 14.52$ hours (AG)

(ii) $S_{15} = \frac{12[(1.1)^{15} - 1]}{1.1 - 1}$ (M1)

$= 381$ hours (3 sf) (A1) 4

(c) $12\,(1.1)^{n-1} > 50$ (M1)

$(1.1)^{n-1} > \frac{50}{12}$ (A1)

$(n-1)\ln 1.1 > \ln\frac{50}{12}$

$n - 1 > \frac{\ln\frac{50}{12}}{\ln 1.1}$ (A1)

$n - 1 > 14.97$

$n > 15.97$

$\Rightarrow$ 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)

$\Rightarrow n - 1 = 15$ (A1)

$\Rightarrow n = 16$ (Week 16) (A1) 4

[11]