1. $S_5 = \frac{5}{2}\{2 + 32\}$ (M1)(A1)(A1)

$S_5 = 85$ (A1)

OR

$a = 2$, $a + 4d = 32$ (M1)

$\Rightarrow 4d = 30$

$d = 7.5$ (A1)

$S_5 = \frac{5}{2}(4 + 4(7.5))$ (M1)

$= \frac{5}{2}(4 + 30)$

$S_5 = 85$ (A1) (C4)

[4]

2. Arithmetic sequence $d = 3$ (may be implied) (M1)(A1)

$n = 1250$ (A2)

$S = \frac{1250}{2}(3 + 3750)$ $\left(\text{or } S = \frac{1250}{2}(6 + 1249 \times 3)\right)$ (M1)

$= 2\,345\,625$ (A1) (C6)

[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) 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), $12(1.1)^2$… (M1)

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

= 14.52 hours (AG)

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

= 381 hours (3 sf) (A1) 4

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

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

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

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

5. $9^{x-1} = \left(\dfrac{1}{3}\right)^{2x}$

$3^{2x-2} = 3^{-2x}$ (M1) (A1)

$2x - 2 = -2x$ (A1)

$x = \dfrac{1}{2}$ (A1) (C4)

[4]

6. (a) $\log_5 x^2 = 2 \log_5 x$ (M1)

$= 2y$ (A1) (C2)

(b) $\log_5 \dfrac{1}{x} = -\log_5 x$ (M1)

$= -y$ (A1) (C2)

(c) $\log_{25} x = \dfrac{\log_5 x}{\log_5 25}$ (M1)

$= \dfrac{1}{2} y$ (A1) (C2)

[6]

7. $1.023^t = 2$ (M1)

$\Rightarrow t = \dfrac{\ln 2}{\ln 1.023}$ (M1)(A1)

$= 30.48...$

30 minutes (nearest minute) (A1) (C4)

Note: *Do not accept 31 minutes.*

[4]

8. (a) $n = 800\text{e}^0$ (A1)

$n = 800$ A1 N2

(b) evidence of using the derivative (M1)

$n'(15) = 731$ A1 N2

(c) **METHOD 1**

setting up inequality (accept equation or reverse inequality) A1

e.g. $n'(t) > 10\,000$

evidence of appropriate approach M1

e.g. sketch, finding derivative

$k = 35.1226...$ (A1)

least value of k is 36 A1 N2

METHOD 2

$n'(35) = 9842$, **and** $n'(36) = 11208$ A2

least value of k is 36 A2 N2

[8]

9. $\log_{10}\left(\frac{P}{QR^3}\right)^2 = 2\log_{10}\left(\frac{P}{QR^3}\right)$ (M1)

$2\log_{10}\left(\frac{P}{QR^3}\right) = 2(\log_{10}P - \log_{10}(QR^3))$ (M1)

$= 2(1\text{og}_{10}P - \log_{10}Q - 3\log_{10}R)$ (M1)

$= 2(x - y - 3z)$

$= 2x - 2y - 6\text{z}$ or $2(x - y - 3z)$ (A1)

[4]

10. $\log_{27}(x(x - 0.4)) = 1$ (M1)(A1)

$x^2 - 0.4x = 27$ (M1)

$x = 5.4$ or $x = -5$ (G2)

$x = 5.4$ (A1) (C6)

***Note**: Award (C5) for giving both roots.*

[6]