1)

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

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

$= 6$ ***(A1)*** ***(C3)***

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

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

$= 2001$ ***(A1)*** ***(C3)***

[6 marks]

M02/520/S(1)M+

2)

7. (a) 10 ***(A2)*** ***(C2)***

(b) $(3x^2)^3\left(-\frac{1}{x}\right)^6$ [for correct exponents] ***(M1)(A1)***

$\binom{9}{6} 3^3 x^6 \frac{1}{x^6}$ $\left(\text{or } 84 \times 3^3 x^6 \frac{1}{x^6}\right)$ ***(A1)***

constant $= 2268$ ***(A1)*** ***(C4)***

[6 marks]

M02/520/S(1)M+

3)

QUESTION 1

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)***

M03/520/S(1)M+

4)

QUESTION 2

(a) $\ln a^3 b = 3\ln a + \ln b$ ***(A1)(A1)***

$\ln a^3 b = 3p + q$ ***A1*** ***N3***

(b) $\ln \frac{\sqrt{a}}{b} = \frac{1}{2}\ln a - \ln b$ ***(A1)(A1)***

$\ln \frac{\sqrt{a}}{b} = \frac{1}{2}p - q$ ***A1*** ***N3***

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5)

QUESTION 8

(a) **METHOD 1**

$5^{x+1}=5^4$	*A1*	
$x+1=4$	*(A1)*	
$x=3$	*A1*	*N2*

METHOD 2

Taking logs	*A1*	
e.g. $x+1=\log_5 625$, $(x+1)\log 5=\log 625$		
$x+1=\dfrac{\log 625}{\log 5}$ $(x+1=4)$	*(A1)*	
$x=3$	*A1*	*N2*

(b) **METHOD 1**

Attempt to re-arrange equation	*(M1)*	
$3x+5=a^2$	*A1*	
$x=\dfrac{a^2-5}{3}$	*A1*	*N2*

METHOD 2

Change base to give $\log(3x+5)=\log a^2$	*(M1)*	
$3x+5=a^2$	*A1*	
$x=\dfrac{a^2-5}{3}$	*A1*	*N2*

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6)

QUESTION 3

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*

$S_{20} = \frac{(1+20)20}{2}$ (or $S = \frac{20}{2}(2\times1+19\times1)$) *A1*

$S_{20} = 210$ *AG* *N0*

[4 marks]

(b) Let there be n cans in bottom row

Evidence of using $S_n = 3240$ *(M1)*

e.g. $\frac{(1+n)n}{2} = 3240,\ \frac{n}{2}(2+(n-1)) = 3240,\ \frac{n}{2}(2n+(n-1)(-1)) = 3240$

$n^2 + n - 6480 = 0$ *A1*

$n = 80$ or $n = -81$ *(A1)*

$n = 80$ *A1* *N2*

[4 marks]

(c) (i) Evidence of using $S = \frac{(1+n)n}{2}$ *(M1)*

$2S = n^2 + n$ *A1*

$n^2 + n - 2S = 0$ *AG* *N0*

(ii) **METHOD 1**

Substituting $S = 2100$

e.g. $n^2 + n - 4200 = 0,\ 2100 = \frac{(1+n)n}{2}$ *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*

e.g. 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*

e.g. 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*

[6 marks]

Total [14 marks]

7)

QUESTION 6

(a) 3, 6, 9 *A1* *N1*

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

e.g. $\frac{20}{2}\ 2\times3+(20-1)\times3$

$\sum_{n=1}^{20}3n=630$ *A1* *N1*

(ii) **METHOD 1**

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

e.g. $\frac{100}{2}(2\times3+99\times3), 15150$

Evidence of subtraction *(M1)*

e.g. $15150-630$

$\sum_{n=21}^{100}3n=14\,520$ *A1* *N2*

METHOD 2

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

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

$\sum_{n=21}^{100}3n=14\,520$ *A1* *N2*

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8)

QUESTION 13

(a) For finding second, third and fourth terms correctly *(A1)(A1)(A1)*

Second term $\binom{4}{1}e^3\left(\frac{1}{e}\right)$, third term $\binom{4}{2}e^2\left(\frac{1}{e}\right)^2$, fourth term $\binom{4}{3}e\left(\frac{1}{e}\right)^3$

For finding first and last terms, **and** adding them to **their** three terms *(A1)*

$\left(e+\frac{1}{e}\right)^4=\binom{4}{0}e^4+\binom{4}{1}e^3\left(\frac{1}{e}\right)+\binom{4}{2}e^2\left(\frac{1}{e}\right)^2+\binom{4}{3}e\left(\frac{1}{e}\right)^3+\binom{4}{4}\left(\frac{1}{e}\right)^4$

$\left(e+\frac{1}{e}\right)^4=e^4+4e^3\left(\frac{1}{e}\right)+6e^2\left(\frac{1}{e}\right)^2+4e\left(\frac{1}{e}\right)^3+\left(\frac{1}{e}\right)^4\left(=e^4+4e^2+6+\frac{4}{e^2}+\frac{1}{e^4}\right)$ *N4*

(b) $\left(e-\frac{1}{e}\right)^4=e^4-4e^3\left(\frac{1}{e}\right)+6e^2\left(\frac{1}{e}\right)^2-4e\left(\frac{1}{e}\right)^3+\left(\frac{1}{e}\right)^4\left(=e^4-4e^2+6-\frac{4}{e^2}+\frac{1}{e^4}\right)$ *(A1)*

Adding gives $2e^4+12+\frac{2}{e^4}$ $\left(\text{accept } 2\binom{4}{0}e^4+2\binom{4}{2}e^2\left(\frac{1}{e}\right)^2+2\binom{4}{4}\left(\frac{1}{e}\right)^4\right)$ *A1* *N2*

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9) **QUESTION 7**

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

$8 = 18r^2$ *(A1)*

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

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

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

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

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