1) A superball is dropped from a height of h feet, and left to bounce. The rebound ratio of the ball is r. In terms of r and h, find formulas for

a) the height of the ball after the nth bounce.

b) the total distance the ball traveled when it comes to rest. Caution: consider both the distance traveled up and down.

2) In problem set #2 you explored the Fibonacci sequence with your calculator. Consider a similar sequence:

L: 3, 7, 10, 17, 27, . . .

a) State the 50th term of this sequence.

b) Let $G_n = \dfrac{L_{n+1}}{L_n}$, for $n \geq 1$. Find G_{20}. Give your answer to 6 decimals.

c) Explore the sequence G_n further. What appears to be $\lim\limits_{n\to\infty} G_n$?

3) Given that $f(x) = x^3 - 4x^2 - 39x - 54$, find $g(x)$ if the roots of $g(x)$ are

a) three more than the roots of $f(x)$.

b) one third the roots of $f(x)$.

OK to use your calculator on this problem. Express each answer as a polynomial with integer coefficients.

4) Write each of the following in expanded form and state the sum. OK to write . . . in expanded form. Recall $\dbinom{a}{b} = C(a,b)$

a) $\displaystyle\sum_{n=0}^{8} -1^{\,n} \binom{9}{n}$

b) $\displaystyle\sum_{n=0}^{9} -1^{\,n} \binom{10}{n}$

c) $\displaystyle\sum_{n=0}^{10} -1^{\,n} \binom{11}{n}$

d) Generalize your result.

5) A large wooden cube is formed by gluing together 1728 small, congruent cubes and then it is painted red. After the paint is dry, the large cube is taken apart into the small cubes. How many of these cubes have

a) three faces painted red?

b) two faces painted red?

c) one face painted red?

d) no faces painted red?

6) Determine the range of each of the following functions. Clearly justify your result.

a. $y = 4\sec\left(x - \frac{\pi}{3}\right) - 7$ b. $y = 4\sin\left(x - \frac{\pi}{3}\right) + 3$

7) a. Using a computer graphing program, graph of $P(x,y) = \begin{cases} x = 12\tan(t) \\ y = 12\sec(t) \end{cases}$ where $0 \le t \le 2\pi$. Print and attach your graph to your answer sheets.

b. Does the curve describe a function? Explain.

c. Suppose $x = a \cdot \tan(t)$ in the above, where $0 < a \le 20$. As the value of a changes, the graph changes. Describe two ways the value of a changes the graph. Be as specific as possible.

8) If the graph of $f(x) = 25^x$ contains the points $A(a,3)$ and $B(b,15)$, find the exact value of the slope of $\overline{AB}$.

9) Determine the set of all real x where $0 < x < 2\pi$, such that $3\sin(x) - 1 > 0$. (Show your thinking.) State the x values of the interval to two decimal places.

10) Find the value of N such that $N = 1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{\cdots}}}}$

where . . . indicates that the pattern continues indefinitely. State answer exactly.

(Hint: Let $x = 1 + \cfrac{1}{1 + \cfrac{1}{\ddots}}$, so that you can solve $x = 1 + \frac{1}{x}$).

11) $a_n = (1-i)^n$, where $i = \sqrt{-1}$

a) State the first 12 terms of a_n. Use your calculator to do this.

b) State two patterns you observe.

12) a) Solve for a and b: $\dfrac{6}{n^2+2n} = \dfrac{a}{n} + \dfrac{b}{n+2}$.

b) Find the exact value of $\displaystyle\sum_{n=1}^{6} \frac{6}{n^2+2n}$ (show thinking)

c) Find the exact value of $\displaystyle\sum_{n=1}^{\infty} \frac{6}{n^2+2n}$ (show thinking)

13) $\{S_n\}$ is the sequence of partial sums of $\{a_n\}$, defined by $S_n = \dfrac{n(13-3n)}{2}$.

a) List: $S_n\,{}_1^6$ and then find the values of $a_n\,{}_1^5$.

b) Find the explicit definition of a_n. (Careful to not confuse S_n and a_n.)

14) Solve for n algebraically, showing your steps. $\displaystyle\sum_{k=1}^{n}(2k-1) = 144$.