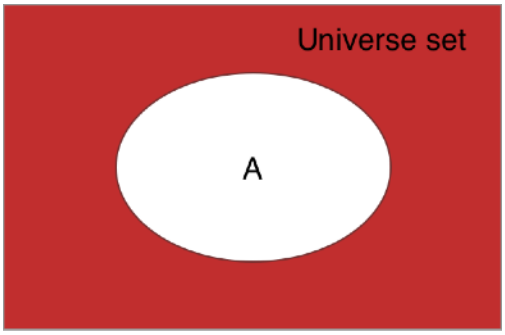
Part 1

1. The complement of set A refers to elements not in A. The red part of the picture below is the complement of set A.



2. A countable set is not a subset of a finite set, and vise versa. A countable set could be a countable infinite set, and a finite set may contains uncountable elements.

3. i. hightest: B, C lowest: A, D
ii. B, C
iii. Yes. A and B
iiii. A, B, C, D

4. {i, t, d}

Part 2

1. Constant: A symbol having a fixed numerical value is called a constant.
Variable: A symbol which takes various numerical values is called a variable.

For example, in equation $2x + 3 = 8$. Number 3, 8 are constant, 'x' is variable and '2' is a numerical coefficient.

2. Coefficients of variables may not always be a constant. Coefficient can be a letter like 'a' or 'b' instead of a number($ax + by + 3 = 7$).

3. i) true
ii) false $a^x \times b^x = (ab)^x$
iii) false $a^2 \times b^3 = a^2 b^3$
iv) false $a^3 \times b^3 = (ab)^3$
v) true
vi) false

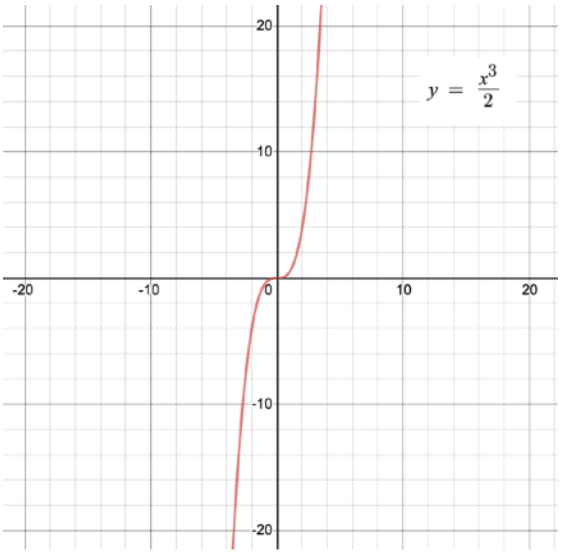
If $f(x) = x^2, x_1 = 1, x_2 = 2$
then $f(x_1 + x_2) = (1+2)^2 = 9$ and $f(x_1) + f(x_2) = 1^2 + 2^2 = 5$
So $f(x_1 + x_2) \neq f(x_1) + f(x_2)$

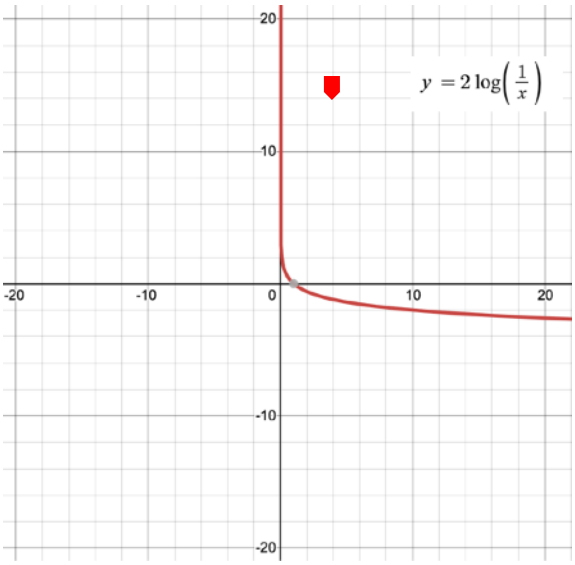
vii) false

If $f(x) = x, a = 2, x = 3$

then $f(ax) = f(2 \times 3) = 6$ and $af(x) = 2 \times f(3) = 6$
So $f(ax) = a\,f(x)$

4.





5. $y' = \dfrac{3x^2}{2}$

1) $x = 0, y = 0, \dfrac{\Delta x}{\Delta y} = \dfrac{3 \times 0^2}{2} = 0$

2) $x = 1, y = 1.25, \dfrac{\Delta x}{\Delta y} = \dfrac{3 \times 1^2}{2} = \dfrac{3}{2}$

3) $x = 1.5, y = 1.6875, \dfrac{\Delta x}{\Delta y} = \dfrac{3 \times 1.5^2}{2} = 3.375$

4) $x = 2, y = 4, \dfrac{\Delta x}{\Delta y} = \dfrac{3 \times 2^2}{2} = 6$

5) $x = 2.5, y = 7.8125, \dfrac{\Delta x}{\Delta y} = \dfrac{3 \times 2.5^2}{2} = 9.375$

Part 3

1. An outcome is a possible result of an experiment. A sample space is a list of all possible outcomes of a statistical experiment. An event is a set of outcomes of an experiment (a subset of the sample space) to which a probability is assigned.

2. i) 154440

ii) $\dfrac{9!}{(9-4)!} = 3024$

iii) 605404800

iiii) 35

3. $P = \frac{10}{{}^{20}C_2} = \frac{1}{19} = 0.0526$

4.

Word	Word Counts
fred	2
fed	2
ted	2
bread	2
and	1

$$P(fed, fred) = \frac{2}{4} = \frac{1}{2}$$
$$P(ted, fed) = \frac{2}{4} = \frac{1}{2}$$
$$P(bread, ted) = \frac{1}{3}$$
$$P(bread, and) = \frac{1}{3}$$
$$P(and, ted) = \frac{1}{2}$$
$$P(fred, bread) = \frac{1}{2}$$

5.

peter	piper	picked	a	peck	of	pickled	peppers	If	Wheres	the
4	4	4	3	4	4	4	4	1	1	1

$$P(piper \mid peter) = \frac{4}{4} = 1$$
$$P(picked \mid piper) = \frac{4}{4} = 1$$
$$P(a \mid picked) = \frac{2}{4} = \frac{1}{2}$$
$$P(peck \mid a) = \frac{3}{4}$$
$$P(of \mid peck) = \frac{4}{4} = 1$$
$$P(pickled \mid of) = \frac{4}{4} = 1$$
$$P(peppers \mid pickled) = \frac{4}{4} = 1$$
$$P(peter \mid peppers) = \frac{2}{4} = \frac{1}{2}$$

$$P(pepter|if) = \frac{1}{1} = 1$$
$$P(the|wheres) = \frac{1}{1} = 1$$
$$P(peck|the) = \frac{1}{1} = 1$$

Part 4

1. $\| \mathbf{a} \| = \sqrt{9^2 + 8^2 + 3^2 + 5^2 + 2^2} = \sqrt{183}$

2. $\mathbf{a} + \mathbf{b} = (3,6,1,7) + (9,4,1,0) = (12,10,2,7)$
   $\mathbf{a} - \mathbf{b} = (3,6,1,7) - (9,4,1,0) = (-6,2,0,7)$
   $\| \mathbf{a} + \mathbf{b} \| + \| \mathbf{a} - \mathbf{b} \| =$
$\sqrt{12^2 + 10^2 + 2^2 + 7^2} + \sqrt{-6^2 + 2^2 + 0^2 + 7^2} = \sqrt{297} + \sqrt{89} = 26.67$

3. $\mathbf{AB} = \begin{bmatrix} 2 & 7 \\ -1 & 17 \end{bmatrix}$ $\mathbf{BA} = \begin{bmatrix} 14 & 8 & -3 \\ 2 & 4 & 4 \\ 3 & 2 & 1 \end{bmatrix}$

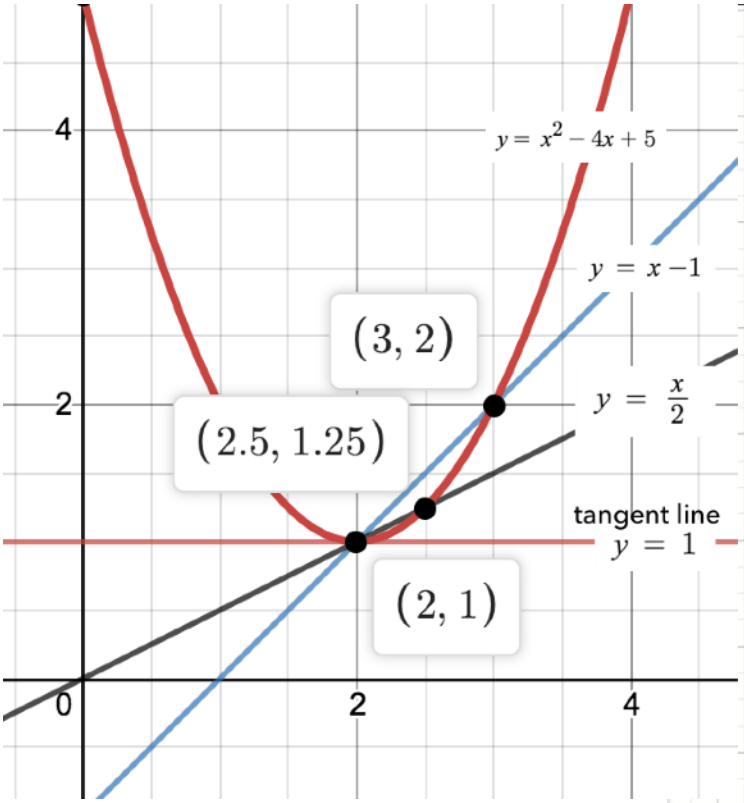
4. $\mathbf{A}^T = \begin{bmatrix} 0 & 2 & 0 \\ 1 & 0 & -2 \\ 2 & -1 & 1 \\ 1 & 4 & 3 \end{bmatrix}$

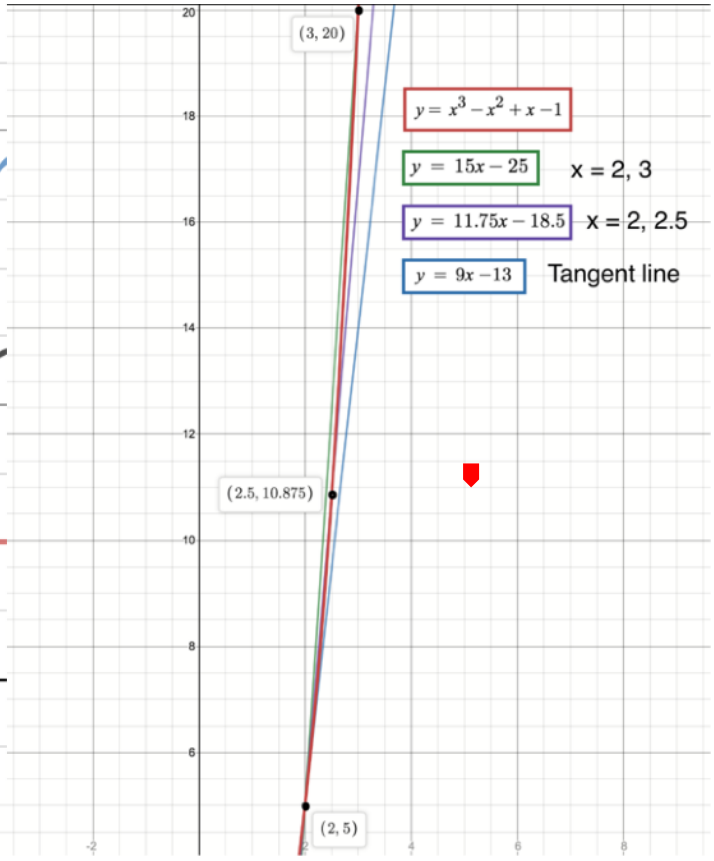
Part Bonus

1. Discrete change is a measure of change in a variable across two discrete moments in time. It follows that the size of a first difference is going to vary across different temporal scales. However, instantaneous change is the rate of change at a specific time. The derivative of $f(x)$ with respect to x represents the instantaneous rate of change of the function at each point.

2. i) $y' = 2x - 4$ ii) $y' = 3x^2 - 2x + 1$

With the interval between x_1, x_2 gets smaller and smaller, the value of slope is more close to the derivative at $f'(x_1)$.





3. Subjective probability is based on people's beliefs. Classical probability assumes that certain outcomes are equally likely, while empirical probability relies on actual experience to determine the likelihood of outcomes.