SECTION A

1. $IQR = Q_3 - Q_1$

Data	1	3	4	5	5	6	7	11
Rank	1	2	3	4.5	4.5	6	7	8

$k = \frac{3}{4}(n+1) = \frac{3}{4}(8+1) = 6.75$

$Q_3 = 6 + (6.75 - 6)(7-6)$

$= 6 + 0.75 = 6.75$

k for $Q_1 = \frac{1}{4}(n+1) = \frac{1}{4}(9) = 2.25$

$Q_1 = 2 + (2.25 - 2)(4-3)$

$= 2 + (0.25)(1) = 2.25$

$IQR = Q_3 - Q_1 = 6.75 - 2.25 = 4.5 = 4.5$

2. Inverse of $f(x) = \frac{9x+5}{6}$

Let $f(x) = y$

$y = \frac{9x+5}{6}$

Interchanging variables

$x = \frac{9y+5}{6}$

$6x = 9y + 5$

$6x - 5 = 9y$

$y = \frac{6x-5}{9}$

$\therefore f^{-1}(x) = \frac{6x-5}{9}$

3. Red = 3

Blue = 2

Green = 5

$P(\text{red}') = 1 - P(\text{red})$

$= 1 - \frac{3}{10} = \frac{7}{10}$

4. There are 26 options for first letter of the password

Therefore

No. of passwords = $26 \times 25 \times 24 \times 23 = 358800$

2nd letter has 25 options

3rd letter has 24 options

4th letter has 23 options.

5. $(1, -3)$

$m_1 = 4$

$m_1 m_2 = -1$

$4 m_2 = -1$

$m_2 = -1/4$

Let the other unknown point $= (x, y)$

(x, y) $(1, -3)$ $m = -1/4$.

$G = \frac{\Delta y}{\Delta x} = \frac{y+3}{x-1} = -1/4.$

$4y + 12 = -x + 1$

$4y = -x - 11$

$y = -x/4 - \frac{11}{4}$

6. (i) The tip of the ∪ shape is the minimum point

(I) Min point $= (-2, 1)$

(II) $y = x^2 + 4x + 5$

Between -5 and -2 the function is decreasing

Between -2 and 1 the function is increasing

7. a) $\frac{d}{dx}(6x^2)$

Using nth rule

$\frac{d}{dx}(6x^2) = 12x$

(vi) $\frac{d}{dx}\cos 5x = -5\sin 5x$

(viii) x^{-2}

$\frac{d}{dx}(x^{-2}) = -2x^{-3} = \frac{-2}{\sqrt[3]{x}}$

8. (v) $\int 5x^3\,dx = \frac{5x^{3+1}}{3+1} + c = \frac{5}{4}x^4 + c$

(vii) $\int 4x\,dx = \frac{4x^2}{2} = 2x^2$

(viii) $\int e^x\,dx = \frac{1}{F'x}e^{fx} = 1e^x = e^x$

9. $(11-6i) - (4-3i) = (11-4) + (-6--3)i$

$= 7 - 3i$

10 $(4-12i)(3-8i)$

Using the foil formula.

$(4-12i)(3-8i) = 12 - 32i - 36i + 96i^2$

$= 12 - 68i - 96$

$= 12 - 96 - 68i$

$= -84 - 68i$

SECTION B

1. Modelling using mathematics

Speed = $\frac{\text{Distance}}{\text{time}}$ $\Rightarrow S = D/t$

Rearranging $D = S \times t = S * t$

If speed $S = 320$ km/h

$t = 15$ mins $= 15/60 = 1/4$ hrs.

$D = S \times t = 320 \times 1/4 = 80$ km

b) $S = ut + \frac{1}{2}at^2$ where u = initial speed, t is time, a is acceleration

or $v^2 = u^2 + 2as$

c) on dry concrete $a = -7.00\ m/s^2$

wet concrete $a = -5.00 m/s^2$

From physics $V^2 = u^2 + 2as$ $V = 0$ being final speed.

$V^2 = u^2 + 2as$ on dry concrete

$0 = 30^2 - 2(7)s$

$\frac{30^2}{14} = s = 64.29$ m

On wet concrete

$V^2 = u^2 + 2as$

$0 = 30^2 + 2(-5)s$

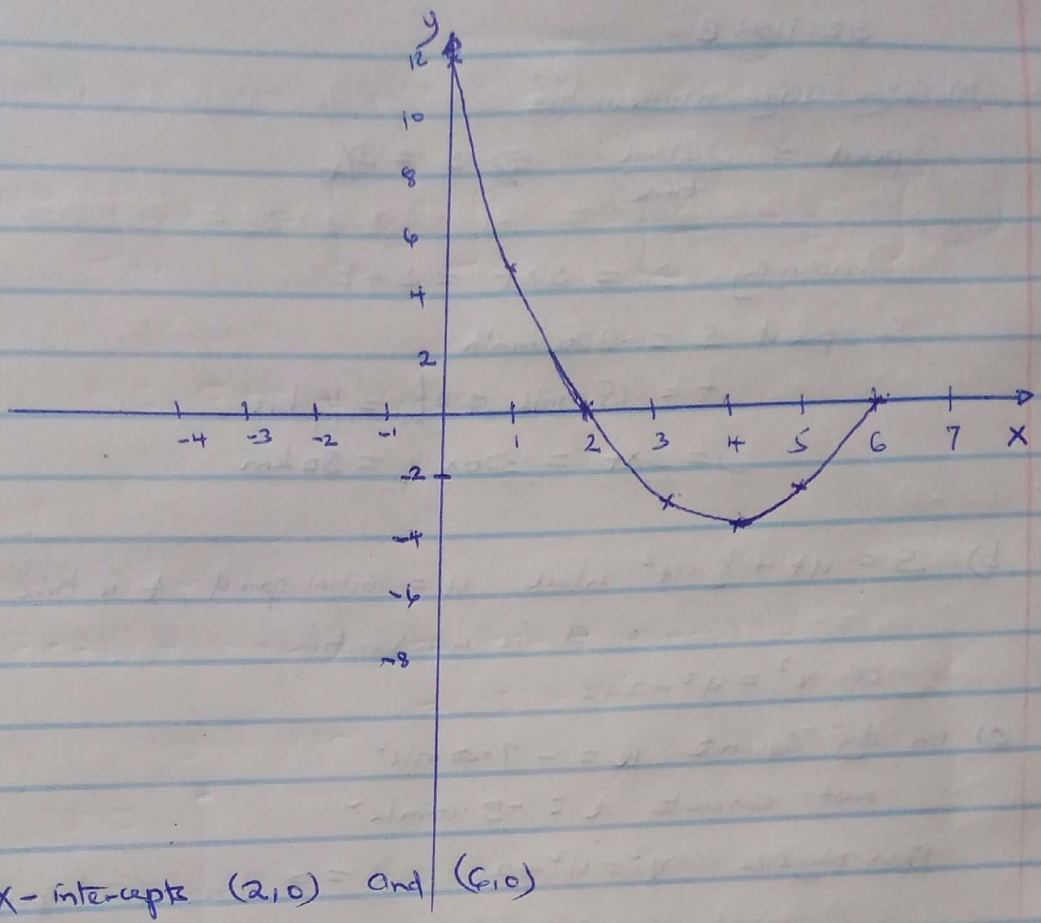
$\frac{30^2}{10} = \frac{10}{10}s \Rightarrow s = 90$ m

2. ~~Statistics and probability~~

3. Functions and Graphs

$y = x^2 - 8x + 12$. For $0 \leq x \leq 6$

x	0	1	2	3	4	5	6
y	12	5	0	-3	-4	-3	0



(i) X-intercepts (2,0) and (6,0)

(ii) Range for the domain $0 \leq x \leq 6$ is 0-12 or 12-0

(iii) Turning point = (4,-4) Lowest point from the graph

SECTION C

1. Calculus

(i) $\frac{dy}{dx}\ (3x^2+1)^5$

$y=(3x^2+1)^5$ Chain rule is used in this case

Let $u = 3x^2+1$ $\quad \frac{du}{dx} = 6x$

Therefore $y = u^5$ $\quad \frac{dy}{du} = 5u^4$

$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$

$\frac{dy}{dx} = 5u^4 \cdot 6x$ but $u = (3x^2+1)$

$\therefore \frac{dy}{dx} = 5(3x^2+1)^4 \cdot 6x$

(ii) $y = \frac{5x^2-3x}{2x^4}$ using quotient rule

$\frac{dy}{dx} = \frac{u'v - v'u}{v^2}$ where $5x^2-3x = u$ $\quad \frac{du}{dx} = 10x-3$

$2x^4 = v$ $\quad \frac{dv}{dx} = 8x^3$

$\frac{dy}{dx} = \frac{(10x-3)(2x^4) - 8x^3(5x^2-3x)}{(2x^4)^2}$

$\frac{dy}{dx} = \frac{20x^5 - 6x^4 - 40x^5 + 24x^4}{4x^8}$

$\frac{dy}{dx} = \frac{20x^5}{4x^8} - \frac{6x^4}{4x^8} - \frac{40x^5}{4x^8} + \frac{24x^4}{4x^8}$

$= 5x^{-3} - \frac{6}{4x^4} - \frac{10}{x^3} + \frac{6}{x^4}$

$= \frac{5}{x^3} - \frac{6}{4x^4} - \frac{10}{x^3} + \frac{6}{x^4}$

(b) $s(t) = t^3 - 12t^2 + 45t$

(i) $\frac{ds(t)}{dt} = v = 3t^2 - 24t + 45$

When $t = 2$.

$v = 3(2^2) - 24(2) + 45 = 9\ m/s$

(ii) $a = \frac{dv}{dt} = 6t - 24$

When $t = 2$ $\quad a = 6(2) - (24) = -12\ m/s^2$

c) Area under the curve $f(x) = x^3$ between $x = 2$ and $x = 4$

$$A = \int_2^4 x^3 = \left[\frac{x^4}{4}\right]_2^4 = \left[\frac{4^4}{4} - \frac{2^4}{4}\right]$$

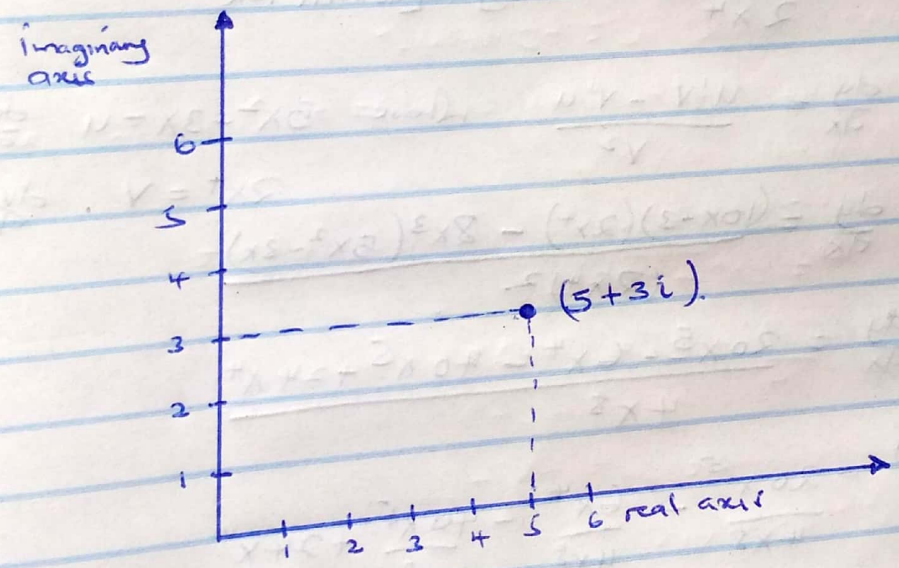
$$A = \frac{240}{4} = 60 \text{ sq. units}$$

2. Complex numbers

a) $(7 - 2i) - (2 - 5i) = (7 - 2 + (2 - -5)i)$

$= 5 + 3i$

argand plot



b) $\frac{6 - 4i}{5 + 4i}$ $\quad a = 6, b = -4, c = 5, d = 4.$

We know that $\frac{a+bi}{c+di} = \frac{ac + bd + (bc - ad)i}{c^2 + d^2}$

$= \frac{6(5) + -4(4) + (-4(4) - 6(4))i}{5^2 + 4^2}$

$= \frac{30 - 16 + -40i}{41}$

$= \frac{14 - 40i}{41} = \frac{14}{41} - \frac{40}{41}i$

c) $x^2 - 2x + 10 = 0$ $\quad a = 1, b = -2, c = 10$

Using quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{2 \pm \sqrt{4 + (4 \times 10)}}{2} = \frac{2 \pm 6.633}{2}$$

$x = 4.3166$ or $x = -2.3165$