Q1

a)

A linear pattern of numbers is a sequence of numbers that increases/decreases by the same amount every time.

e.g. $\underbrace{7, 12}_{+5}, \underbrace{12, 17}_{+5}, \underbrace{17, 22}_{+5} \ldots$

b)

$4, 11, 18, \ldots$ ($+7$, $+7$)

Method 1: (Table)

Term Number	Pattern	Term
1	$7(1)-3$	4
2	$7(2)-3$	11
3	$7(3)-3$	18
⋮		
n	$7(n)-3$	

$\Rightarrow \boxed{T_n = 7n - 3}$

c)

$T_n = 7n - 3$

$T_{1000} = 7(1000) - 3$
$= 7000 - 3$
$= \boxed{6997}$

d)

Particular Term $= 599$

$\Rightarrow 7n - 3 = 599$
$7n = 599 + 3$
$\frac{7n}{7} = \frac{602}{7}$
$n = 86$

$\Rightarrow \boxed{86^{th} \text{ term}}$

Q2(a)

i)

Write out a few terms of the sequence first – starts at 4cm and grows by 2cm each day

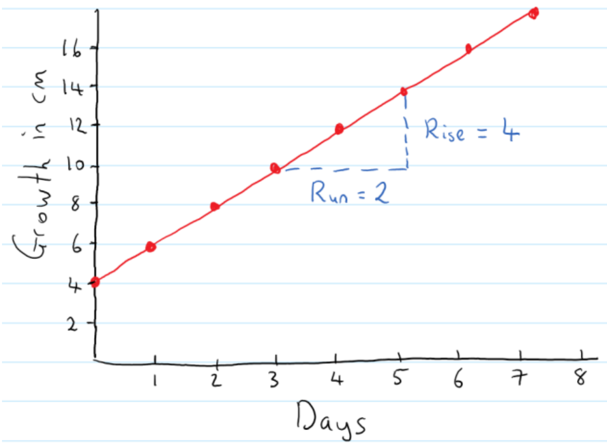
$\Rightarrow T_n = 4 + 2n$

We now use some letter instead of T_n i.e. 'g' for growth

$\Rightarrow \boxed{g = 4 + 2n}$

g = growth in cm
n = no. of days

ii)



iii)

$$T_n = 30$$
$$4 + 2n = 30$$
$$2n = 30 - 4$$
$$\frac{2n}{2} = \frac{26}{2}$$
$$\boxed{n = 13}$$

iv)

$$T_n = 60$$
$$4 + 2n = 60$$
$$2n = 60 - 4$$
$$\frac{2n}{2} = \frac{56}{2}$$
$$\boxed{n = 28}$$

v)

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}}$$
$$= 4/2$$
$$= \boxed{2}$$

vi)

The slope of the line shows us how much the plant is growing per day or the rate of growth. Rate of growth = 2cm/day.

Q2(b)

i)

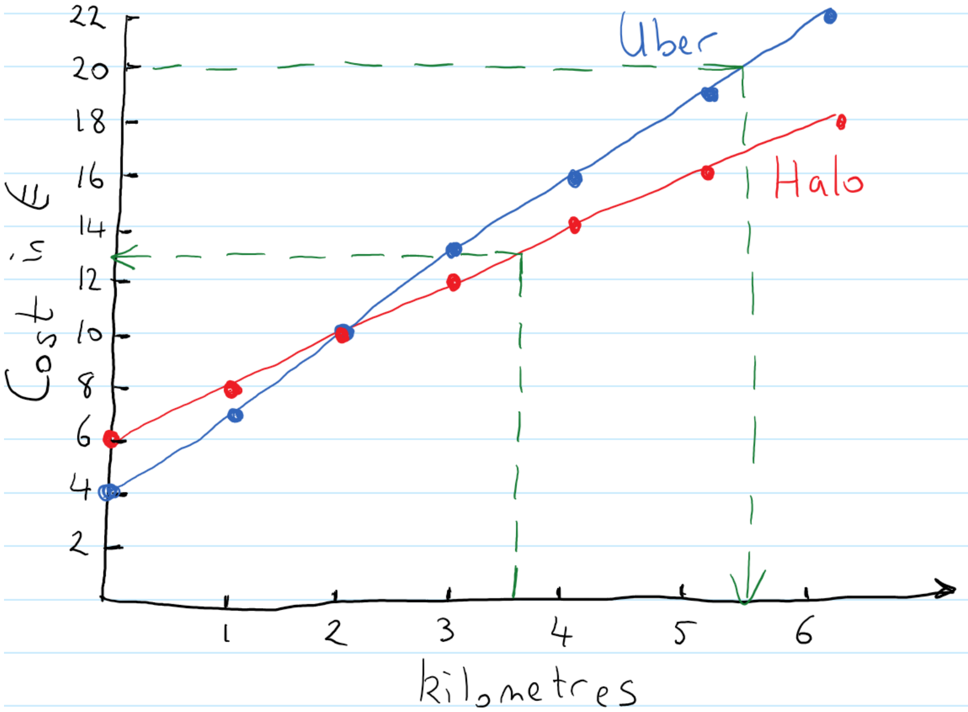
Halo : Fixed Charge €6 + €2 per km

$\Rightarrow$ $\boxed{C = 6 + 2k}$ where C = cost and k = no. of kilometres

Uber : Fixed Charge €4 + €3 per km

$\Rightarrow$ $\boxed{C = 4 + 3k}$ [C = cost, k = no. of km]

ii)



iii)

From graph cost = €13 for Halo

iv)

From graph €20 would take you 5.5km with Uber.

v)

Point of Intersection on graph @ 2km

vi)

Slopes of the lines give us how much each taxi company is charging per kilometre

vii)

For journeys shorter than 2km choose Uber because they are cheaper but for longer journeys it would be cheaper to use Halo.

Q3(a)

i)

Exponential $\Rightarrow$ multiplying by 3 to go from term to term

$$\Rightarrow 3 \xrightarrow{\times 3} 9 \xrightarrow{\times 3} 27 \xrightarrow{\times 3} \boxed{81 \xrightarrow{\times 3} 243 \xrightarrow{\times 3} 729}$$

ii)

3, 9, 27, 81, 243, 729

$+6 \quad +18 \quad +54 \quad +162 \quad +486$

$+12 \quad +36 \quad +108 \quad +324$

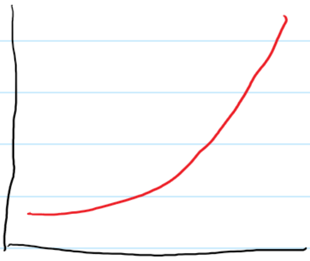
$\Rightarrow 2^{nd}$ difference not constant

iii)

Not quadratic because 2^{nd} difference is not a constant

iv)

Increases slowly at the start but then increases rapidly



Q3(b)

(i)

$T_n = 2n^2 - 1$

$T_1 = 2(1)^2 - 1 = \boxed{1}$

$T_2 = 2(2)^2 - 1 = \boxed{7}$

$T_3 = 2(3)^2 - 1 = \boxed{17}$

$T_4 = 2(4)^2 - 1 = \boxed{31}$

Q3(c)

$T_n = an^2 + bn + c$

$2, 7, 14, 23$

$+5 \quad +7 \quad +9$

$+2 \quad +2$

$2a = +2$

$\Rightarrow a = 1$

$\Rightarrow T_n = 1n^2 + bn + c$

$\underline{T_1 = 2}$

$1(1)^2 + b(1) + c = 2$

$1 + b + c = 2$

$b + c = 1 \quad \text{I}$

$\underline{T_2 = 7}$

$1(2)^2 + b(2) + c = 7$

$4 + 2b + c = 7$

$2b + c = 3 \quad \text{II}$

Solving I & II:

$\text{I}: \; b + \cancel{c} = 1$

$\text{II}: \; {}^{(-)}2b \; {}^{(-)}\cancel{+c} \; {}^{(-)}= 3$

$-b = -2$

$b = 2$

Using I:

$2 + c = 1$

$c = -1$

$\Rightarrow \boxed{T_n = n^2 + 2n - 1}$

Q4(a)

$T_n = an^2 + bn + c$

$8 \underbrace{,\ 15}_{+7} \underbrace{,\ 26}_{+11} \underbrace{,\ 41}_{+15} \underbrace{,\ 60}_{+19}$

$+4 \quad +4$

$2a = +4$

$\Rightarrow a = 2$

$\Rightarrow T_n = 2n^2 + bn + c$

$\underline{T_1 = 8}$

$2(1)^2 + b(1) + c = 8$

$2 + b + c = 8$

$b + c = 6 \quad \text{I}$

$\underline{T_2 = 15}$

$2(2)^2 + b(2) + c = 15$

$8 + 2b + c = 15$

$2b + c = 7 \quad \text{II}$

$\underline{\text{Solving I \& II}}$:

$\text{I}: b + \cancel{c} = 6$

$\text{II}: {}^{(-)}2b \, {}^{(-)}\cancel{+c} = {}^{(-)}7$

$-b = -1$

$b = 1$

$\underline{\text{Using I}}$:

$1 + c = 6$

$c = 5$

$\Rightarrow \boxed{T_n = 2n^2 + n + 5}$

Q4(b)

(i)

If linear $\Rightarrow$ must be going up by 6 every term

$\Rightarrow 3, 9, \boxed{15, 21, 27}$

(ii)

If quadratic $\Rightarrow$ 2^{nd} difference must be same every time

$\Rightarrow$ lots of possible answers

e.g. $3 \underbrace{,\ 9}_{+6} \underbrace{,\ 17}_{+8} \underbrace{,\ 27}_{+10} \underbrace{,\ 39}_{+12}$ (boxed: $\boxed{17, 27, 39}$)

$+2 \quad +2 \quad +2$

iii)

If Exponential $\Rightarrow$ must be multiplying by 3 every time

$\Rightarrow 3, 9, \boxed{27, 81, 243}$

iv)

The exponential one.

Q4(c)

$p \overset{+3}{,} q \overset{+3}{,} r$

Common Diff = 3

$\Rightarrow \boxed{p+3=q}$ (A) $\boxed{q+3=r}$ and $\boxed{p+6=r}$ (B)

Terms sum to 42

$\Rightarrow \boxed{p+q+r=42}$ (C)

We can put (A) and (B) into (C)

$$\Rightarrow p+(p+3)+(p+6)=42$$
$$3p+9=42$$
$$3p=42-9$$
$$\frac{3p}{3}=\frac{33}{3}$$
$$\boxed{p=11}$$

We know the common difference is +3

$\Rightarrow$ If $p=11 \Rightarrow q=11+3=\boxed{14}$ and $r=14+3=\boxed{17}$

Alternatively we could do the following to find q and r:

We now sub p into A and B:

(A): $p+3=q$
$11+3=q$
$\Rightarrow \boxed{q=14}$

(B): $p+6=r$
$11+6=r$
$\Rightarrow \boxed{r=17}$