Q1:

Put $(x, y) = (-2, 41)$ and $(x, y) = (5, 20)$ into the functions respectively, we have equations:

$4A + 2B + C = 41$......(1)

$25A - 5B + C = 20$......(2).

On the other hand, by completing the square, we have $y = A(x - \frac{B}{2A})^2 - \frac{B^2}{4A} + C$.

As the function is minimized at $x = 2$, we have $\frac{B}{2A} = 2$, i.e. $4A - B = 0$......(3).

(2)-(1): $21A - 7B = -21$, i.e. $3A - B = -3$......(4).

(3)-(4): $A = \boxed{3}$.

Substitue $A = 3$ into (3), $B = 4A = \boxed{12}$.

Substitue $(A, B) = (3, 12)$ into (1), $C = 41 - 4A - 2B = 41 - 12 - 24 = \boxed{5}$.

Moreover, when $x = 2$, we obtain the minimum value of the function, which is $y = -\frac{B^2}{4A} + C = -\frac{12^2}{12} + 5 = -12 + 5 = \boxed{-7}$.

(Note: The minimum value can also be calculated by putting $x = 2$ into the function.)

Alternative (with calculus) The equation (3) can also be obtained as the following:

$y' = 2Ax - B$.

When y attains to its extremum, $y' = 0$. Hence, by putting $x = 2$, we have $4A - B = 0$......(3).

Q2:

As x satisfies $x^2+2x-2=0$, we have $x^3=-2x^2+2x$. Therefore, P can be rewritten as $P=(-2x^2+2x)+x^2+ax+1=-x^2+(a+2)x+1$.

Moreover, as $x^2=-2x+2$, $P=-(-2x+2)+(a+2)x+1=(a+4)x-1$.

As P is independent on the value of x, we have $a+4=0$, i.e. $a=\boxed{-4}$.

In this case, the value of P is $\boxed{-1}$.

Q3:

(i):

$$x^2-3x-10<0$$

$$\iff (x-5)(x+2)<0$$

$$\iff \boxed{-2<x<5}$$

(ii):

$$|x-2|<a$$

$$\iff -a<x-2<a$$

$$\iff 2-a<x<a+2$$

In case $x^2-3x-10<0 \implies |x-2|<a$, we have

$$2-a\leq -2 \text{ and } 5\leq a+2$$

$$\iff 4\leq a \text{ and } 3\leq a$$

$$\iff \boxed{a\geq 4}$$

(iii) In case $|x-2| < a \implies x^2 - 3x - 10 < 0$, we have

$$-2 \leq 2 - a \text{ and } a + 2 \leq 5$$

$$\iff a \leq 4 \text{ and } a \leq 3$$

$$\iff a \leq 3$$

On the other hand, for the inequality $|x-2| < a$ holds with a solution, we have the hidden condition $a > 0$.

Combine the above, we have $\boxed{0 < a \leq 3}$.

Q4:

(1): $X = x \leq 4$ if and only if $x \in \{1, 2, 3, 4\}$, where the set has 4 elements.

On the other hand, the universal set, $\{1, 2, 3, 4, 5, 6\}$, has 6 elements.

Therefore, $P(X = x \leq 4) = \frac{4}{6} = \frac{2}{3}$.

Then, $P(B) = (P(X = x \leq 4))^3 = (\frac{2}{3})^3 = \boxed{\dfrac{8}{27}}$.

Similarly, $P(C) = (P(X = x \leq 3))^3 = (\frac{3}{6})^3 = \boxed{\dfrac{1}{8}}$.

(2): $P(B) = P(A \cup C) \iff P(B) = P(A) + P(C)$ as A and C are mutually exclusive.

Therefore, $P(A) = P(B) - P(C) = \frac{8}{27} - \frac{1}{8} = \boxed{\dfrac{37}{216}}$.

Q5:

Square the first equality, we have

$(x+y+z)^2 = x^2+y^2+z^2+2(xy+yz+zx) = 3^2 = 9.$

By the second equality, we have $x^2+y^2+z^2 = 9$.

Substitue it into the equality we got, we have $xy+yz+zx = \boxed{0}$.

Next, $(x^2+y^2+z^2)^2 = x^4+y^4+z^2+\boxed{2}((xy)^2+(yz)^2+(zx)^2)$

$= x^4+y^4+z^2+2((xy+yz+zx)^2-2(xy^2z+yz^2x+zx^2y))$

$= x^4+y^4+z^2+2((0)^2-2xyz(x+y+z))$

$= x^4+y^4+z^2+2(-2(-2)(3))$

$= x^4+y^4+z^2+24 = (9)^2 = 81.$

Therefore, $x^4+y^4+z^2 = 81-24 = \boxed{57}$.

Q6:

(1): We have

$\triangle ADF = \frac{1}{2}(AD)(AF)\sin\angle A = \frac{1}{2}(AD)(DF)\sin 60^\circ = \frac{\sqrt{3}}{4}AD\cdot DF.$

On the other hand, by the circle power theorem, we have $AD\cdot DF = AG\cdot AE$.

Therefore, $\frac{\triangle ADF}{AG\cdot AE} = \frac{\frac{\sqrt{3}}{4}AG\cdot AE}{AG\cdot AE} = \boxed{\dfrac{\sqrt{3}}{4}}$.

(2): As both BE, BD and CE, CF are tangent to the circle, we have

$BE = BD = 4$ and $CE = CF = 2$.

Then, $BC = BE+EC = 4+2 = \boxed{6}$.

On the other hand, $AF = AD = x$. By the cosine formula, we have

$$BC^2 = AB^2 + AC^2 - 2(AB)(AC)\cos\angle A$$

$$6^2 = (x+4)^2 + (x+2)^2 - 2(x+4)(x+2)\cos 60^\circ$$

$$36 = x^2+8x+16+x^2+4x+4-x^2-6x-8$$

$$x^2 + \boxed{6}x - \boxed{24} = 0$$

$$x = \frac{-6 \pm \sqrt{6^2 - 4(1)(-24)}}{2} = -3 \pm \sqrt{33}$$

As $AD > 0$, we have $AD = \boxed{-3 + \sqrt{33}}$.

Q7:

If the x-coordinate of P is α, then the x-coordinates of Q and T will also be α. Moreover, by symmetry along the y-axis (as the axis of symmetry of the parabolas is $x = 0$), the x-coordinate of R will be $-\alpha$.

As Q, R lie on a straight line parallel to the x-axis, we have

$QR = \alpha - (-\alpha) = \boxed{2}\alpha$.

Moreover, substitue $x = \alpha$ into the equations of the two parabolas respectively, the y-coordinates of Q and T are $-\alpha^2 + 4$ and $\frac{1}{2}\alpha^2 - 2$ respectively.

As Q, P, T lie on a straight line parallel to the y-axis, we have

$PQ = (-\alpha^2 + 4) - 0 = \boxed{4} - \alpha^2$ and $PT = 0 - (\frac{1}{2}\alpha^2 - 2) = \boxed{2} - \frac{1}{\boxed{2}}\alpha^2$.

Then, we have $l = 2(QR + RT) = 2(2\alpha + (4 - \alpha^2 + 2 - \frac{1}{2}\alpha^2)) = \boxed{12} + \boxed{4}\alpha - \boxed{3}\alpha^2$.

By completing the square, we have $l = -3(\alpha - \frac{2}{3})^2 + \frac{40}{3}$.

As $-2(\alpha - \frac{2}{3})^2 \leq 0$ and the equality holds when $\alpha = \frac{2}{3}$, we have $l \leq \frac{40}{3}$.

When $\alpha = \boxed{\frac{2}{3}}$, l is maximized and the value of it is $\boxed{\frac{40}{3}}$.