Q1(1):

$$8x^2 - 10x + 3 = 0$$

$$(4x-3)(2x-1) = 0$$

$$x = \boxed{\frac{1}{2}, \frac{3}{4}}$$

Q1(2):

$$\begin{cases} 2x^2 - 5x - 3 < 0 \\ 3x^2 - 4 - 11x \geq 0 \end{cases}$$

$$\iff \begin{cases} (2x+1)(x-3) < 0 \\ (3x+1)(x-4) \geq 0 \end{cases}$$

$$\iff \begin{cases} -\tfrac{1}{2} < x < 3 \\ x \leq -\tfrac{1}{3} \text{ or } x \geq 4 \end{cases}$$

$$\iff \boxed{-\frac{1}{2} < x \leq -\frac{1}{3}}$$

Q1(3):

$$2\cos^2 x + 3\sin x - 3 = 0$$

$$2 - 2\sin^2 x + 3\sin x - 3 = 0$$

$$2\sin^2 x - 3\sin x + 1 = 0$$

$$(2\sin x - 1)(\sin x - 1) = 0$$

$$\sin x = \frac{1}{2}, 1$$

$$x = \boxed{30^\circ, 90^\circ, 150^\circ}$$

Q1(4):

$$\log_3(2x-1) + \log_3(x-1) < 1$$

$$\log_3(2x-1)(x-1) < 1$$

$$2x^2 - 3x + 1 < 3$$

$$(x-2)(2x+1) < 0$$

$$-\frac{1}{2} < x < 2$$

Note the hidden condition for $\log_3(2x-1)$ and $\log_3(x-1)$ to be defined is $x > 1$.

Finding the intersection, the solution is $\boxed{1 < x < 2}$.

Q1(5):

As $(\vec{a} - \vec{b}) \perp (6\vec{a} + \vec{b})$, we have

$$(\vec{a} - \vec{b}) \cdot (6\vec{a} + \vec{b}) = 0$$

$$6|\vec{a}|^2 - 5\vec{a}\cdot\vec{b} - |\vec{b}|^2 = 0$$

$$\vec{a}\cdot\vec{b} = 3$$

$$|\vec{a}||\vec{b}|\cos\theta = 3$$

$$\cos\theta = \frac{1}{2}$$

$$\theta = \boxed{60^\circ}$$

Q1(6):

Sum of roots=$a + 3a = -\frac{8}{3}$, i.e. $a = -\frac{2}{3}$.

Product of roots=$a(3a) = \frac{4}{3} = \frac{k}{3}$, i.e. $k = \boxed{4}$.

Q1(7):

As $\frac{1}{2-\sqrt{3}} = 2 + \sqrt{3}$, we have $a = 3$ and $b = \sqrt{3} - 1$.

Therefore, $a - b + \frac{2}{b} = 3 - \sqrt{3} + 1 + \frac{2}{\sqrt{3}-1} = \boxed{5}$.

Q1(8):

We have $\log_{10} A = a = -b$, i.e. $A = 10^{-b}$, i.e. $A^{\frac{1}{b}} = 10^{-1}$.

Similarly, $B^{\frac{1}{a}} = 10^{-1}$ and $A^{\frac{1}{b}}B^{\frac{1}{a}} = \boxed{10^{-2}}$.

Q1(9):

Taking the square of both sides, we have $\sin^2\alpha + \cos^2\beta + 2\sin\alpha\cos\beta = \frac{1}{4}$ and $\cos^2\alpha + \sin^2\beta + 2\cos\alpha\sin\beta = \frac{3}{4}$.

Adding the two equations together, we have

$$2 + 2\sin(\alpha+\beta) = 1$$

$$\sin(\alpha+\beta) = -\frac{1}{2}$$

$$\alpha+\beta = \boxed{\frac{7\pi}{6}} \text{ (as } \frac{\pi}{2} < \alpha+\beta < \frac{3\pi}{2})$$

Q1(10):

$\alpha + \alpha^{-1} = (\alpha^{\frac{1}{2}} + \alpha^{-\frac{1}{2}})^2 - 2 = \boxed{3}$.

Q1(11):

$\sum_{n=1}^{\infty} (\frac{9}{10})^n = \frac{\frac{9}{10}}{1-\frac{9}{10}} = \boxed{9}$.

Q1(12):

$\lim_{x\to 4} \frac{\sqrt{x}-2}{x-4}$

$= \lim_{x\to 4} \frac{1}{\sqrt{x}+2}$

$= \frac{1}{2+2}$

$= \boxed{\frac{1}{4}}$

Q1(13):

$\frac{dy}{dx} = \sqrt{x} + \frac{1}{2\sqrt{x}}(x+2) = \boxed{\dfrac{3}{2}\sqrt{x} + \dfrac{1}{x}}$

Q1(14):

$\int_0^2 (x-1)^3 dx + 2\int_{-1}^2 x(x-1)dx$

$= [\frac{1}{4}(x-1)^4]_0^2 + 2[\frac{1}{3}x^3 - \frac{1}{2}x^2]_{-1}^2$

$= \frac{1}{4} - \frac{1}{4} + 2(\frac{8}{3} - 2 + \frac{1}{3} + \frac{1}{2})$

$= \boxed{3}$

Q2:

1): $A^2 + pA + qE$

$$= \begin{bmatrix} 14 & -10 \\ 5 & -1 \end{bmatrix} + \begin{bmatrix} 4p & -2p \\ p & p \end{bmatrix} + \begin{bmatrix} q & 0 \\ 0 & q \end{bmatrix}$$

$$= \begin{bmatrix} 14+4p+q & -10-2p \\ 5+p & -1+p+q \end{bmatrix}$$

Solving $14 + 4p + q = 0$ and $5 + p = 0$, we have $p = \boxed{-5}$ and $q = \boxed{6}$.

Check: When $p = -5$ and $q = 6$, $-1 + p + q = -1 - 5 + 6 = 0$.

2): As $x^2 - 5x + 6 = (x-2)(x-3)$, the two roots are 2 and 3.

Therefore, we have $2^n = 2a + b$ and $3^n = 3a + b$.

Solving, we have $a = \boxed{3^n - 2^n}$ and $b = \boxed{3 \cdot 2^n - 2 \cdot 3^n}$.

3): As $A^2 - 5A + 6E = 0$, we have

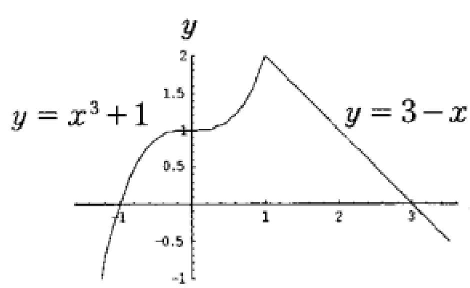
$$A^n = (3^n - 2^n)A + (3 \cdot 2^n - 2 \cdot 3^n)E = \boxed{\begin{bmatrix} 2 \cdot 3^n - 2^n & 2^{n+1} - 2 \cdot 3^n \\ 3^n - 2^n & 2^{n+1} - 3^n \end{bmatrix}}.$$

Q3:

1): Solving $x^3 + 1 = 3 - x$ by testing the potential rational roots given by the rational root theorem ± 1, we have $x = 1$ is a root.

Do the factorisation by the long division, $(x-1)(x^2 + x + 2) = 0$, i.e. $x = 1$ or $x^2 + x + 2 = 0$. For the latter, as $\Delta = -7 < 0$, it has no real roots.

Therefore, $\min\{x^3 + 1, 3 - x\} = \begin{cases} x^3 - 1, & x \leq 1 \\ 3 - x, & x \geq 1 \end{cases}$ and the graph can be sketched:



2): $F'(x) = f(x)$ by the foundamental theorem of calculus.

To find the extrema, we set $F'(x) = 0$. Then $x = -1$ and $x = 3$.

As $F''(x) = \begin{cases} 3x^2, \ x \leq 1 \\ \\ -1, \ x \geq 1 \end{cases}$, we have $F''(-1) > 0$ and $F''(3) < 0$.

Therefore, the maximal value of $F(x)$ is $F(3) = \int_1^3 (3-x)dx = [3x - \frac{1}{2}x^2]_1^3 = \boxed{2}$

and the minimum value of $F(x)$ is $F(-1) = \int_1^{-1} (x^3+1)dx = [\frac{1}{4}x^4 + x]_1^{-1} = \boxed{-2}$.