Q1(1):

By testing the potential rational roots given by the rational root theorem ± 1,

we have $x = -1$ is a root.

Then, we can do the factorisation by the long division:

$$x^3 + 4x^2 + 4x + 1 = 0$$

$$(x+1)(x^2 + 3x + 1) = 0$$

$$x = \boxed{-1, \frac{-3 \pm \sqrt{5}}{2}}$$

Q1(2):

$$\cos 2x + \cos x = 0$$

$$2\cos^2 x + \cos x - 1 = 0$$

$$(2\cos x - 1)(\cos x + 1) = 0$$

$$\cos x = \frac{1}{2}, -1$$

$$x = \boxed{\frac{\pi}{3}, \frac{3\pi}{2}, \frac{5\pi}{3}}$$

Q1(3):

$$3^{x+1} + \frac{1}{3^x} < 4$$

$$3 \cdot 3^{2x} - 4 \cdot 3^x + 1 < 0$$

$$(3 \cdot 3^x - 1)(3^x - 1) < 0$$

$$\frac{1}{3} < 3^x < 1$$

$$\boxed{-1 < x < 0}$$

Q1(4):

$$\log_2 \sqrt{2x-1} < \log_4 x$$

$$\log_4(2x-1) < \log_4 x$$

$$2x - 1 < x$$

$$x < 1$$

Moreover, for $\sqrt{2x-1}$ to be defined, we have $x > \frac{1}{2}$.

Therefore, the solution is $\boxed{\frac{1}{2} < x < 1}$.

Q1(5):

$\sum_{n=0}^{120} \frac{1}{\sqrt{n+1}+\sqrt{n}}$

$= \sum_{n=0}^{120} (\sqrt{n+1} - \sqrt{n})$

$= \sqrt{121} - 0$

$= \boxed{11}$

Q1(6):

Number of n such that n is divisible by 2 and divisible by 5 are 100 and 40 respectively.

Moreover, number of n such that n is divisible by both 2 and 5 (i.e. divisible by 10) is 20.

Therefore, number of n such that n is divisible by 2 or 5 is 100+40-20=120.

Number of n such that n is not divisible by 2 nore 5=200-120=$\boxed{80}$.

Q1(7):

We have $\vec{c}\cdot\vec{a}=0$ and $\vec{c}\cdot\vec{b}=0$, i.e.

$$\begin{cases} 3s+2t=0 \\ s-t=-5 \end{cases}$$

By solving, we have $s=\boxed{-2}$ and $t=\boxed{3}$.

Q1(8):

$\frac{dy}{dx}=\frac{1}{2}e^{\frac{x}{2}}$.

Let the point of tangency be $(k,e^{\frac{k}{2}})$, then the equation of it is $y-e^{\frac{k}{2}}=\frac{1}{2}e^{\frac{k}{2}}(x-k)$.

As it passes through (0,0), we have $-e^{\frac{k}{2}}=\frac{1}{2}e^{\frac{k}{2}}(-k)$, i.e. $k=2$.

Therefore, the equation of it is $y=\frac{1}{2}e(x-2)+e=\boxed{\dfrac{e}{2}x}$.

Q1(9):

Note that a_n is a geometric sequence with the first term 5 and the common ratio $\frac{3}{4}$.

Therefore, the required sum$=\frac{5}{1-\frac{3}{4}} = \boxed{20}$.

Q1(10):

$\lim\limits_{x\to 0} \frac{1-\sqrt{1-\sin x}}{x}$

$= (\lim\limits_{x\to 0} \frac{\sin x}{x})(\lim\limits_{x\to 0} \frac{1}{1+\sqrt{1-\sin x}})$

$= \boxed{\dfrac{1}{2}}$

Q1(11):

$f'(x) = 1 - \frac{2}{2x+1}$

$$f'(x) < 0$$

$$1 - \frac{2}{2x+1} < 0$$

$$2x + 1 < 2$$

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

Moreover, for $\ln(2x+1)$ to be defined, we have $x > -\frac{1}{2}$.

Therefore, the solution is $\boxed{-\dfrac{1}{2} < x < \dfrac{1}{2}}$.

Q1(12):

$\int_0^\pi x\sin x dx$

$= \int_0^\pi x d(-\cos x)$

$= -x\cos x|_0^\pi + \int_0^\pi \cos x dx$

$= \pi + [\sin x]_0^\pi$

$= \boxed{\pi}$

Alternative

$$\int_0^\pi x\sin x dx = \int_0^\pi (\pi - x)\sin(\pi - x)dx = \pi\int_0^\pi \sin x dx - \int_0^\pi x\sin x dx$$

$$\int_0^\pi x\sin x dx = \frac{1}{2}[-\pi\cos x]_0^\pi = \boxed{\pi}$$

Q2:

1): $A^2 = a^2 \begin{bmatrix} 0 & -2 \\ 2 & 0 \end{bmatrix}$

$A^3 = a^3 \begin{bmatrix} -2 & -2 \\ 2 & -2 \end{bmatrix}$

$A^4 = a^4 \begin{bmatrix} -4 & 0 \\ 0 & -4 \end{bmatrix}$

Therefore, $a^4 = \frac{1}{4}$, i.e. $a = \boxed{\frac{1}{\sqrt{2}}}$.

2): Note that $\begin{bmatrix} 0 & 1 \\ x & 0 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$.

We are to find the minimum n such that A^n is in the form of $\begin{bmatrix} 0 & 1 \\ x & 0 \end{bmatrix}$.

As $A^2 = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$ and $A^4 = -I$, i.e. $A^{4n+k} = (-1)^n A^k$, the minimum n will be $4 \cdot 1 + 2 = \boxed{6}$.

3): $A^{2014} = A^{503 \cdot 4 + 2} = (-1)^{503} A^2 = \boxed{\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}}$

Q3:

1): $f'(x) = (1-x)^n - nx(1-x)^{n-1}$.

Solving $f'(x) = 0$, we have $x = \boxed{\dfrac{1}{n+1}}$.

2): For $f'(x) = 0$, we have $x = \frac{1}{n+1}$ and $x = 1$.

As we have:

$f(0) = 0$

$f(\frac{1}{n+1}) = \frac{n^n}{(n+1)^{n+1}}$

$f(1) = 0$

We have $a_n = \frac{n^n}{(n+1)^{n+1}}$.

Therefore, $\lim\limits_{n\to\infty} (n+1)a_n = \lim\limits_{n\to\infty} \frac{n^n}{(n+1)^n} = \frac{1}{\lim\limits_{n\to\infty} (1+\frac{1}{n})^n} = \boxed{\dfrac{1}{e}}$.

3): $\int_0^1 x(1-x)^n dx$

$= -\frac{1}{n+1}\int_0^1 xd((1-x)^{n+1})$

$= -\frac{1}{n+1}x(1-x)^{n+1}|_0^1 + \frac{1}{n+1}\int_0^1 (1-x)^{n+1}dx$

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

$$= \boxed{\frac{1}{(n+1)(n+2)}}$$