Q1(1):

By testing the potential rational roots given by the rational root theorem, $\pm 1, \pm 2, \pm 4, \pm\frac{1}{3}, \pm\frac{2}{3}, \pm\frac{4}{3}$, we have $x = 2$ is a root.

Then, do the factorisation by the long division, we have

$$3x^3 - 10x^2 + 10x - 4 = 0$$

$$(x-2)(3x^2 - 4x + 2) = 0$$

$$x = \boxed{2, \frac{2 \pm \sqrt{2}i}{3}}$$

Q1(2):

$$\begin{cases} 3x^2 - 8x - 3 \geq 0 \\ 2x^2 - 11x + 9 < 0 \end{cases}$$

$$\iff \begin{cases} (3x+1)(x-3) \geq 0 \\ (2x-9)(x-1) < 0 \end{cases}$$

$$\iff \begin{cases} x \leq -\frac{1}{3} \text{ or } x \geq 3 \\ 1 < x < \frac{9}{2} \end{cases}$$

$$\iff \boxed{3 \leq x < \frac{9}{2}}$$

Q1(3):

$$\log_2(x-1) - \log_4(x+3) = \frac{1}{2}$$
$$\log_2 \frac{x-1}{\sqrt{x+3}} = \frac{1}{2}$$
$$\frac{x^2-2x+1}{x+3} = 2$$
$$x^2 - 4x - 5 = 0$$
$$(x-5)(x+1) = 0$$

$x = \boxed{5}$ (Note the hidden condition for $\log_2(x-1)$ to be defined: $x > 1$)

Q1(4):

$$2\sin^2 x > 3\cos x$$
$$2 - 2\cos^2 x > 3\cos x$$
$$2\cos^2 x + 3\cos x - 2 < 0$$
$$(2\cos x - 1)(\cos x + 2) < 0$$
$$-2 < \cos x < \frac{1}{2}$$
$$\boxed{\frac{\pi}{3} < x < \frac{5\pi}{3}}$$

Q1(5):

Sum of roots=$\alpha + \beta = \frac{5}{2}$ and the product of roots=$\alpha\beta = \frac{1}{2}$.

Then, $a = -(\frac{1}{\alpha} + \frac{1}{\beta}) = -\frac{\frac{5}{2}}{\frac{1}{2}} = \boxed{-5}$.

$b = \frac{1}{\alpha} \cdot \frac{1}{\beta} = \frac{1}{\frac{1}{2}} = \boxed{2}$.

Q1(6):

$\frac{\alpha+\beta}{\gamma} = \frac{2+\sqrt{3}+i}{1+i} = \frac{2+\sqrt{3}+(1-2-\sqrt{3})i+1}{2} = \frac{3+\sqrt{3}}{2} + \frac{-1-\sqrt{3}}{2}i.$

Therefore, $r = \sqrt{(\frac{3+\sqrt{3}}{2})^2 + (\frac{-1-\sqrt{3}}{2})^2} = \sqrt{\frac{16+8\sqrt{3}}{4}} = \sqrt{4+2\sqrt{3}} = \boxed{1+\sqrt{3}}$.

$\theta = \arctan(\frac{\frac{-1-\sqrt{3}}{2}}{\frac{3+\sqrt{3}}{2}}) = -\arctan(\frac{\sqrt{3}}{3}) = \boxed{-\dfrac{\pi}{6}}$.

Q1(7):

$\sum_{k=1}^{n}(k+1)(k+2)$
$= \sum_{k=1}^{n}(k^2+3k+2)$
$= \frac{1}{6}n(n+1)(2n+1) + \frac{3}{2}n(n+1) + 2n$
$= \boxed{\dfrac{1}{3}n^3 + 2n^2 + \dfrac{11}{3}n}$

Q1(8):

$|\vec{a} - 2\vec{b}|^2 = |\vec{a}|^2 + 4|\vec{b}|^2 - 4\vec{a} \cdot \vec{b} = 4.$

Therefore,

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

$$\cos\theta = \frac{\sqrt{3}}{2}$$
$$\theta = \frac{\pi}{6}$$

Q1(9):

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

$= \lim\limits_{x\to 0} \frac{2}{\sqrt{1+x}+\sqrt{1-x}}$

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

$= \boxed{1}$

Q1(10):

As $\lim\limits_{x\to\infty}(1+\frac{1}{kx})^x = (\lim\limits_{kx\to\infty}(1+\frac{1}{kx})^{kx})^{\frac{1}{k}} = e^{\frac{x}{k}}$, we have $k = \boxed{2}$.

Q1(11):

$$\log y = \sin x \log x$$
$$\frac{1}{y}\cdot\frac{dy}{dx} = \cos x \log x + \frac{\sin x}{x}$$
$$\frac{dy}{dx} = \boxed{x^{\sin x}(\cos x \log x + \frac{\sin x}{x})}$$

Q1(12):

$\int_0^1 x^2 e^x dx$

$= \int_0^1 x^2 d(e^x)$

$= x^2 e^x|_0^1 - 2\int_0^1 x d(e^x)$

$= e - 2[xe^x]_0^1 + 2\int_0^1 e^x dx$

$= -e + 2[e^x]_0^1$

$= \boxed{e-2}$

Q2:

1): $(I+A)(I-A) = I^2 - A^2$ (as the multiplication operation involving I is commutative)

$= I - O$

$= \boxed{I}$

2): By 1), $(I+A)^{-1} = I - A$ and similarly $(I+2A)^{-1} = I - 2A$.

Therefore, the expression=$(I-A)(I-2A)B$

$= (I-3A)B$

$= \boxed{B}$

3): As $A^2 = \begin{bmatrix} 1+xy & x+xz \\ y+yz & xy+z^2 \end{bmatrix} = O$ and $AB = \begin{bmatrix} 2+x & 4+2x \\ 2y+z & 4y+2z \end{bmatrix} = O$, by solving, we have $x = \boxed{-2}$, $y = \boxed{\frac{1}{2}}$ and $z = \boxed{-1}$.

Q3:

1): First, as A lies on C, we have $2=\sqrt{b}$, i.e. $b=\boxed{4}$.

Moreover, as $\frac{dy}{dx}=\frac{a}{2\sqrt{ax+4}}$, $\frac{dy}{dx}|_{x=0}=\frac{a}{4}$.

Therefore, the tangent at A is $y=\frac{a}{4}x+2$ and the x-intercept is $\frac{-8}{a}=-8$, i.e. $a=\boxed{1}$.

2): Let the point of tangent be $(p,\sqrt{4+p})$, then $\frac{dy}{dx}|_{x=p}=\frac{1}{2\sqrt{p+4}}$.

Therefore, the equation of the tangent is $y-\sqrt{4+p}=\frac{1}{2\sqrt{p+4}}(x-p)$.

As the tangent passes through $(-1,2)$, we have

$$2-\sqrt{4+p}=\frac{1}{2\sqrt{p+4}}(-1-p)$$

$$4\sqrt{p+4}-2(p+4)=-1-p$$

$$16(p+4)=p^2+14p+49$$

$$(p+3)(p-5)=0$$

$$p=-3,5$$

Hence, the equations are $y-1=\frac{1}{2}(x+3)$, i.e. $\boxed{y=\dfrac{1}{2}x+\dfrac{5}{2}}$ and $y-3=\frac{1}{6}(x-5)$, i.e. $\boxed{y=\dfrac{1}{6}x+\dfrac{13}{6}}$.

3): The point of intersection of the two tangents is P(-1,2).

Therefore, the area$=\int_{-3}^{-1}((\frac{1}{2}x+\frac{5}{2})-\sqrt{x+4})dx+\int_{-1}^{5}((\frac{1}{6}x+\frac{13}{6})-\sqrt{x+4})dx$

$=[\frac{1}{4}x^2+\frac{5}{2}x]_{-3}^{-1}+[\frac{1}{12}x^2+\frac{13}{6}x]_{-1}^{5}-[\frac{2}{3}(x+4)^{\frac{3}{2}}]_{-3}^{5}$

$$= 3 + 15 - \tfrac{52}{3}$$

$$= \boxed{\frac{2}{3}}$$