Q1(1):

$\log_{10} \frac{4}{5} + 2\log_{10} 5\sqrt{5} = \log_{10} 4 - \log_{10} 5 + 3\log_{10}$

$= 2(\log_{10} 2 + \log_{10} 5)$

$= 2\log_{10} 10$

$= \boxed{2}$.

Q1(2):

$2\cos x - \sqrt{3} < 0 \iff \cos x < \frac{\sqrt{3}}{2}$.

$\cos x$ is decreasing from $x = 0$ to $x = \pi$ and increasing from $x = \pi$ to $x = 2\pi$.

Note that $\cos\frac{\pi}{6} = \cos\frac{11\pi}{6} = \frac{\sqrt{3}}{2}$.

Therefore, we have the solution to the inequality: $\boxed{\dfrac{1}{6}}\pi < x < \boxed{\dfrac{11}{6}}\pi$.

Q1(3):

$$\sqrt{2-2a} = a$$

$$2 - 2a = a^2 \text{ and } 2 - 2a \geq 0 \text{ and } a > 0$$

$$a^2 + 2a - 2 = 0 \text{ and } 0 < a \leq 1$$

$$a = \boxed{-1+\sqrt{3}}$$

(Note: One can also calculate both roots of the quadratic equation and reject the root $-1-\sqrt{3}$ by root checking.)

Q1(4):

The equation of the line through the two points is given by $y = -tx + t$ using the point-slope form of straight line.

Substitue it to $x^2 + y^2 = 1$ so as to solve a:

$$x^2 + (-tx + t)^2 = 1$$

$$(1 + t^2)x^2 - 2t^2x + t^2 - 1 = 0$$

$$(x + 1)((1 + t^2)x + (t^2 - 1)) = 0*$$

$$x = -1, \frac{1 - t^2}{1 + t^2}$$

Therefore, $a = \frac{\boxed{1} + \boxed{0}t + \boxed{-1}t^2}{1+t^2}$.

(*: As we know $x = -1$ is a root, we know $(x + 1)$ is a factor and hence we can do the factorisation easily.)

Q1(5):

By the binomial expansion, we have $(1 + x)^{10} = \sum_{k=0}^{10} \binom{10}{k} x^k$.

Thereofre, put $x = 1$, we have $\sum_{k=0}^{10} \binom{10}{k} = 2^{10} = \boxed{1024}$.

Alternative Consider the combinatoric meaning of $\sum_{k=0}^{10} \binom{10}{k}$: The number of ways to picks 1,2,...,9, or 10 objects among 10 different objects.

We can calculate the number in another way: For each object, we can decide whether or not pick it, i.e. there are 2 possibilities. As there are 10 objects, the number of possibilities is 2^k.

Given the above, we have $\sum\limits_{k=0}^{10} \binom{10}{k} = 2^{10} = \boxed{1024}$.

Q1(6):

$1 = \frac{1}{x} + \frac{1}{y} + \frac{1}{z} \iff xyz = xy + yz + zx.$

As $x < y < z$, we have $xy, xz < yz$. Therefore, $xyz < yz + yz + yz = 3yz$, i.e. $x < 3$.

Note that the case $x = 1$ is impossible. Therefore, we have $x = \boxed{2}$.

Now, the equation becomes $yz = 2y + 2z$, i.e. $z(y-2) = 2y$. Obviously, $(y, z) = (\boxed{3}, \boxed{6})$.

Q2:

(1): The area under the parabola$=\int_a^b x^2 dx$

$= [\frac{1}{3}x^3]_a^b$

$= \frac{1}{3}(b^3 - a^3)$.

Moreover, the region under the line is a tripazium, the area$=\frac{(a^2+b^2)(b-a)}{2}$.

As $y = x^2$ convex downwards, we have the required area$=\frac{(a^2+b^2)(b-a)}{2} - \frac{1}{3}(b^3 - a^3)$

$= \frac{-a^3+b^3-ab^2+a^b}{6}$

$= \boxed{\dfrac{(b-a)^3}{6}}$.

(2): The slope of $l = \frac{b^2-a^2}{b-a} = a + b$.

The slope of the tangent to the parabola is given by $y' = 2x$. When $x = b$, the slope=$2b$.

As l is perpendicular to the tangent, we have $(a+b)(2b) = -1$, i.e. $a = \boxed{-\dfrac{1+2b^2}{2b}}$.

(3): Substitue the result of (2) into the result of (1), we have

$S = \frac{1}{6}(b - (-\frac{1+2b^2}{2b}))^3 = \frac{1}{48}(\frac{1+4b^2}{b})^3$.

Then, $S' = \frac{1}{48}(3)(\frac{1+4b^2}{b})^2(-\frac{1}{b^2} + 4)$.

To find the extremum of S, we set $S' = 0$, then $b = \pm\frac{1}{2}$.

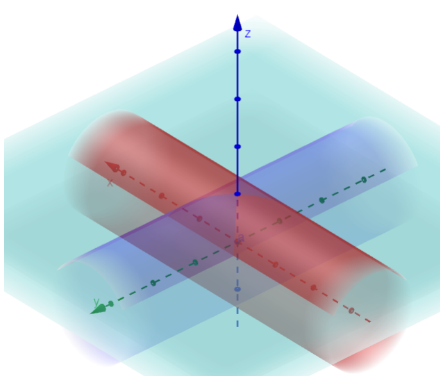
The table of signs is given:

b	$(-\infty, -\frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, +\infty)$
S'	$+$	$-$	$+$
S	$\nearrow$	$\searrow$	$\nearrow$

Therefore, S attains to its minimum when $b = \boxed{\dfrac{1}{2}}$. By that time, $m = \boxed{\dfrac{4}{3}}$.

Q3:

A sketch for reference:



(1): The horizontal cross section of a cylinder is a rectangle.

When $z = t$, the two equations become $\sqrt{r^2 - t^2} \leq x \leq \sqrt{r^2 - t^2}$ and $\sqrt{r^2 - t^2} \leq y \leq \sqrt{r^2 - t^2}$, which are two rectangles with widgth $2\sqrt{r^2 - t^2}$ extending on the x-direction and the y-direction respectively.

As the two rectangles are perpendicular to each other, the intersection of them is a square with side length $2\sqrt{r^2 - t^2}$.

Therefore, the area is $(2\sqrt{r^2 - t^2})^2 = \boxed{4(r^2 - t^2)}$.

(2): The integration of the cross section area of B among the boundaries gives its volume.

Therefore, the volume$=\int_{-r}^{r} 4(r^2 - t^2)dt$

$= 4[r^2 t - \frac{1}{3}t^3]_{-r}^{r}$

$= \boxed{\dfrac{16}{3}r^3}$.