Material : calculator; something to write   1h   Marked on 50; all questions on 10

1- Find the area of the triangle determined by the given points.
   (1,0,3), (0,0,6) and (2,4,5).

2- A shell is fired from a height of 20 m with an initial speed of 10 m/s at an angle of 30º from the horizontal (x direction). Find (use a constant acceleration downward, 9,8 m/s^2):
   a) a vector and parametric equation for the trajectory of the shell
   b) the maximum altitude of the shell
   c) the speed when it touches the ground (at impact)

3- Find the curvature of the elliptical helix at a point $t = \pi/2$
   $\vec{r}(t) = \langle a\cos(t), b\sin(t), ct \rangle$ with $a > 0, b > 0$ and $c > 0$

4- An insect tries to cool down rapidly on a square heating plate on which the temperature at every point (x,y) is given by $T(x, y) = 5 + 2x^2 + y^2$. In which direction should the insect goes starting at (4,2) to cool down as fast as he can?

5- Suppose a body rotates with an angular velocity $\vec{\omega}$ about an axis. If $\vec{r}$ is the position vector of a point P on the body measured from the origin, it is known that the velocity of the object in rotation is $\vec{v} = \vec{\omega} \times \vec{r}$. Using the general value in rectangular coordinates $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$ and $\vec{\omega} = \omega_x\vec{i} + \omega_y\vec{j} + \omega_z\vec{k}$, show that we can write $\vec{\omega} = \frac{1}{2}\text{curl } \vec{v}$.