Question 1  Given a parametrized surface $\Phi : D \to \mathbb{R}^3$. $\Phi$ is regular at $(u_0, v_0)$ means

A. the vector $T_u \times T_v$ is normal to the surface $S = \Phi(D)$ at $(u_0, v_0)$.

*B. the vector $T_u \times T_v$ is not zero at $(u_0, v_0)$.

C. the surface $S = \Phi(D)$ has a tangent plane at $\Phi(u_0, v_0)$.

D. $T_u \times T_v$ at $(u_0, v_0)$ is a unit vector.

E. both B and C, since C follows from B.
Question 2  The surface $x^2 + y^2 + z = 1$ for $z \geq 0$ is parametrized by $\Phi : D \to \mathbb{R}^3$, where $D$ is the unit disk $u^2 + v^2 \leq 1$ and $\Phi(u, v) = (u, v, 1 - u^2 - v^2)$. Then, $T_u \times T_v = (2u, 2v, 1)$ and

A. $\Phi$ is a one-to-one mapping of $D$ onto $S = \Phi(D)$.

B. The parametrized surface $\Phi$ is regular at every point of $S$.

C. The surface $S = \Phi(D)$ has a tangent plane at every point of $S$.

*D. A, B and C

E. none of the above
Question 3  The surface $x^2 + y^2 + z = 1$ for $z \geq 0$ is parametrized by $\Psi : R \to \mathbb{R}^3$, where $R$ is the rectangle $[0, 1] \times [0, 2\pi]$ and $\Psi(u, v) = (u \cos(v), u \sin(v), 1 - u^2)$. Then, $T_u \times T_v = u(2u \cos(v), 2u \sin(v), 1)$ and

A. $\Psi$ is a one-to-one mapping of $R$ onto $S = \Psi(R)$.

B. The parametrized surface $\Psi$ is regular at every point of $S$.

*C. The surface $S = \Psi(R)$ has a tangent plane at every point of $S$.

D. A, B and C

E. none of the above