CMPUT 414/498: Winter 2006, NAME: _____

QUIZ 1, Jan 17th 2006, Max. marks: 10 (0.5% of final grade)

1. What is the homogenous transformation matrix for: (5 marks)

    a) Rotation by 30 degrees around x-axis;
    b) Followed by Translate by (10, 10, -20);
    c) Followed by Rotation by 45 degrees around y-axis.

a) $X = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(30) & \sin(30) & 0 \\ 0 & -\sin(30) & \cos(30) & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & \sqrt{3}/2 & 0.5 & 0 \\ 0 & -0.5 & \sqrt{3}/2 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$ (1 mark)

b) $T = \begin{pmatrix} 1 & 0 & 0 & \Delta x \\ 0 & 1 & 0 & \Delta y \\ 0 & 0 & 1 & \Delta z \\ 0 & 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 10 \\ 0 & 1 & 0 & 10 \\ 0 & 0 & 1 & -20 \\ 0 & 0 & 0 & 1 \end{pmatrix}$ (1 mark)

c) $Y = \begin{pmatrix} \cos(45) & 0 & \sin(45) & 0 \\ 0 & 1 & 0 & 0 \\ -\sin(45) & 0 & \cos(45) & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} \sqrt{2}/2 & 0 & \sqrt{2}/2 & 0 \\ 0 & 1 & 0 & 0 \\ -\sqrt{2}/2 & 0 & \sqrt{2}/2 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$ (1 mark)

The homogenous transformation matrix $M = X*T*Y$ (2 marks)

2. What is the rotation matrix that converts the vector from the origin to (0, 0, 1) to the vector from the origin to $(0, 1/\sqrt{2}, 1/\sqrt{2})$? (5 marks)

Solution 1: Rotation by 315 (or 45) degrees around x-axis.

The matrix is $X = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos(315) & -\sin(315) \\ 0 & \sin(315) & \cos(315) \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1/\sqrt{2} & 1/\sqrt{2} \\ 0 & -1/\sqrt{2} & 1/\sqrt{2} \end{pmatrix}$

Solution 2: cross product is $(-\sqrt{2}/2, 0, 0)$, the normalized direction is (-1, 0, 0) (A lot of people forgot to normalized the vector!), … And you will get the same answer.
(1 mark for cross product, 2 marks for normalized cross product, 2 marks for the answer)