

# Farmer Mathematics: Matrix Transformation

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Wahoo!

1. A certain rabbit is snooking some stars. A snooker ball at position  $(44, 72)$  is reflected in the  $x$ -axis and then undergoes an  $x$ -invariant shear of 3 units. Calculate the final position of the ball.
2. A rotten egg was using my pull-up bar so I rotated him about the  $z$ -axis clockwise by  $\frac{\pi}{3}$  relative to the origin. What is the matrix that this transformation can be conveyed by?
3. I went to G's fitness club and my arms grew relative to the origin by scale factor 5 in the  $x$ -axis, 7 in the  $y$ -axis and 11 in the  $z$ -axis. What matrix reflects this change?
4. This time I decided to snook some stars. I was trying to play the game normally, but due to my extreme buffness I accidentally rotated the table by 45 degrees anticlockwise around the  $y$ -axis and then 90 degrees clockwise around the  $x$ -axis, all relative to the origin. Find a matrix that describes this.
5. (a) An inclined slope has points  $O(0, 0)$ ,  $A(7, 5)$  and  $B(7, 0)$ . Find  $a, b$  where the slope is invariant to the transformation  $\begin{bmatrix} 8 & b \\ a & 7 \end{bmatrix}$ .  
(b) Find the angle  $\theta$  by which this rough slope of coefficient of friction  $\frac{1}{2}$  is inclined. Particle P of mass  $mg$  is on the slope and connected to particle Q of mass  $3kg$  by a string passed through a smooth frictionless pulley. Given that the system is in limiting equilibrium, find the Tension  $T$ .

## Solutions

1.  $(260, 72)$

2. 
$$\begin{bmatrix} \frac{1}{2} & \frac{-\sqrt{3}}{2} & 0 \\ \frac{\sqrt{3}}{2} & \frac{1}{2} & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

3. 
$$\begin{bmatrix} 5 & 0 & 0 \\ 0 & 7 & 0 \\ 0 & 0 & 11 \end{bmatrix}$$

4. 
$$\begin{bmatrix} \frac{1}{\sqrt{2}} & \frac{-1}{\sqrt{2}} & 0 \\ 0 & 0 & 1 \\ \frac{-1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & 0 \end{bmatrix}$$

5. (a)  $a = \frac{-30}{7}, b = \frac{-49}{5}$

(b)  $29.4N$