Question 1 (50 points):

The `TransformNode` of your scene graph stores two transformations: `transform` and `animationTransform`. The former is used to create a stationary pose, while the latter is used for animation.

In Assignments 4 and 5, you animated a scene graph model by writing a function that set the `animationTransform` of certain nodes in your scene graph. Thus, you created the animation through your program, not through the input file. This question explores the possibility of specifying the animation directly in the scene graph.

Amit decided that the simplest way to do this would be to create a new type of node : `AnimationNode`. This would store two transformations as matrices `A` and `B`, and a time interval (t_{min}, t_{max}) during which the animation would be active. At any time 't', such that $t_{min}<=t<=t_{max}$, the animation transformation could be calculated as:

$f = (t-t_{min})/(t_{max}-t_{min})$

$C = B*f + A*(1-f)$ (linearly interpolate each of the 16 numbers in the matrices)

Thus, at $t=t_{min}$, C=A and at $t=t_{max}$, C=B.

<u>Unfortunately, this would not work because linear interpolation of matrices does not always produce correct transformation matrices!</u>

(a) If the animation is a pure translation (one translation to another translation): what data should the animation node store and how would it compute the intermediate animation transform at time 't'? (10 points)
(b) If the animation is a pure scale (one scale to another scale, scales can be non-uniform): what data should the animation node store and how would it compute the intermediate animation transform at time 't'? (10 points)
(c) If the animation is a pure rotation (one type of rotation to another): what data should the animation node store and how would it compute the intermediate animation transform at time 't'? (10 points)
(d) Given that interpolation of matrices does not work and your answers above, explain how animation nodes can be used in the scene graph to draw it. Your answer should include the possibility that the motion being transformed is a composite motion (e.g. rotation+translation). (10 points)
(e) Provide an example in XML about how you would use the above machinery to specify a single sphere that starts out in its standard position and size (unit radius, centered at origin), and then moves its center to (10,10,10) from t=1 to t=10, and getting bigger from unit radius to radius 10 from t=3 to t=8.

Your answer should be brief and concise. Please use numbered lists (sequence of steps) wherever possible. Please include code snippets for each case above, specifying only those parts of code that are directly relevant to the answer.