Multiple Choice Questions
Section = 15 marks (3 marks for each question; 5 questions)

Question 1 (3 marks)

Suppose you are modelling an airplane that is created with its front facing the direction of the positive X-axis.

This means that your airplane would initially appear in 3D space as in the diagram, with heading =0, pitch =0, and roll =0.

Also, suppose you need to transform the airplanes orientation to heading=120, pitch =30, and roll=10.

Which of the following sets of transforms could you use:

a) Rotate around Z by 10, then rotate around Y by 30, then rotate around X by 120.
b) Rotate around X by 10, then rotate around Y by 30, then rotate around Z by 120.
c) Rotate around X by 10, then rotate around Z by 30, then rotate around Y by 120.
d) Rotate around Z by 10, then rotate around X by 30, then rotate around Y by 120.
Question 2  

(3 marks)

Suppose you are modelling a beacon using an emissive Sphere defined by the following VRML code:

```vrml
def beaconTransform {
  children [
    shape {
      geometry shape Sphere {
        appearance Appearance {
          material DEF BeaconMaterial Material {
          }
        }
      }
    }
  ]
}
```

Also, suppose you need to animate the beacon so that it is initially turned off, then it turns on gradually, it remains fully lit for 1 second, and it then turns off gradually.

**Which of the following nodes and routing could you use?**

a)  
$\$  A TimeSensor with intervalCycle 1  
$\$  A ScalarInterpolator with the following fields:
  o key       [ 0 , .25 , .75 , 1 ]
  o keyValue  [ 0 , 1 , 1 , 0 ]
$\$  Route the value to the set_intensity field of the Material

b)  
$\$  A TimeSensor with intervalCycle 2  
$\$  A ScalarInterpolator with the following fields:
  o key       [ 0 , .25 , .75 , 1 ]
  o keyValue  [ 1 , 0 , 0 , 1 ]
$\$  Route the value to the set_intensity field of the Material

c)  
$\$  A TimeSensor with intervalCycle 1  
$\$  A ScalarInterpolator with the following fields:
  o key       [ 0 , .5 , 1 ]
  o keyValue  [ 0 , 1 , 0 ]
$\$  Route value to the set_transparency field of the Material

d)  
$\$  A TimeSensor with intervalCycle 2  
$\$  A ScalarInterpolator with the following fields:
  o key       [ 0 , .25 , .75 , 1 ]
  o keyValue  [ 1 , 0 , 0 , 1 ]
$\$  Route the value to the set_transparency field of the Material
Question 3  (3 marks)

Assume you have created an animated model in the Solar System using a hierarchy of transforms. Which of the following transforms is the most deeply nested in the hierarchy?

a) A translation that sets the Earth and the Moon 30 million kms away from the origin
b) A rotation that makes the Earth and Moon travel around the Sun
c) A translation which sets the Moon 200,000 kms away from the Earth
d) A rotation which makes the Moon travel around the Earth

Question 4  (3 marks)

Which of the following computations are not practical in real time 3D graphics?

a) Processing Java code
b) Computing global diffuse shading
c) Rendering with anti-aliasing
d) Computing smooth interpolation
e) Bump-mapping (i.e. Using texture maps to modify normals for shading)
f) All of the above
g) B, C and D only

Question 5  (3 marks)

Suppose you are modelling a cannon that is 1 metre long that is created pointing in the direction of the X axis with its base at the origin, and which has been rotated so that it has a pitch of 30 degrees. (See the picture at right).

Also, suppose you wish to animate a missile coming from the end of the cannon.

How could you calculate the coordinates of the end of the cannon (in metres)?

a) Use the sine of 30 degrees as the X coordinate, and the cosine of 30 degrees as the Y coordinate.
b) Use the cosine of 30 degrees as the X coordinate, and the sine of 30 degrees as the Y coordinate.
c) Use the sine of 30 degrees as the X coordinate, and the cosine of 60 degrees as the Y coordinate.
d) Use the cosine of 30 degrees as the X coordinate, and the sine of 60 degrees as the Y coordinate.
Short Answer Matching
Section = 13 marks (1 mark for each question; 13 questions)

Question 6  (1+1+1+1+1+1+1+1+1+1+1+1+1= 13 marks)

For each of the following definitions, write a word or phrase that matches, choosing from the list of words and phrases provided below:

a) A field of a VRML node which can be used in a ROUTE … TO statement.
   __________________________________________________________________________

b) A procedure in which polygons which are not visible in a view are eliminated from processing
   __________________________________________________________________________

c) A function which tests to see whether a point in a scene is inside or outside of a shape in the scene.
   __________________________________________________________________________

d) A set of objects in a VRML scene that rotates and translates in response to the position and orientation of the Viewpoint
   __________________________________________________________________________

e) A set of objects in a VRML scene that rotates in response to the position of the Viewpoint
   __________________________________________________________________________

f) An extra 8 bits of information per pixel used to model transparency in textures
   __________________________________________________________________________

g) A technique which is used to calculate the position, colour, texture coordinates and normals of a polygon’s pixels from the position, colour, texture coordinates and normals of its vertices.
   __________________________________________________________________________

h) A basic pre-defined model from which other models may be built.
   __________________________________________________________________________

i) A word describing a polygon that can be contained within a plane, and which can therefore be rendered properly in 3D.
   __________________________________________________________________________

j) A jointed model that may be posed in realistic positions by controlling a set of built –in rotation transforms.
   __________________________________________________________________________

k) A node which may be used to switch from one model to another in a VRML scene using a set_choice input.
   __________________________________________________________________________

l) A 3D shape which is defined by specifying vertices, edges between vertices, and sets of edges which form polygons.
   __________________________________________________________________________

m) A node which automatically switches one model for another in a VRML scene.
   __________________________________________________________________________

Culling  Switch  Polygon Mesh
Alpha-channel Primitive Concave
Billboard EventIn Planar
Heads-Up Display LOD (Level of Detail) Bi-Linear Interpolation
Collision Detection Articulated model


Short Answer Questions
Section = 36 marks (6 marks for each question; 6 questions)

Write a sentence or paragraph for each of the following:

Question 7 (6 marks)
Explain the benefits of using PROTO statements and Script nodes in creating complex VRML scenes.

Question 8 (6 marks)
Briefly describe the ways in which you specify and control the mapping of 2-D textures onto 3-D objects in VRML?

Question 9 (6 marks)
Define the term normal and explain why normals are essential in shading 3D objects.

Question 10 (6 marks)
An orthographic view is a view with no perspective. Is it possible to create an orthographic view in VRML? If not, how would you approximate an orthographic view?

Question 11 (6 marks)
Explain how a scientist can use VRML to visualise a 2-dimensional table of data?

Question 12 (6 marks)
When video is streamed over the Internet, a continuous series of image and sound data is sent from a specialised video server to a specialised video viewer. How does this compare to what happens when Web 3D is viewed over the Internet?
VRML Code Questions
Section = 45 marks (15+10+15 marks)

Question 11 (15 marks)

Write some VRML code to model the following simple scene.

$\quad$ A polygon mesh that forms a very simple “house” as depicted in the picture.

(Use the coordinates indicated in the drawing. Include all four walls and roof in your model, but no floor. You do not need to model the color.)

Question 11 (10 marks)

Write some VRML code to model the following simple scene:

$\quad$ A cone made of polished silver metal.

(You must create a Material that approximates the correct appearance).
Examine the VRML code below. In this scene there is a stop-watch (a clock with only one hand.)
Write the additional VRML code needed to animate the hand of this clock rotating all the way around.

A Script node has been provided which will convert an angle value into a Z rotation. All you need to do is create a ScalarInterpolator, a TimeSensor, and the necessary ROUTE statements.

```vrml
#VRML V2.0 utf8

DEF ClockHand Transform { # minute hand
  children [
    Transform {
      translation 0 2 0 # move bottom of the stick to origin
      children [
        Shape {
          geometry Box { size .2 4 .2 }
        }
      ]
    }
  ]
}

Inline { url "ClockFace.wrl" } 

DEF Z_Rotator Script {
  eventIn SFFloat set_angle
  eventOut SFRotation value_changed
  url "javascript:
    function set_angle ( radians, ts ) {
      value_changed[0] = 0;
      value_changed[1] = 0;
      value_changed[2] = 1;
      value_changed[3] = radians;
    }
  "
}

# Without any animation, the ClockHand will be pointing up
```
Scene Graphs

Question 13 (16 marks)

Draw a Scene Graph or hierarchy that represents a model of the lamp pictured below, as it would be modelled in VRML. (Write object name and the type for each node in the Scene Graph.)

THE END