1- ... suffer from a pixelization effect on zoom in.

i- Raster Images
ii- Vector Images
iii- Both of them
iv- None of them

2- To solve the issue of non-linear response on screens we use …

i- Deferred Correction
ii- Raster Correction
iii- Gamma Correction
iv- Bonferroni correction

3- Vector images are resolution-dependent.

i- True
ii- False

4- Given 3 triangles A, B, and C, with C being the nearest and A the furthest. Fill colors (RGBA) of each triangle are:

$$C_A = (0.5, 0.5, 0.5, 1)$$

$$C_B = (0.1, 0.7, 0.5, 0.5)$$

$$C_C = (0.7, 0.6, 0.9, 0.75)$$

Then the final color of a pixel covered by the 3 triangles: C =

i- $(0.5, 0.5, 0.5)$
ii- $(0.6, 0.6, 0.8)$
iii- $(0.3, 0.6, 0.5)$
iv- $(0.4333, 0.6, 0.6333)$

5- For the line represented by $f(x,y) = Ax + By + C = 0$ and passing by (x_0, y_0) and (x_1, y_1), the values of A and B are

i- $A = y_0 - y_1$ and $B = x_1 - x_0$
ii- $A = y_1 - y_0$ and $B = x_1 - x_0$
iii- $A = y_0 - y_1$ and $B = x_0 - x_1$
iv- $A = y_1 - y_0$ and $B = x_0 - x_1$

6- If we add an RGB color [255, 0, 0] to another color [0, 255, 0], the result is the color [255, 255, 0].

i- True
ii- False

7- for $f(x,y) = ax + by + c$, the vector $[a\ b]$ represents:

i- The normal vector on the line $f(x,y) = 0$
ii- the gradient vector of $f(x,y)$
iii- The direction in which the distance from the line doesn't change
iv- None of the above

8- **The following line-drawing algorithm suffers from the following problems:**

```
y = y_0
d = f(x_0 + 1, y_0 + 0.5)
for x = x_0 to x_1 do
  draw(x,y)
  if d < 0 then
    y = y + 1
    d = d + (x_1 - x_0) + (y_0 - y_1)
  else
    d = d + (y_0 - y_1)
```

i- Excessive evaluation for the function of the line
ii- Floating-point calculations
iii- Both of them
iv- None of them

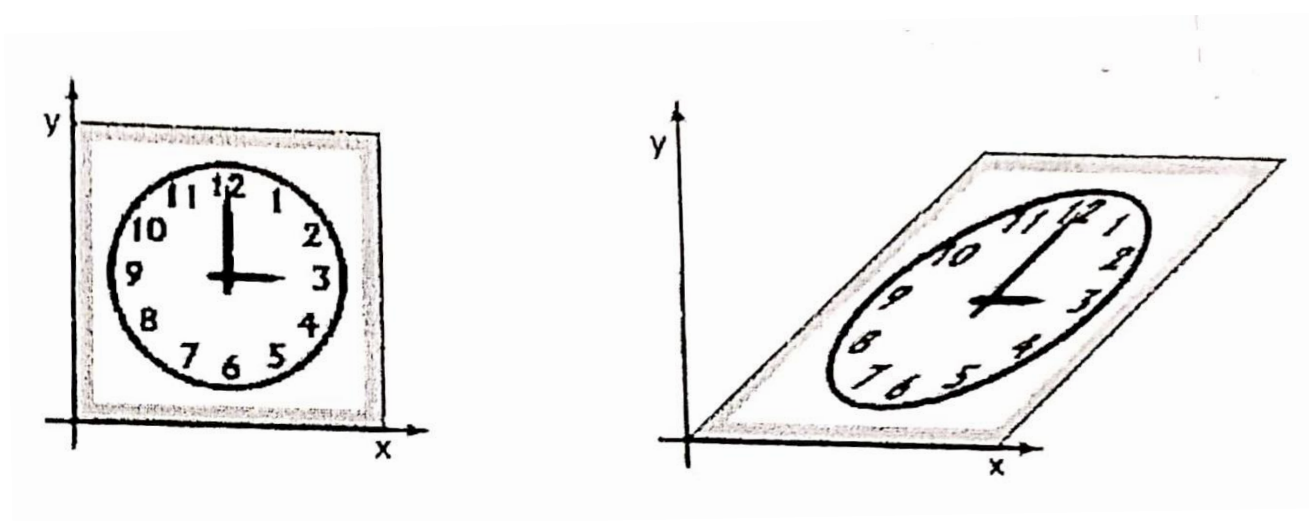
9- Which of the following transformations has an orthonormal matrix?

i- Scaling
ii- Rotation
iii- Shearing
iv- Translation

10- The 2D Reflection around the line y=x is orthonormal.

i- True
ii- False

11- To transform the shape on the left to the shape on the right (square -> skewed square), the following transformation matrix is needed.



i- [1, 0; 0, 1]
ii- [1, 2; 0, 1]

iii- [1, 1; 0, 1]
iv- [1, 0; 1, 1]

12- The following triangle drawing algorithm can be optimized by modifying the line:

```
1 for all x[0:screen_width] do: for all y[0:screen_height] do:
2    compute (alpha, beta, gamma) for (x,y)
3    // Inside?
4    if (alpha in (0,1) AND beta in (0,1) AND gamma in (0,1)) then
5         c = alpha*c0 + beta*c1 + gamma*c2
6         drawpixel(x,y) with color c
```

i- #1
ii- #4
iii- Both of them
iv- None of them

13- if a rectangle defined by the points A (1,1), B (3,1), C (1,3) and D (3,3) is transformed to the new points A' (5,2), B' (9,2), C'(6,4), D'(10, 4). What is the order of transformations needed to transform ABCD to A'B'C'D'?

i- Translation, Uniform Scaling, Shearing in x-direction, Translation.
ii- Translation, Non-uniform Scaling, Shearing in x-direction, Translation.
iii- Translation, Non-uniform Scaling, Shearing in y-direction, Translation.
iv- None of the above

14-16 - Given triangle ABC, $A = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}, C = \begin{bmatrix} 2 \\ 2 \end{bmatrix}$, With color values at each respectively: $C_A = \begin{bmatrix} 0.6 \\ 0.4 \\ 0.1 \end{bmatrix}, C_B = \begin{bmatrix} 0 \\ 0.5 \\ 0.7 \end{bmatrix}, C_C = \begin{bmatrix} 0.6 \\ 0.6 \\ 1 \end{bmatrix}$.
Given arbitrary point P:

14- if $\beta = 0$ and P is on the edge CA, $\gamma =$ …..

i- 0
ii- 0.5
iii- 1
iv- Not enough Information

15- Given $\beta = 0.5$ and P is inside ABC, $\gamma =$ …..

i- 0.0
ii- 0.3
iii- 0.5
iv- 0.7

16- Given P = $\begin{bmatrix}1\\1\end{bmatrix}$ Color at point P (C_P) $=$

i- $[0.6\ 0.9\ 0.8]^T$
ii- $[0.3\ 0.3\ 0.5]^T$
iii- $[0.4\ 0.5\ 0.6]^T$
iv- Not enough Information

17- If rotation R(θ) is applied to point P = (x,y), followed by reflection about the x-axis, followed by reflection about the y-axis and finally a uniform scaling is applied by factor σ to obtain the point P' then which of the following is correct about the transformation of point P to point P'?

i- P' = R(θ) * R(180) * S(σ) * P
ii- P' = S(σ) * R(-180) * R(θ) * P
iii- P' = S(σ) * R(90) * R(90) * R(θ) * P
iv- None of the above

18- The off-diagonal elements in a transformation matrix may be non-zeros only if the transformation applied is:

i- Scaling
ii- Shearing
iii- Reflection
iv- Scaling followed by reflection.

19-22- The next four questions are related:

19- What are the transformations needed for a reflection about an arbitrary line y = mx + c? (c>0) (regardless of the order of transformations).

i- Translation
ii- Scaling
iii- Reflection
iv- Rotation

20- if translation is needed, how many translation operations are needed?

i- 1
ii- 2
iii- 3
iv- Translation is not needed.

21- If scaling is needed, what are the scaling factors Sx and Sy?

i- Sx = m, Sy = 1
ii- Sx = 1, Sy = m
iii- Sx = m/c, Sy = 1/c
iv- Scaling is not needed.

22- If rotation is needed, what will be the absolute value of the angle of rotation?

i- $|m|$

ii- $|\tan^{-1}(m)|$

iii- $|\tan^{-1}(m/c)|$

iv- Rotation is not needed.

23- The rotation matrix [cos θ, sin θ; -sin θ, cos θ]

i- Rotates points around the X-axis using an angle θ counter-clockwise.
ii- Rotates points around the Y-axis using an angle θ clockwise.
iii- Rotates points around the origin using an angle θ counter-clockwise,
iv- Rotates points around the origin using an angle θ clockwise.

24- The transformation matrix [-1, 0; 0, 1]

i- Reflects points around the X-axis
ii- Reflects points around the Y-axis
iii- None of them

25- If we transform a point by a transformation matrix M_1 followed by another transformation matrix M_2 this is equivalent to the transformation matrix $M = M_1M_2$.

i- True
ii- False

26- The inverse of [cos θ, -sin θ, sin θ cos θ] is

i- [cos θ, sin θ; -sin θ, cos θ]
ii- [cos θ, -sin θ; sin θ, cos θ]
iii- [cos -θ, -sin -θ; sin -θ, cos -θ]
iv- None of the above

27- Given that R = [cos θ, -sin θ; sin θ, cos θ] and S = [cos α, -sin α; sin α, cos α]

i- RS != SR because the order of transformations matter.
ii- RS=SR
iii- It depends on θ and α.

28- The 2D point [1 5] is represented in homogeneous coordinates as

i- [1 5 1]
ii- [1 5 0]
iii- [2 10 2]
iv- None of the above

29- The 2D vector [1 5] is represented in homogeneous coordinates as

i- [1 5 1]
ii- [1 5 0]
iii- [2 10 2]
iv- None of the above

30- The following matrix represents

$$\begin{bmatrix} R_{2\times2} & t_{2\times1} \\ 0^T & 1 \end{bmatrix}$$

i- A translation then a rotation in the 2D space
ii- A translation then a rotation in the 3D space
iii- A rotation then a translation in the 3D space
iv- None of the above

31- Given that xyz is the canonical frame, the following matrix

$$\begin{bmatrix} x_u & x_v & x_w \\ y_u & y_v & y_w \\ z_u & z_v & z_w \end{bmatrix}$$

i- Rotates uvw to xyz
ii- Rotates xyz to uvw
iii- Changes the coordinate system from uvw to xyz
iv- Changes the coordinatet system from xyz to uvw

32- Given the canonical frame xy and another arbitrary frame uv that is located at e, the following matrix represents

$$\begin{bmatrix} x_u & y_u & 0 \\ x_v & y_v & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} 1 & 0 & -x_e \\ 0 & 1 & -y_e \\ 0 & 0 & 1 \end{bmatrix}$$

i- The canonical to frame transformation
ii- The frame to canonical transformation
iii- Either of the above
iv- None of the above

33-if we rotate the points of a surface using the rotation matrix M, the surface normal vectors can be transformed by the matrix

i- M^{-1}
ii- MT
iii- M
iv- None of the above

34- A windowing transform may be obtained by

i- Translation then scaling then translation
ii- Translation then scaling
iii- Scaling then translation
iv- None of the above

35- Which of the following projections have parallel lines remain parallel and never intersect?

i- Orthographic projection
ii- Perspective Projection
iii- None of them

36- In the perspective projection, there is a single vanishing point in any image because parallel lines intersect at this point.

i- True
ii- False

37- The modeling transformation converts points from object space into the world space.

i- True
ii- False

38- The viewport transformation is a

i- Rotation transformation
ii- Windowing transform
iii- Canonical to frame transformation
iv- Frame to canonical transformation

39- The camera transformation is a

i- Rotation transformation
ii- Windowing transform
iii- Canonical to frame transformation
iv- Frame to canonical transformation

40- The orthographic projection transformation is

i- Rotation transformation
ii- Windowing transform
iii- Canonical to frame transformation
iv- Frame to canonical transformation

41- The modeling transformation is a

i- Rotation transformation
ii- Windowing transform
iii- Canonical to frame transformation
iv- Frame to canonical transformation

42- Which transformation depends on the object position and orientation?

i- Camera transformation
ii- Viewport transformation
iii- Modeling transformation
iv- Projection transformation

43- Which transformation depends on the resolution of the output image?

i- Camera transformation
ii- Viewport transformation
iii- Modeling transformation
iv- Projection transformation

44- if the camera was located at the origin of the world coordinates, then the camera transformation matrix must be the identity matrix.

i- True
ii- False

45- If the distance between point A and point B is 2. Assume that there is a camera at location (0, 10,0), looking at the origin and its up vector points in the direction (1,0,1). What will be the distance between A and B after applying the camera transform to them?

i- 4
ii- sqrt(2)
iii- 2
iv- Cannot be determined using the given information.

46 - (In Barycentric Coordinates of Triangle ABC). We can calculate $\beta = \frac{Area(\Delta APC)}{Area(\Delta ABC)}$

i- True
ii- False

47 - Raster images are made up of Pixels and do not depend on the resolution. What is wrong about this sentence?

i- The first part is wrong. Instead, raster Images are made up of object description.
ii- The second part is wrong. Instead, raster images depend on the resolution.
iii- None of the above. The sentence is already correct.

48 – Of the following components, which depend on the eye (viewpoint) position

i- diffuse
ii- specular
iii- ambient
iv- None of the above.

49 – Of the following components, which depend on the light source position

i- diffuse
ii- specular
iii- ambient
iv- None of the above.

50 – Rasterization is/does

i- Readily available in GPUs
ii- Produce realistic images
iii- Parallelizable
iv- Loop over pixels and for each, loops over each triangle.

51- The factor of reflected light ray between entering a refractive medium depends on:

i- The normal vector of the surface separating the mediums

ii- The direction of the ray falling on the surface

iii- The intensity of the light

iv- The distance between light source and surface

52 – As described in the Ray intersection with 2D boxes, we determine $t_{min} and\ t_{max}$ using $t_{xmin}, t_{xmax}, t_{ymin}, and\ t_{ymax}$. These four values can take ….. distinct value/s

i- 1

ii- 2

iii- 3

iv- 4

---

53 – We say that there is an intersection between the ray and a rectangle in 3D if ………………

i- The ranges $[t_{xmin}\ , t_{xmax}]$, $[t_{ymin}, t_{yman}]$ overlap

ii- $max(t_{xmin}, t_{ymin}) < min(t_{xmax}, t_{ymax})$

ii- $max(t_{xmin}, t_{ymin}) > min(t_{xmax}, t_{ymax})$

iv – The ranges $[t_{xmin}\ , t_{xmax}]$, $[t_{ymin}, t_{yman}]$ don't overlap

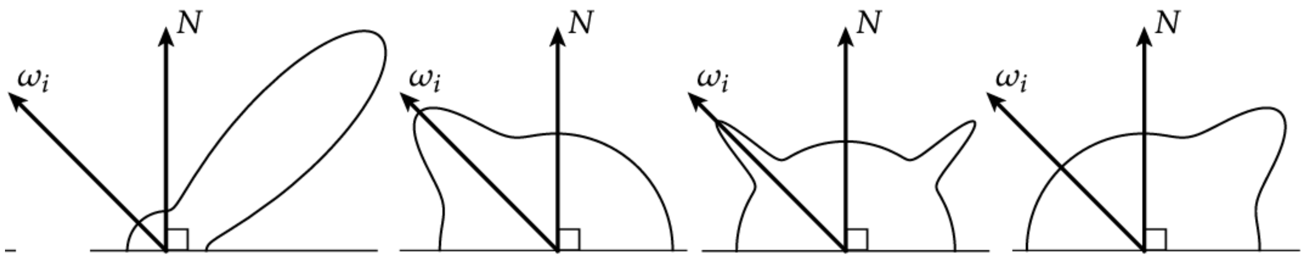
54- To get the depth values for pixels inside a triangle, we use

i- Barycentric Coordinates

ii- Homogenous Coordinates

iii- None of the above

55- To decorate your new bedroom, you decide to paint it with a unique painting. you first paint it with a bright white diffuse paint, then a dull glossy (specular) glaze. For a given light direction wi. Which material BRDF looks most like your paint?



(i) (ii) (iii) **(iv)**

56- To check for faces that will not be drawn (back face culling), A face is not drawn if: (n is the normal vector to the face, v_{cam} is the viewpoint vector)

i- $n \cdot v_{cam} > 0$
ii- $n \cdot v_{cam} < 0$
iii- $\|n + v_{cam}\| < 0$
iv- $\|n + v_{cam}\| > 0$

57- Raytracing's runtime complexity scales with ...

i- Number of pixels (resolution)
ii- Number of objects
iii- Number of lights
iv- None of the above

58- By using Z-Buffering in rasterization, for each pixel, we loop over all triangles to check the depth at this point and color it with triangle color having the minimum depth value

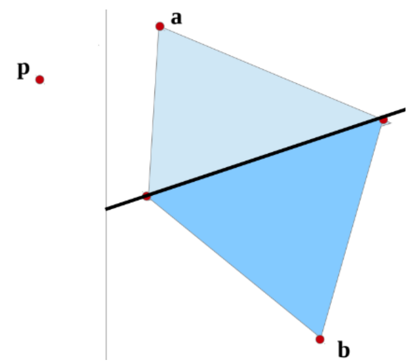
i- True
ii- False

59- By using Z-Buffering in rasterization, for each pixel, we loop over all triangles to check the depth at this point and color it with triangle color having the minimum depth value

i- True
ii- False

60- A 2D vector can be written as a linear combination of any two non-parallel vectors. This is called …. And the two vectors are called …..

i- Non-linear Independence, origin vectors.
ii- Non-linear Independence, basis vectors.
iii- linear Independence, basis vectors.
iv- linear Independence, origin vectors.



61- What is the value of $f(b) \times f(p)$?

i- < 0
ii- > 0
iii- $= 0$
iv- Not enough information.

62- In which step in the 3D viewing pipeline, we drop the z coordinate?

i- Modelling Transformation.
ii- Camera Transformation.
iii- Projection Transformation.
iv- Viewport Transformation.

63 – To implement soft shadows using ray tracing you can……….

i- Shoot rays from each pixel to different points of the area light source
ii- Shoot rays from different pixels and average those meeting at the same point in

the area light source
iii – Shoot rays from the light source to all other pixels
iv – Shoot one ray from the pixel to the middle of the light source

64- Flat shading

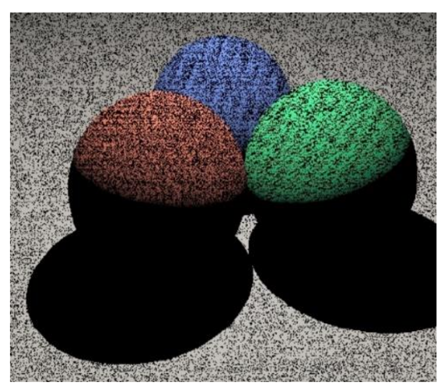
i- computes Shading Once per vertex
ii- is very cheap computationally
iii- results in a faceted appearance
iv- None of the above

65- Gourard Shading ..

i- suffers from Mach banding
ii- is very fast
iii- is more realistic than Phong shading
iv- None of the above

66- The following Code snippet produces a noisy result as shown below, which line can be changed to avoid this issue.

```
1 function ComputeShading(ray, t0, t1)
2     Get intersection of ray with scene
3     if intersection != NULL
4         Color = ambient
5         Get n, h, l
6         if !blocked(shadowray, 0, ∞)
7             Color += kd * max(0, <n,l>) + ks * <h,n> * p
8     else
9         Color = background
```



i- #6
ii- #7

iii- #9
iv- None of the above

67- Raytracing handles objects:

i- With parameterized equations (Spheres, planes, etc..)
ii- With arbitrary shapes
iii- With meshes

68- Phong shading computes shading at each vertex using vertex normal then interpolates across triangle using Barycentric Coordinates.

i- True
ii- False

69- BRDF stands for ….

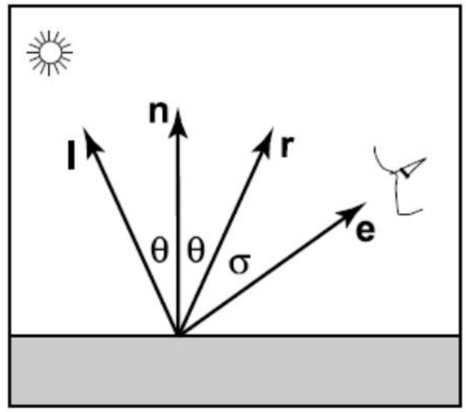
i- Bidirectional Refraction Distribution Function
ii- Bidirectional Reflectance Distribution Function
iii- Bounded Refraction Distribution Function
iv- Bounded Reflectance Distribution Function

70- ….. is modelled as a constant lighting component depending on the material of the object

i- diffusion
ii- specular
iii- alpha
iv- ambient

71-75: Next 5 questions are related: A light source hits a surface with, Given that:

$$I = [-0.707 \quad 0.707]$$
$$n = [0\ 1]$$
$$e = [0.8\ 0.6]$$
$$k_{spec} = 0.5, k_{diff} = 0.2, k_{amb} = 0.2$$
$$I = 0.5, I_a = 0.2, p = 4$$



l: Light direction n: Surface normal

e: To eye vector p: Specular exponent

I: Light source intensity I_a: Surrounding light intensity

kspec, kdiff, kamb: material constants for specular, diffusion and ambient components respectively

71- r =

i- [0.707   0.707]

ii- [0.6 0.8]

iii- [0.354   0.354]

iv- [−0.354   0.354]

72- Specular Component of reflected light, $Rspec$=

i- 0

ii- 0.2399

iii- 0.2475

iv- 0.9598

73- Diffuse Component of reflected light, $Rdiff$=

i- 0

ii- 0.071

iii- 0.354

iv- 0.707

74-The total reflected light, $\boldsymbol{R}$=

i- 0.04

ii- 0.2238

iii- 0.3509

iv- 0.7802

75- If we were to add one more light ray falling on the same point, the … component/s of reflected light could be affected

i- diffusion

ii- specular

iii- ambient

76- Raytracing can approximate …... better than rasterization:

i- Shadows
ii- Reflections
iii- Refractions
iv- None of the above

77- The sun can be modeled as a ….. for an observer on the earth

i- Point light source
ii- Directional light source
iii- Spot light source
iv- PBS light source

78- Distribution raytracing can be used for ...

i- Anti-aliasing (super-sampling)
ii- Glossy reflections
iii- Glossy refractions
iv- Soft shadows

79- One of the drawbacks of Ray tracing with single Ray is that it looks too clean and crisp

i- True
ii- False

80- One To compute the normal of a triangle face ABC, n =

i- $A \cdot B$
ii- $(A - B) \cdot (A - C)$
iii- $A \times B$
iv- $(A - B) \times (A - C)$

81- In ray tracing, we can define the ray by its starting and ending points

i- True
ii- False

82- The phenomenon of light being trapped in a material.

i- Inter-material trapping.
ii- Inter-material refraction.
iii- Total Internal Refraction.
iv- Total Internal Reflection.

83- Ray tracing computation is mainly based on the .... concept

i- recursion
ii- parallelism
iii- memory sharing
iv- gamma correction

84- Barycentric coordinates are only used with rasterization rendering.

i- True

ii- False

85- Of the following values for d, which causes a total internal reflection?

i- $[0 \quad -1]$
ii- $[0.707 \quad -0.707]$
iii- $[0.8 \quad -0.6]$
iv- $[0.6 \quad -0.8]$

86- given that $\boldsymbol{d}$ = [0.8 −0.6], compute $\boldsymbol{t}$=

i- $[0.436 \quad -0.9]$
ii- $[0.9 \quad -0.436]$
iii- $[0.634 \quad -0.773]$
iv- $[0.773 \quad -0.634]$

87- It would be correct to apply perspective projection using the matrix $\begin{pmatrix} n & 0 & 0 & 0 \\ 0 & n & 0 & 0 \\ 0 & 0 & a & b \\ 0 & 0 & 1 & 0 \end{pmatrix}$ on a point $\begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix}$ if i- $a = 0$ and $b = 0$

ii- $a = 1$ and $b = -1$

iii- $a = 1$ and $b = 0$
iv- $a = 2$ and $b = 0$

88 – According the to the right answer in the question above, if the near plane is at $z = 4$ and the far plane is at $z = 10$ then an object whose z value satisfies …….. would not be rendered.

i- $z < 0.75$
ii- $z > 0.9$
iii- $z > 0$
iv- $z < 0.8$

89 – Projection lines are parallel to the camera's ……… in an orthographic projection

i- gaze direction
ii- turn-up vector
iii- w-axis
iv- u-axis

90 – An orthographic projection ………. on camera's position meanwhile a perspective projection ……….. on camera's position

i- depends, depends
ii- depends, does not depend
iii- does not depend, does not depend
iv- does not depend, depends

91 – After the camera transformation, normalizing the view volume ………….

i- is a step incorporated in the projection transformation
ii- makes it such that objects with $z > 1$ or $z < -1$ should not be drawn

iii- is a windowing transformation
iv- can be ignored if that’s taken into account in further steps

92 – If your height is 160 cm then your height becomes …………. after perspective projection with the near plane being at z = 10, far plane being at z = 20 and your feet having z = 15 and y = 0

i- 106.6 cm
ii- 125 cm
iii- 80 cm
iv- 160 cm

93 – In ray tracing with orthographic projection, we shoot ……… rays if our display is 200x200 and all of them emerge from ……….. point in the near plane.

i- 40000, the same
ii- 400, the same
iii- 800, a different
iv- 40000, a different

94 – In ray tracing with perspective projection, we shoot ……… rays if our display is 20x20 and we are using anti-aliasing with supersampling at 100 times the resolution and all of them emerge from ……….. point in the near plane.

i- 40000, the same
ii- 400, the same
iii- 800, a different
iv- 40000, a different

95 – Ray Tracing is ………..

i- Readily supported by GPUs
ii- Includes a unified, parallelizable way of dealing with reflections

iii- For each triangle, it loops on every pixel to decide which color
iv- Can be too slow for interactive applications

96 – Each pixel on the screen corresponds one-to-one to a point on the near plane from which we shoot a ray and check where it hits.

i- True
ii- False

97 – Once we shoot a ray through the near plane, its sufficient to stop at the first object hit and record its color in the corresponding pixel

i- True
ii- False

98 – If there are 10 objects in the scene and 3 light sources then the number of total rays shot due to one pixel is ………… assuming handling of shadows

i- 2
ii- 13
iii – at least 13
iv – at most 4

99 – A ray may have at most ……… intersections with a sphere, meanwhile at most ……. Intersections with a plane where the ray does not live

i- 2, 1
ii- 1, 2
iii – 1, 1
iv – 2, 2

100 – To check the intersection between a ray and a triangle mesh, the efficient approach is to ………………

i- Start with each triangle’s plane and inequalities for each of its sides
ii- Use barycentric coordinates and find α, β, γ, t
iii – Breakdown the mesh into bounding boxes and check intersections there first
iv – Find intersections between the ray and the three straight lines forming the triangles side