

Important Question with Answer

Q1. What do you mean by computer graphics?

Ans. The branch of science and technology concerned with methods and techniques for converting data to or from visual presentation using computers.

data → visual presentation

Q2. What are the applications of computer graphics?

Ans. 1. Computer Aided Design ✓

2. Graphical User Interface ✓

3. Entertainment ✓

4. Simulation and Training ✓

5. Education and Presentation ✓

6. Computer Generated Art ✓

7. Scientific Visualization ✓

8. Image Processing ✓

9. Virtual reality ✓

10. Cartography ✓

*user can interact, like icons in GUI
where we can interact
via cursor*

Q3. What do you mean by interactive computer Graphics?

Ans. Interactive computer Graphics like a website, it is only useful if it is browsed by a visitor and no two visitors are exactly alike. It means the website must support the interaction of users with a variety of skills, interests and end goals. **Interactive computer graphics involves the user's interaction.**

Q4. What do you mean by GUI?

Ans. **GUI stands for Graphical user interface. A major component of a GUI is a window manager that allows a user to display multiple-window areas.** To make a particular window active we simply click in that window using an interactive pointing device. **Interfaces also display menus and icons for fast selection of processing options or parameter values.**

Q5. What does it mean by RGB?

Ans. The **RGB is a color model**, it is an **additive color model in which red, green, and blue light are added together in various ways to reproduce a broad array of colors.** The name of the model comes from the initials of the three **additive primary colors, red, green, and blue.** The main purpose of the RGB color model is for the sensing, representation, and display of images in electronic systems, such as televisions and computers, though it has also been used in conventional photography.

Q6. Define VDU?

Ans. A monitor or display (sometimes called a visual display unit) is a piece of electrical equipment which displays images generated by devices such as computers, without producing a permanent record. The monitor comprises the display device, circuitry, and an enclosure. The display device in modern monitors is typically a thin film transistor liquid crystal display (TFT-LCD), while older monitors use a cathode ray tube (CRT).

Q7. Define persistence in terms of CRT Phosphorous.

"Persistence"

Persistence is the one of the major property of phosphorous used in CRT's. It means how long they continue to emit light after the electron beam is removed.

Q8. Define resolution. → # of pixels on a screen

The maximum number of points that can be displayed without overlap on a CRT is referred to as the resolution.

Q8. What do you mean by an aspect ratio? → (width : height)

Aspect ratio is a number which gives the ratio of vertical points to horizontal points necessary to produce equal length lines in both directions on the screen. An aspect ratio of $\frac{3}{4}$ means that a vertical line plotted with three points has same length as a horizontal line plotted with 4 points.

Q9. What are the different properties of phosphorus?

1. Color

2. Persistence

→ color, persistence

Q10. Differentiate raster and random scan displays.

Ans. In a raster scan displays the electron beam is swept across the screen, one row at a time from top to bottom. Contrasting in random scan displays the electron beam is directed to the parts of the screen where a picture is to be drawn.

Q11. Define refresh buffer/Frame buffer?

Picture definition is stored in a memory area called the refresh buffer or frame buffer. This memory area holds the set of intensity values for all the screen points.

Q12. Define Pixel.

Ans. Each screen point is referred to as a pixel or pel.

Q13. Define bitmap.

Ans. On a black and white system with one bit per pixel, the frame buffer is commonly known as a bitmap.

*frame Buffer of a Black & white system
1 pixel → 1 bit
0 Black
1 white*

Q14. What do you mean by retracing? Define horizontal as well as vertical retracing.

Ans. At the end of each scan line, the electron beam returns to the left side of the screen to begin displaying the next scan line. The return to the left of the screen, after refreshing each scan line is called the horizontal retrace. And at the end of each frame, the electron beam returns to the top left corner of the screen to begin the next frame is called the vertical retrace.

→ returning of beam from right & left (inactive)

Q15. What do you mean by interlacing?

Ans. It is the method of incrementally displaying a visual on a CRT. On some raster scan systems, each frame is displayed in two passes using an interlaced refresh procedure. In the first pass, the beam sweeps across every other scan line from top to bottom. Then after the vertical retrace, the beam sweeps out the remaining scan lines.

Q16. What is a Beam penetration method?

Ans. This technique is used in random scan display systems. Two layers of phosphor (red and green) are coated onto the inside of the CRT screen, the displayed colors depends on how far the electron beam penetrates into the phosphors layers. A slow electron beam excites only the outer red layer. A very fast electron beam penetrates through the red layer and hence excites the green layer. An average electron beam gives the combination of red and green color. That is yellow and orange. This technique only provides four colors.

Q17. Define shadow masking.

This technique is used in raster scan display devices. It gives much wider range of colors than a beam penetration method. A shadow Mask CRT has three phosphor color dots at each pixel location. One phosphor dot emits a red light, another emits green light and the last one emits a blue light. This type of CRT also has three electron guns one for each color dot. A shadow mask grid is installed just behind the phosphor coated screen. The three electron beams are deflected and focused as a group onto the shadow mask, which contains a series of very fine holes aligned with the phosphor dot patterns. When the three beams pass through a hole in the shadow mask, they activate a dot triangle, which appears as a small color spot on the screen. Different colors can be obtained by varying the intensity levels. More than 17

million different colors can be obtained in a full color system.

Q18. What are composite monitors?

Ans. Composite monitors are the adaptations of TV sets that allow bypass of the broadcast circuitry. These display devices still require that the picture information be combined, but no carrier signal is needed. Picture information is combined into a composite signal and then separated by the monitor, so the resulting picture quality is still not the best attainable.

Q19. What are advantages of DVST over CRT? Also list some disadvantages of DVST.

Ans. Advantages:

- i. No refreshing is needed.
 - ii. Very complex pictures can be displayed at very high resolution without flicker.
- Disadvantages:
- i. They ordinarily do not display color
 - ii. Selected part of the picture can not be erased
 - iii. The erasing and redrawing process can take several seconds for complex pictures.

Q20. Differentiate emissive and non emissive displays.

Ans. Emissive display displays are devices that convert electrical energy into light. Non-emissive displays use optical effects to convert sunlight or light from some other source into graphics patterns.

Q21. List some 3D viewing devices.

- Ans.
- 1. Stereoscopic systems
 - 2. Virtual reality systems

Q22. What is the role of a video controller?

Ans. It is the one of the component of an interactive raster scan system. It is used to control the operation of the display device by accessing the frame buffer to refresh the screen.

Q23. Define Graphics controller /Display controller/Display processor.

Ans. The purpose of the display processor is to free the CPU from graphic chores. A major task of the display processor is digitizing a picture definition given in an application program into a set of pixel intensity values for storage in the frame buffer.

Q24. What do you mean by scan conversion?

Ans. A major task of the display processor is digitizing a picture definition given in an application program into a set of pixel intensity values for storage in the frame buffer. This digitization process is called scan conversion.

Q25. Explain the merits and demerits of Penetration techniques.

Ans. The merits and demerits of the Penetration techniques are as follows;

- [1] It is an inexpensive technique
- [2] It has only four colors
- [3] The quality of the picture is not good when it is compared to other techniques
- [4] It can display color scans in monitors

Q26. Explain the merits and demerits of DVST.

Ans. The merits and demerits of direct view storage tubes [DVST] are as follows;

- [1] It has a flat screen
- [2] Refreshing of screen is not required
- [3] Selective or part erasing of screen is not possible
- [4] It has poor contrast
- [5] Performance is inferior to the refresh CRT.

Q27. Explain the merits and demerits of Plasma panel display.

ADVANTAGES:

- [1] Refreshing is not required
- [2] Produce a very steady image free of Flicker
- [3] Less bulky than a CRT.

DISADVANTAGES:

- [1] Poor resolution of up to 60 d.p.i
- [2] It requires complex addressing and wiring
- [3] It is costlier than CRT.

Q28. What is the difference between impact and non-impact printers?

Impact printers press formed character faces against an inked ribbon on to the paper.

A line printer and dot-matrix printer are examples.

Non-impact printer and plotters use Laser techniques, inkjet sprays, Xerographic process, electrostatic methods and electro thermal methods to get images onto the papers.

Examples are: Inkjet/Laser printers.

Q29. What is the features of Inkjet printers?

Features:

- a] They can print 2 to 4 pages/minutes.
- b] Resolution is about 360d.p.i. Therefore better print quality is achieved.
- c] The operating cost is very low. The only part that requires replacement is ink cartridge.
- d] 4 colors cyan, yellow, magenta, black are available.

Q30. What are the advantages of laser printers?

Ans. 1] High speed, precision and economy.

2] Cheap to maintain.

3] Quality printers.

4] Lasts for longer time.

5] Toner power is very cheap.

Q31. What are the advantages of electrostatic plotters?

1] They are faster than pen plotters and very high quality printers. 2]

Recent electrostatic plotters include a scan-conversion capability.

3] Color electrostatic plotters are available. They make multiple passes over the paper to plot color pictures.

Q32. Consider three different raster systems with resolutions of 640 x 480, 1280 x 1024, and 2560 x 2048.

a) What size is frame buffer (in bytes) for each of these systems to store 12 bits per pixel?

Ans. Because eight bits constitute a byte, frame-buffer sizes of the systems are as follows:

$640 \times 480 \times 12 \text{ bits} / 8 = 450\text{KB};$

$1280 \times 1024 \times 12 \text{ bits} / 8 = 1920\text{KB};$

$2560 \times 2048 \times 12 \text{ bits} / 8 = 7680\text{KB};$

b) How much storage (in bytes) is required for each system if 24 bits per pixel are to be stored?

Similarly, each of the above results is just doubled for 24 (12×2) bits of storage per pixel.

Q33. Consider two raster systems with the resolutions of 640 x 480 and 1280 x 1024.

a) How many pixels could be accessed per second in each of these systems by a display controller that refreshes the screen at a rate of 60 frames per second?

Ans. Since 60 frames are refreshed per second and each frame consists of 640 x 480 pixels, the access rate of such a system is $(640 \times 480) \times 60 = 1.8432 \times 10^7$ pixels/second.

Likewise, for the 1280 x 1024 system, the access rate is $(1280 \times 1024) \times 60 = 7.86432 \times 10^7$ pixels/second.

b) What is the access time per pixel in each system?

Ans. According to the definition of access rate, we know that the access time per pixel should be $1/(\text{access rate})$. Therefore, the access time is around 54 nanoseconds/pixel for the 640 x 480 system, and the access time is around 12.7 nanoseconds/pixel for the 1280x1024 system.

Q34. Consider a raster system with the resolution of 1024 x 768 pixels and the color palette calls for 65,536 colors. What is the minimum amount of video RAM that the computer must have to support the above-mentioned resolution and number of colors?

Ans. Recall that the color of each pixel on a display is represented with some number of bits. Hence, a display capable of showing up to 256 colors is using 8 bits per pixels (i.e. “8-bit color”).

Notice first that the color palette calls for 65,536 colors. This number is but 2^{16} , which implies that 16 bits are being used to represent the color of each pixel on the display. The display’s resolution is 1024 by 768 pixels, which implies that there is a total of 786,432 (1024×768) pixels on the display. Hence, the total number of bits required to display any of 65,536 colors on each of the screen’s 786,432 pixels is 12,582,912 ($786,432 \times 16$). Dividing this value by 8 yields an answer of 1,572,864 bytes. Dividing that value by 1,024 yields an answer of 1,536 KB. Dividing that value by 1,024 yields an answer of 1.5 MB.

Q35. Define resolution.

Ans. The maximum number of points that can be displayed without overlap on a CRT is referred to as the resolution.

Q36. How Many k bytes does a frame buffer needs in a 600 x 400 pixel ?

Ans.

Given :- Resolution is 600 x 400

Suppose 1 pixel can store n bits

$$\begin{aligned}\text{Then, the size of frame buffer} &= \text{Resolution} \times \text{bits per pixel} \\ &= (600 \times 400) \times n \text{ bits} \\ &= 240000 \text{ } n \text{ bits} \\ &= \frac{240000 \text{ } n}{1024 \times 8} \text{ k bytes} \quad (\text{as } 1 \text{ kb} = 1024 \text{ bytes}) \\ &= \mathbf{29.30 \text{ } n \text{ k bytes}}\end{aligned}$$

Q37. Find out the aspect ratio of the raster system using 8 x 10 inches screen and 100 pixel/inch.

Ans. We know that,

$$\begin{aligned}\text{Aspect ratio} &= \frac{\text{Width}}{\text{Height}} \\ &= \frac{8 \times 100}{10 \times 100} = 4 / 5\end{aligned}$$

$$\text{Aspect ratio} = \mathbf{4 : 5}$$

Q38. How much time is spent scanning across each row of pixels during screen refresh on a raster system with resolution of 1280 X 1024 and a refresh rate of 60 frames per second?

Ans: Here, resolution = 1280 X 1024

That means system contains 1024 scan lines and each scan line contains 128 pixels

refresh rate = 60 frame/sec.

So, 1 frame takes = $1/60$ sec.

Since resolution = 1280 X 1024

1 frame buffer consist of 1024 scan lines

It means then 1024 scan lines takes $1/60$ sec

Therefore, 1 scan line takes ,

$$\frac{1}{60 \times 1024} \text{ Sec} = \mathbf{0.058 \text{ sec}}$$

Q 39. Suppose RGB raster system is to be designed using on 8 inch X 10 inch screen with a resolution of 100 pixels per inch in each direction. If we want to store 6 bits per pixel in the frame buffer, how much storage (in bytes) do we need for frame buffer?

Ans. Here, resolution = 8 inch X 10 inch

First, we convert it in pixel then

Now resolution = 8 X 100 by 10 X 100 pixel = 800 X 1000 pixel

1 pixel can store 6 bits

So, frame buffer size required = 800 X 100 X 6 bits

$$= \frac{800 \times 100 \times 6}{8} \text{ Bytes} = 6 \times 10^5 \text{ bytes.}$$

Q.40. A unit square is transformed by 2 x 2 transformation matrix. The resulting position vector are :-

$$\begin{pmatrix} 0 & 2 & 8 & 6 \\ 0 & 3 & 4 & 1 \end{pmatrix}, \text{ what is the transformation matrix?}$$

Ans: Suppose the unit square have coordinates

(x, y)
(x+1, y)
(x+1, y+1)
(x, y+1)

and let the transformation matrix be $\begin{pmatrix} a & c \\ b & d \end{pmatrix}$

$$\text{So, } \begin{pmatrix} 0 & 2 & 8 & 6 \\ 0 & 3 & 4 & 1 \end{pmatrix} = \begin{pmatrix} a & c \\ b & d \end{pmatrix} \begin{pmatrix} x & x+1 & x+1 & x \\ y & y & y+1 & y+1 \end{pmatrix}$$

$$= \begin{pmatrix} ax+cy & a(x+1)+cy & a(x+1)+c(y+1) & ax+c(y+1) \\ bx+by & b(x+1)+dy & b(x+1)+d(y+1) & bx+d(y+1) \end{pmatrix}$$

Now, $ax+cy=0$ and $bx+cy=0$

$a(x+1)+cy=2$ and $b(x+1)+dy=3$

$a(x+1)+c(y+1)=8$ and $b(x+1)+d(y+1)=4$

$ax+c(y+1)=6$ and $bx+d(y+1)=1$

from this we get,

$a=2, \quad b=3, \quad c=6, \quad d=1$

Thus, the transformation matrix is $\begin{pmatrix} 2 & 6 \\ 3 & 1 \end{pmatrix}$

Q41. a) Find the matrix that represents rotation of an object by 45° about the origin.

b) What are the new coordinates of the point P(2, -4) after the rotation?

Ans. SOLVE IT BY YOURSELF

Q42. A triangle is defined by $\begin{pmatrix} 2 & 4 & 4 \\ 2 & 2 & 4 \end{pmatrix}$

Find the transformed coordinates after the following transformation

(1) 90° rotation about origin.

(2) Reflection about line $y = -x$.

Ans. SOLVE IT BY YOURSELF

Q43. Translate the square ABCD whose co-ordinate are A(0,0), b(3,0), C(3,3), D(0,3) by 2 units in both direction and then scale it by 1.5 units in x direction and 0.5 units in y direction.

Q44. Perform a 45° rotation of a triangle A(0,0, B(1,1), C(5,2)

1) About the origin.

2) About the point p(-1,-1)

Q45. Find the transformation matrix that transforms the square ABCD whose center is at (2,2) is reduced to half of its size, with center still remaining at (2,2). The coordinate of square ABCD are A(0,0), B(0,4), C(4,4) and D(4,0). Find the co-ordinate of new square.

Ans. (HINT:- After scaling the square to half of its size, the new translated square will have center at (1,1) so, translate again the new square by (1,1), so that center again reach to (2,2).)

Q46. Consider the square A(1,0), B(0,0), C(0,1), D(1,1). Rotate the square ABCD by 45° clockwise about A(1,0).

Ans . HINT:-

- 1) First, translate the square by $T_x = -1$ and $T_y = 0$.
- 2) Then rotate the square by 45°.
- 3) Again translate the square by $T_x = 1$ and $T_y = 0$.

Q.47. Magnify the triangle with vertices A(0,0), B(1,1) and C(5,2) to twice its size while keeping C(5,2) fixed.

Ans . HINT:-

- 1) First, translate the triangle by $T_x = -5$ and $T_y = -2$
- 2) Then Magnify the triangle by twice its size
- 3) Again translate the triangle by $T_x = 5$ and $T_y = 2$.

Q48. Prove that 2D rotation and scaling is commutative i.e $R.S = S.R$ if

- 1.) $S_x = S_y$
- 2.) $\theta = n\pi$

Q49. Show that the 2 X 2 matrix

$$[T] = \begin{pmatrix} \frac{1-t^2}{1+t^2} & \frac{2t}{1+t^2} \\ \frac{-2t}{1+t^2} & \frac{1-t^2}{1+t^2} \end{pmatrix} \quad \text{represents pure rotation.}$$

Ans. We know that for pure rotational transformation determinant of the transformation matrix is always equal to 1.

$$\begin{aligned} \text{So, the determinant of } [T] &= \left\{ \left(\frac{1-t^2}{1+t^2} \right)^2 - \left(-\frac{2t}{1+t^2} \right)^2 \right\} \\ &= \frac{(1-t^2)^2}{(1+t^2)^2} + \frac{4t^2}{(1+t^2)^2} \\ &= \frac{(1-t^2)^2 + 4t^2}{(1+t^2)^2} = \frac{1-2t^2+t^2+4t^2}{(1+t^2)^2} = \frac{(1+t^2)^2}{(1+t^2)^2} = 1 \end{aligned}$$

Q 50. Prove that simultaneous shearing in both direction (X & y direction) is not equal to the composition of pure shear along x-axis followed by pure shear along y-axis.

Ans:- We know the simultaneous shearing

$$S_h = \begin{pmatrix} 1 & a \\ b & 1 \end{pmatrix}$$

Shearing in x direction is $\begin{pmatrix} 1 & a \\ 0 & 1 \end{pmatrix}$ and in y direction is $\begin{pmatrix} 1 & 0 \\ b & 1 \end{pmatrix}$. Therefore,

shearing in x direction followed by y direction is

$$\begin{pmatrix} 1 & a \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ b & 1 \end{pmatrix} = \begin{pmatrix} 1 + ab & a \\ b & 1 \end{pmatrix}$$

is not equal to S_h .

Q51. Prove that two 2D rotation about the origin commutative i.e. $R_1 R_2 = R_2 R_1$.

Ans :- Hint take R_1 be the rotation by the angle θ and R_2 be the rotation in same direction by the angle α . First perform matrix for $R_1 R_2$ then $R_2 R_1$ and prove.

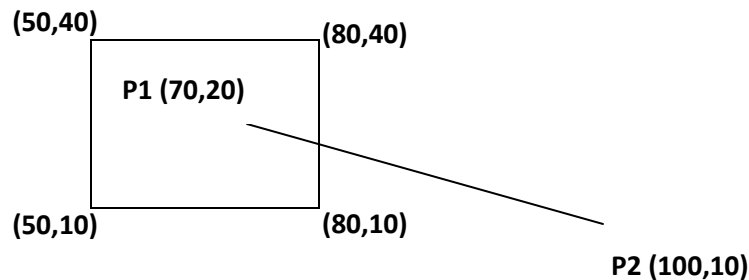
Q52. Prove that two scaling transformation are commutative i.e. $S_1 S_2 = S_2 S_1$

Ans. Hint take $S_1 = \begin{pmatrix} m & 0 & 0 \\ 0 & m & 0 \\ 0 & 0 & 1 \end{pmatrix}$ and $S_2 = \begin{pmatrix} n & 0 & 0 \\ 0 & n & 0 \\ 0 & 0 & 1 \end{pmatrix}$

Then solve $S_1 S_2$ and then $S_2 S_1$ and prove .

Q53. Use the Cohen Sutherland algorithm to clip line P1 (70,20) and p2(100,10) against a window lower left hand corner (50,10) and upper right hand corner (80,40).

Ans:



Given , P1(70,20) and p2(100,10)
 Window lower left corner = (50,10)
 Window upper right corner = (80,40)

Now, we assign 4 bit binary outcode.

Point P1 is inside the window so the outcode of P1 = 0000 and the outcode for P2 = 0010.

Logical AND operation will give , 0000

$$\begin{array}{r} 0010 \\ \underline{0000} \\ 0000 \end{array}$$

Slope of the line P1P2 is $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{10 - 20}{100 - 70} = \frac{-10}{30} = \frac{-1}{3}$

We, have to find intersection of line P1 P2 with right edge of window i.e P2 (x,y).

Here x=80 , we have to find the value of y.

We use the point P2(x2,y2) = P2(100,10)\

$$M = \frac{y - y_2}{x - x_2}$$

$$-1/3 = \frac{y - 10}{80 - 100}$$

$$y - 10 = 20 / 3$$

$$y = 16.66$$

thus, the intersection point P3 = (80, 16.66)

So, after clipping line P1P2 against the window, new line P1P3 with co ordinates P1(70, 20) and P3 (80, 16.66)

