Arab Academy For Science and Technology & Maritime Transport

College of Engineering & Technology

Computer Engineering Department

EXAMINATION PAPER – Week 7 makeup

Course Title: Computer Graphics

Course Code: CC416

Date: Sun. Jan, 4-2015　　　　　　　　Lecturer: Dr. Manal Helal

Time allowed: 60 mins　　　　　　　　　Start Time: 12:30 p.m.

Student's name:	Reg.# :

| Question #	Marks	
	Available	**Actual**
Graphics Systems	4	
Colors	4	
Line Drawing	4	
Circle Drawing	4	
Ellipse Drawing	4	
Total	**20**	
Lecturer	Name :　Dr. Manal Helal	
	Signature :	
	Date:	

Graphics Systems: [4 points]

1) Choose the image type (raster or vector file formats) used to draw the following images on a computer system.

a)

b)

c)

d)

e)

f)

Colors: **[4 points]**
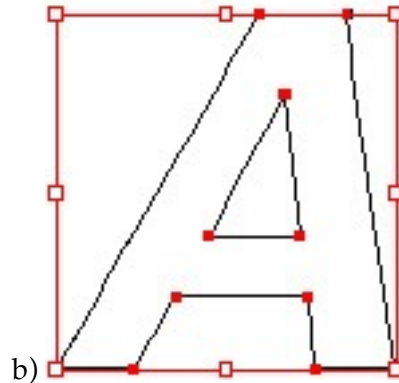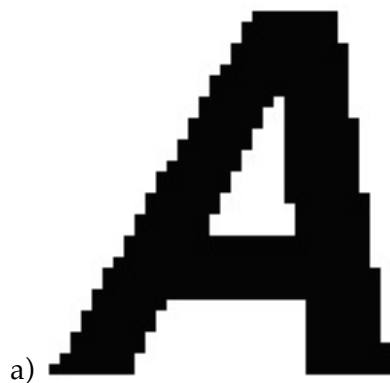
2) Given the following RGB Color values, what are the equivalent CMY values?

RGB = (62, 29, 64)

You can infer the transformation operation from the following illustration:
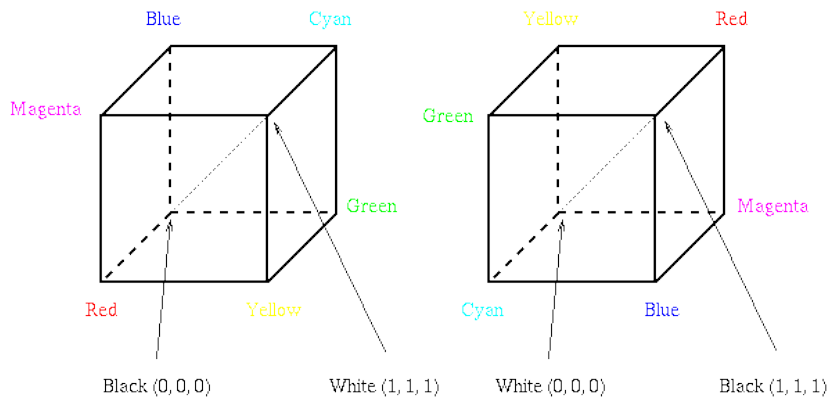
3) Given the following line equation:

y=x+4

Trace the Bresenham line drawing algorithm to fill the following table, from a starting point (0, 4) to an ending point (4, 8):

Hints:
$p_0 = 2\Delta y - \Delta x$
If $(p_k < 0)$
$$p_{k+1} = p_k + 2\Delta y$$
Otherwise
$$p_{k+1} = p_k + 2\Delta y - 2\Delta x$$

k	x_k	y_k	p_k
0	0	4	4
1	1	5	4
2	2	6	4
3	3	7	4
4	4	8	

Circle Drawing: **[4 points]**

4) Given a Circle with center at (4, 5) and radius 6, trace the mid point circle drawing algorithm for 4 points:

Hints:
$p_0 = 1 - r$
If $(p_k < 0)$
$$p_{k+1} = p_k + 2x_{k+1} + 1$$
Otherwise
$$p_{k+1} = p_k + 2x_{k+1} + 1 - 2y_{k+1}$$

k	x_k	y_k	p_k
0			
1			
2			
3			
4			

Ellipse Drawing:

5) Given an ellipse with $r_x = 2$ and $r_y = 4$ and center (4, 5), trace the mid-point ellipse drawing algorithm for 4 points.

Hints:

$$p1_0 = r_y^2 - r_x^2 r_y + \frac{1}{4} r_x^2$$

$$increment = \begin{cases} 2r_y^2 x_{k+1} + r_y^2 & if \; p1_k < 0 \\ 2r_y^2 x_{k+1} + r_y^2 - 2r_x^2 y_{k+1} & if \; p1_k \geq 0 \end{cases}$$

k	x_k	y_k	p_k
0	0	4	
1			
2			
3			
4			

Solutions:

1)

a) Raster
b) Vector
c) Vector
d) Raster
e) Vector
f) Raster

2)

Normalize first (divide by 255):
CMY = (1-62/255, 1-29/255, 1-64/255)=
0.7568627450980392
0.8862745098039215
0.7490196078431373

3)

$\Delta y = 6\text{-}4 = 2$
$\Delta x = 2\text{-}0 = 2$
$m = 1$
$p_0 = 2\Delta y - \Delta x = 2$
$p_1 = p_0 + 2\Delta y = 2 + 4 = 6$
$p_2 = p_1 + 2\Delta y = 6 + 4 = 10$
$p_3 = p_2 + 2\Delta y = 10 + 4 = 14$
$p_4 = p_3 + 2\Delta y = 14 + 4 = 18$

k	x_k	y_k	p_k
0	0	4	2
1	1	5	6
2	2	6	10
3	3	7	14
4	4	8	18

4) **Given a Circle with center at (4, 5) and radius 6, trace the mid point circle drawing algorithm for 4 points:**

Hints:
$p_0 = 1 - r$
If $(p_k < 0)$
$$p_{k+1} = p_k + 2x_{k+1} + 1$$
Otherwise
$$p_{k+1} = p_k + 2x_{k+1} + 1 - 2y_{k+1}$$

k	x_k	y_k	p_k
0	0	6	-5

1	1	6	-4
2	2	6	-1
3	3	5	4
4	4	4	1

Moving to origin and starting from $(0, r) = (0, 6)$

$p_0 = 1-r = -5$
$p_1 = p_0 + 2x_{k+1} + 1 = -5 + (2*0) + 1 = -4$
$p_2 = p_1 + 2x_{k+1} + 1 = -4 + (2*1) + 1 = -1$
$p_3 = p_2 + 2x_{k+1} + 1 = -1 + (2*2) + 1 = 4$
$p_4 = p_3 + 2x_{k+1} + 1 - 2y_{k+1} = 4 + (2*3) + 1 - (2*5) = 1$

5) Given an ellipse with $r_x = 2$ and $r_y = 4$ and center (4, 5), trace the mid-point ellipse drawing algorithm for 4 points.

Hints:

$$p1_0 = r_y^2 - r_x^2 r_y + \frac{1}{4} r_x^2$$

$$increment = \begin{cases} 2r_y^2 x_{k+1} + r_y^2 & if \ p1_k < 0 \\ 2r_y^2 x_{k+1} + r_y^2 - 2r_x^2 y_{k+1} & if \ p1_k \geq 0 \end{cases}$$

k	x_k	y_k	p_k
0	0	4	1
1	1	3	-15
2	2	3	33
3	3	2	89
4	4	1	

$r_y^2 = 16$
$r_x^2 = 4$
$r_x^2 r_y = 16$

$p1_0 = r_y^2 - r_x^2 r_y + 1/4\ r_x^2 = 16 - 16 + 4/4 = 1$
$p1_1 = p_0 + 2r_y^2 x_{k+1} + r_y^2 - 2 r_x^2 y_{k+1} = 1 + (2*16*0) + 16 - (2*4*4) = -15$
$p1_2 = p_1 + 2r_y^2 x_{k+1} + r_y^2 = -15 + (2*16*1) + 16 = 33$
$p1_3 = p_2 + 2r_y^2 x_{k+1} + r_y^2 - 2 r_x^2 y_{k+1} = 33 + (2*16*2) + 16 - (2*4*3) = 89$
$p1_4 = p_3 + 2r_y^2 x_{k+1} + r_y^2 - 2 r_x^2 y_{k+1} = 89 + (2*16*3) + 16 - (2*4*2) = 185$