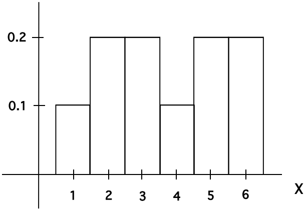
Question 9, Ex 2, F07

9 The following is a histogram for the probability distribution of a random variable X.



What is $P(X \leq 3)$?

(a) 0.4 (b) 0.6 (c) 0.8 (d) 0.2 (e) 0.5

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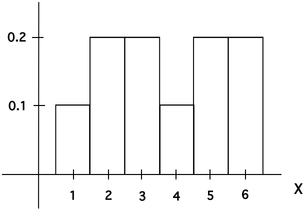

What is $P(X \leq 3)$?

(a) 0.4 (b) 0.6 (c) 0.8 (d) 0.2 (e) 0.5

- $P(X \leq 3) = P(X = 1) + P(X = 2) + P(X = 3) = 0.1 + 0.2 + 0.2 = 0.5$

Question 9, Ex 2, F07

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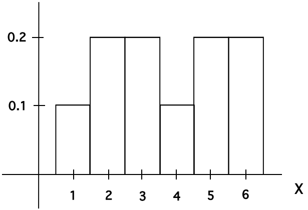

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- $P(X \leq 3) = P(X = 1) + P(X = 2) + P(X = 3) = 0.1 + 0.2 + 0.2 = 0.5$
- *The correct answer is (e)*

Question 10, Ex 2, F07

10 A fair die is rolled 10 times. What is the probability that the number on its top face was 5 or higher (i.e. either 5 or 6) on exactly 7 of the rolls?

(a) $C(10, 7)\left(\frac{1}{3}\right)^7\left(\frac{2}{3}\right)^3$ (b) $P(10, 3)\left(\frac{1}{3}\right)^3\left(\frac{2}{3}\right)^3$ (c) $C(10, 3)\left(\frac{1}{3}\right)^3\left(\frac{2}{3}\right)^7$ (d) $P(10, 7)\left(\frac{1}{3}\right)^7\left(\frac{2}{3}\right)^3$

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- *The probability of getting a 5 or higher (a 5 or a 6) on one roll of the die is 1/3*

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- *The probability of getting a 5 or higher (a 5 or a 6) on one roll of the die is 1/3*
- *Let X denote the number of times we get a 5 or higher out of the 10 rolls. Using the formula for a Binomial Random Variable, we get* $P(X = k) = C(n, k)p^k q^{n-k}$.

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- *The correct answer is (a)*

Question 1, Ex 3, F07

1 In a survey of 10 students, each was aked to count the number of keys they were carrying. The results were as follows:

$$1, 1, 1, 2, 2, 2, 2, 2, 3, 5.$$

Calculate the average number of keys carried by the students surveyed.

(a) 2 (b) 2.5 (c) 3 (d) 2.1 (e) 21

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- *The average is* $(1+1+1+2+2+2+2+2+3+5)/10$

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- $= 21/10 = 2.1$
- *The correct answer is (d)*

Question 2, Ex 3, F07

2 A random variable X has the following probability distribution:

k	Pr(X = k)
-1	$1/2$
0	$1/4$
1	$1/8$
2	$1/8$

Find the Expected value of the random variable X.

(a) 1 (b) $\frac{-1}{8}$ (c) $\frac{1}{4}$ (d) $\frac{1}{2}$ (e) 0

Question 2, Ex 3, F07

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- $E(X) = \sum kP(X = k)$

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Question 2, Ex 3, F07

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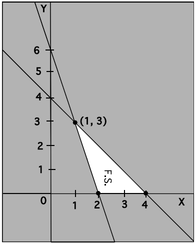
- $E(X) = \sum kP(X = k) = -1/2 + 0 + 1/8 + 1/4 = -1/8$
- The correct answer is (b)

Question 6, Ex 3, F07

6 What is the maximum of the objective function $4x + y$ on the feasible set in the following diagram?



(a) 16 (b) 8 (c) 7 (d) 20 (e) 13

Question 6, Ex 3, F07

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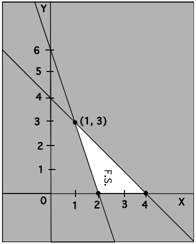

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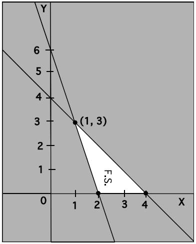

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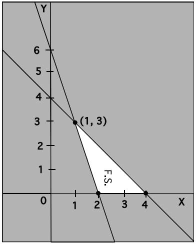

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- *The maximum must occur at one of the corner points of the feasible set.*
- *The xy co-ordinates of the corner points of the feasible sets are* $(1, 3)$, $(4, 0)$, *and* $(2, 0)$.
- *We check which one gives the maximum:*

(x, y)	$4x + y$
$(1, 3)$	$4 + 3 = 7$
$(4, 0)$	$16 + 0 = 16(max)$
$(2, 0)$	$8 + 0 = 8$

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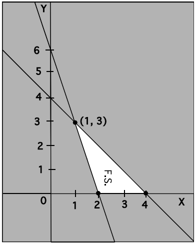

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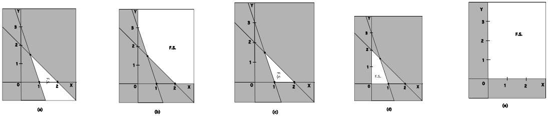
$(2, 0)$	$8 + 0 = 8$

- *The maximum is 16 and the correct answer is (a).*

Question 7, Ex 3, F07

7 Select the graph of the feasible set (F.S.) of the system of linear inequalities given by:

$$\begin{array}{ccccc} & & x & \geq & 0 \\ & & y & \geq & 0 \\ 3x & + & y & \geq & 3 \\ 2x & + & 2y & \leq & 4 \end{array}$$



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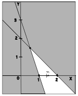
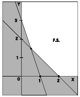

(a)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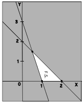
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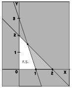
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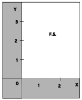
(e)

Inequality	*Standard Form*	*line*	*intercepts*		*graph*
			x (*when* $y=0$)	y (*when* $x=0$)	$F.S.$
$x \geq 0$					
$y \geq 0$					
$3x + y \geq 3$					
$2x + 2y \leq 4$					

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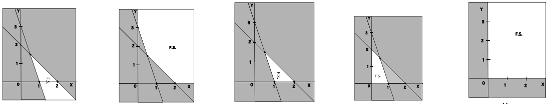

(a) (b) (c) (d) (e)

Inequality	*Standard Form*	*line*	*intercepts* x (*when* $y=0$)	y (*when* $x=0$)	*graph* $F.S.$
$x \geq 0$	$x \geq 0$				
$y \geq 0$	$y \geq 0$				
$3x + y \geq 3$	$y \geq 3 - 3x$				
$2x + 2y \leq 4$	$y \leq 2 - x$				

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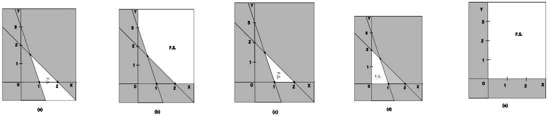

▶

Inequality	*Standard Form*	*line*	*intercepts*		*graph*
			x (*when* $y=0$)	y (*when* $x=0$)	$F.S.$
$x \geq 0$	$x \geq 0$	$x = 0$ (y *axis*)			
$y \geq 0$	$y \geq 0$	$y = 0$ (x *axis*)			
$3x + y \geq 3$	$y \geq 3 - 3x$	$y = 3 - 3x$			
$2x + 2y \leq 4$	$y \leq 2 - x$	$y = 2 - x$			

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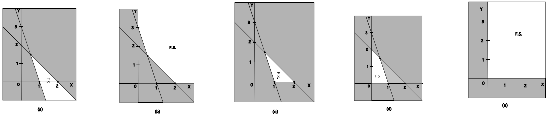

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$x \geq 0$	$x \geq 0$	$x=0$ (y *axis*)	0	N/A	
$y \geq 0$	$y \geq 0$	$y=0$ (x *axis*)	N/A	0	
$3x+y \geq 3$	$y \geq 3-3x$	$y=3-3x$	1	3	
$2x+2y \leq 4$	$y \leq 2-x$	$y=2-x$	2	2	

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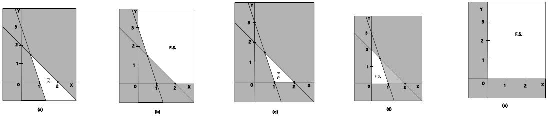

Inequality	*Standard Form*	*line*	*intercepts* x (*when* $y=0$)	y (*when* $x=0$)	*graph F.S.*
$x \geq 0$	$x \geq 0$	$x = 0$ (y *axis*)	0	N/A	*Right*(*shade left*)
$y \geq 0$	$y \geq 0$	$y = 0$ (x *axis*)	N/A	0	*Above*(*shade below*)
$3x + y \geq 3$	$y \geq 3 - 3x$	$y = 3 - 3x$	1	3	*Above*(*shade below*)
$2x + 2y \leq 4$	$y \leq 2 - x$	$y = 2 - x$	2	2	*Below*(*shade above*)

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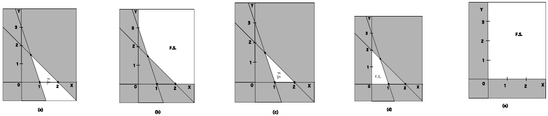

▶

Inequality	*Standard Form*	*line*	*intercepts* x (*when* $y = 0$)	y (*when* $x = 0$)	*graph* $F.S.$
$x \geq 0$	$x \geq 0$	$x = 0$ (y *axis*)	0	N/A	*Right*(*shade left*)
$y \geq 0$	$y \geq 0$	$y = 0$ (x *axis*)	N/A	0	*Above*(*shade below*)
$3x + y \geq 3$	$y \geq 3 - 3x$	$y = 3 - 3x$	1	3	*Above*(*shade below*)
$2x + 2y \leq 4$	$y \leq 2 - x$	$y = 2 - x$	2	2	*Below*(*shade above*)

▶ *We also need to calculate the vertices of the Feasible set. These are the points at which the lines meet in pairs. Since the x and y axis meet the other lines at their intercepts, we have only one calculation; that is we must find where* $y = 3 - 3x$ *meets* $y = 2 - x$.

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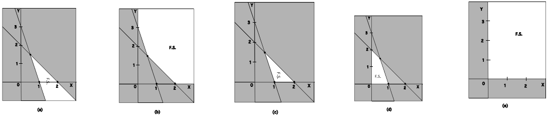

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$y \geq 0$	$y \geq 0$	$y = 0$ (x *axis*)	N/A	0	*Above(shade below)*
$3x + y \geq 3$	$y \geq 3 - 3x$	$y = 3 - 3x$	1	3	*Above(shade below)*
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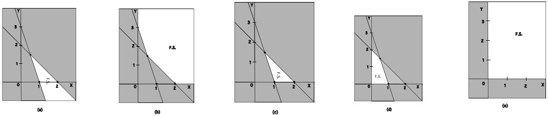
- $y = 3 - 3x$ *and* $y = 2 - x$ *meet when* $3 - 3x = 2 - x$ *or* $1 = 2x$ *or* $1/2 = x$

7 Select the graph of the feasible set (F.S.) of the system of linear inequalities given by:

$$\begin{array}{rcrcl} & & x & \geq & 0 \\ & & y & \geq & 0 \\ 3x & + & y & \geq & 3 \\ 2x & + & 2y & \leq & 4 \end{array}$$



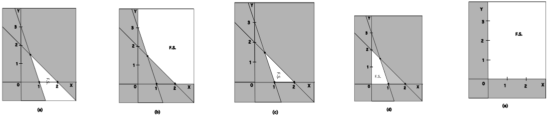
-

Inequality	*Standard Form*	*line*	*intercepts*		*graph*
			x (*when* $y = 0$)	y (*when* $x = 0$)	$F.S.$
$x \geq 0$	$x \geq 0$	$x = 0$ (y *axis*)	0	N/A	*Right*(*shade left*)
$y \geq 0$	$y \geq 0$	$y = 0$ (x *axis*)	N/A	0	*Above*(*shade below*)
$3x + y \geq 3$	$y \geq 3 - 3x$	$y = 3 - 3x$	1	3	*Above*(*shade below*)
$2x + 2y \leq 4$	$y \leq 2 - x$	$y = 2 - x$	2	2	*Below*(*shade above*)

- *We also need to calculate the vertices of the Feasible set. These are the points at which the lines meet in pairs. Since the x and y axis meet the other lines at their intercepts, we have only one calculation; that is we must find where $y = 3 - 3x$ meets $y = 2 - x$.*
- $y = 3 - 3x$ *and* $y = 2 - x$ *meet when* $3 - 3x = 2 - x$ *or* $1 = 2x$ *or* $1/2 = x$
- *Substituting this back into the equation of one of the lines gives:* $y = 2 - x = 2 - 1/2 = 3/2$, *giving the meeting point at* $(1/2, 3/2)$.

7 Select the graph of the feasible set (F.S.) of the system of linear inequalities given by:

$$\begin{array}{rcrcl} & & x & \geq & 0 \\ & & y & \geq & 0 \\ 3x & + & y & \geq & 3 \\ 2x & + & 2y & \leq & 4 \end{array}$$



▶

Inequality	*Standard Form*	*line*	*intercepts* x (*when* $y=0$)	y (*when* $x=0$)	*graph F.S.*
$x \geq 0$	$x \geq 0$	$x = 0$ (y *axis*)	0	N/A	*Right(shade left)*
$y \geq 0$	$y \geq 0$	$y = 0$ (x *axis*)	N/A	0	*Above(shade below)*
$3x + y \geq 3$	$y \geq 3 - 3x$	$y = 3 - 3x$	1	3	*Above(shade below)*
$2x + 2y \leq 4$	$y \leq 2 - x$	$y = 2 - x$	2	2	*Below(shade above)*

- *We also need to calculate the vertices of the Feasible set. These are the points at which the lines meet in pairs. Since the* x *and* y *axis meet the other lines at their intercepts, we have only one calculation; that is we must find where* $y = 3 - 3x$ *meets* $y = 2 - x$.
- $y = 3 - 3x$ *and* $y = 2 - x$ *meet when* $3 - 3x = 2 - x$ *or* $1 = 2x$ *or* $1/2 = x$
- *Substituting this back into the equation of one of the lines gives:* $y = 2 - x = 2 - 1/2 = 3/2$, *giving the meeting point at* $(1/2, 3/2)$.
- *The graph which has the correct graphs of lines and correct shading is (c).*

Question 8, Ex 3, F07

8 Joe and Mary are about to start a business making surf boards. They will make two models, "The Mulakai" and "The Coolabah". Joe will shape the boards and Mary will paint them. Mary has 20 hours available to spend on painting the boards each week and Joe has 30 hours per week available to spend shaping them. It takes 2 hours to paint "The Mulakai" and 3 hours to paint "The Coolabah". It takes five hours to shape "The Mulakai" and four hours to shape "The Coolabah". Let x denote the number of "The Mulakai" made in one week and let y denote the number of "The Coolabah" made in a week. Which of the following sets of inequalities describe the constraints for this problem.

(a) $\begin{aligned} 2x + 3y &\leq 20 \\ 5x + 4y &\leq 30 \\ x \geq 0, \quad y &\geq 0 \end{aligned}$ (b) $\begin{aligned} 2x + 5y &\leq 30 \\ 3x + 4y &\leq 20 \\ x \geq 0, y &\geq 0 \end{aligned}$ (c) $\begin{aligned} 2x + 5y &\leq 20 \\ 3x + 4y &\leq 30 \\ x \geq 0, \quad y &\geq 0 \end{aligned}$ (d) $\begin{aligned} 2x + 3y &\leq 30 \\ 4x + 5y &\leq 30 \end{aligned}$ (e) $\begin{aligned} 2x + 3y &\geq 0 \\ 5x + 4y &\geq 0 \end{aligned}$

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- *We organize the info in a table:*

	Coolabah	*Mulakai*	*Available*
Paint			
Shape			

Question 8, Ex 3, F07

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- *We organize the info in a table:*

	Coolabah	*Mulakai*	*Available*
Paint	3	2	20
Shape			

Question 8, Ex 3, F07

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- *We organize the info in a table:*

	Coolabah	*Mulakai*	*Available*
Paint	3	2	20
Shape	4	5	30

Question 8, Ex 3, F07

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Paint	3	2	20
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- *We organize the info in a table:*

	y Coolabah	*x Mulakai*	*Available*
Paint	3	2	20
Shape	4	5	30

- *The correct answer is (a).*

Question 11, Ex 3, F07

11 Abe and Beryl play a game. They throw a fair six sided die. If the outcome is a six, Abe gives Beryl \$1 and if the outcome is not a six, Beryl gives Abe \$2.

(a) Let X denote Abes earnigs for the game, show the probability distribution for X below.

(b) What are the expected earnings for Abe for this game?

(c) If Abe and Beryl play the game 100 times, roughly how much would Abe be expected to win?

(d) If Abe and Beryl play the game 100 times, roughly how much would Beryl be expected to win?

Question 11, Ex 3, F07

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(a) Let X denote Abes earnigs for the game, show the probability distribution for X below.

▶

k	$Pr(X = k)$
$-\$1$ (*outcome is a six*)	$\frac{1}{6}$
$\$2$ (*outcome is not a six*)	$\frac{5}{6}$

(b) What are the expected earnings for Abe for this game?

(c) If Abe and Beryl play the game 100 times, roughly how much would Abe be expected to win?

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(b) What are the expected earnings for Abe for this game?

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k	$Pr(X = k)$	$kP(X = k)$
$-\$1$	$\frac{1}{6}$	$\frac{-1}{6}$
$\$2$	$\frac{5}{6}$	$\frac{10}{6}$

(c) If Abe and Beryl play the game 100 times, roughly how much would Abe be expected to win?

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Question 11, Ex 3, F07

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(b) What are the expected earnings $= E(X)$, for Abe for this game?

k	$Pr(X = k)$	$kP(X = k)$
$-\$1$	$\frac{1}{6}$	$\frac{-1}{6}$
$\$2$	$\frac{5}{6}$	$\frac{10}{6}$
		$\frac{9}{6} = 1.5 = E(X)$

(c) If Abe and Beryl play the game 100 times, roughly how much would Abe be expected to win?

(d) If Abe and Beryl play the game 100 times, roughly how much would Beryl be expected to win?

Question 11, Ex 3, F07

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$-\$1$	$\frac{1}{6}$	$\frac{-1}{6}$
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		$\frac{9}{6} = 1.5 = E(X)$

(c) If Abe and Beryl play the game 100 times, roughly how much would Abe be expected to win? $100 \times E(X) = \$150$

(d) If Abe and Beryl play the game 100 times, roughly how much would Beryl be expected to win?

Question 11, Ex 3, F07

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(b) What are the expected earnings = E(X), for Abe for this game?

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$-\$1$	$\frac{1}{6}$	$\frac{-1}{6}$
$\$2$	$\frac{5}{6}$	$\frac{10}{6}$
		$\frac{9}{6} = 1.5 = E(X)$

(c) If Abe and Beryl play the game 100 times, roughly how much would Abe be expected to win? $100 \times E(X) = \$150$

(d) If Abe and Beryl play the game 100 times, roughly how much would Beryl be expected to win? Abe's loss = Beryls gain and vice-versa, hence Beryl's expected winning for 100 games = -\$150 (a loss)

Question 13, Ex 3, F07

13 *Miss Muffet is in charge of the next field trip for the Notre Dame society of Aracnophobics. She will make survival kits available for the trip.*
The Basic survival kit will contain a bottle of anti-venom and a can of spider repellant.
The Deluxe survival kit will have a bottle of anti-venom and two cans of spider repellant and one Tuffet.
Miss Muffet has available 42 bottles of anti-venom, 50 cans of spider repellant and 10 tuffets. She must provide at least 5 Deluxe kits, (since 5 of the members insist on sitting on Tuffets to eat their lunch).
Let x denote the number of Basic kits she makes and let y denote the number of Deluxe kits she makes.

(a) Write the constraints given above in terms of x and y.

(b) The volume of a Basic kit is 25 square inches, the volume of a Deluxe kit is 50 square inches and Miss Muffet wants to minimize the amount of space devoted to survival kits on the coach, what is the objective function describing the amount of space taken up by the survival kits?

Question 13, Ex 3, F07

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Let x denote the number of Basic kits she makes and let y denote the number of Deluxe kits she makes.

(a) Write the constraints given above in terms of x and y.

- *We organize the info in a table:*

	x Basic	y Deluxe	Available
Anti — Venom			
Spider — Rep			
Tuffets			
Required			

(b) The volume of a Basic kit is 25 square inches, the volume of a Deluxe kit is 50 square inches and Miss Muffet wants to minimize the amount of space devoted to survival kits on the coach, what is the objective function describing the amount of space taken up by the survival kits?

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(a) Write the constraints given above in terms of x and y.

- *We organize the info in a table:*

	x Basic	y Deluxe	Available
Anti — Venom	1	1	42
Spider — Rep			
Tuffets			
Required			

(b) The volume of a Basic kit is 25 square inches, the volume of a Deluxe kit is 50 square inches and Miss Muffet wants to minimize the amount of space devoted to survival kits on the coach, what is the objective function describing the amount of space taken up by the survival kits?

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Let x denote the number of Basic kits she makes and let y denote the number of Deluxe kits she makes.

(a) Write the constraints given above in terms of x and y.

- *We organize the info in a table:*

	x Basic	y Deluxe	Available
Anti — Venom	1	1	42
Spider — Rep	1	2	50
Tuffets			
Required			

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	x Basic	y Deluxe	Available
Anti — Venom	1	1	42
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Tuffets		1	10
Required		5	

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This gives the constraints: (*a*)

$$\begin{gathered} x + y \leq 42 \\ x + 2y \leq 50 \\ y \leq 10 \\ y \geq 5 \\ x \geq 0, \quad y \geq 0 \end{gathered}$$

(b) The volume of a Basic kit is 25 square inches, the volume of a Deluxe kit is 50 square inches and Miss Muffet wants to minimize the amount of space devoted to survival kits on the coach, what is the objective function describing the amount of space taken up by the survival kits?

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This gives the constraints: (a)

$$\begin{aligned} x + y &\leq 42 \\ x + 2y &\leq 50 \\ y &\leq 10 \\ y &\geq 5 \\ x \geq 0, \quad y &\geq 0 \end{aligned}$$

(b) The volume of a Basic kit is 25 square inches, the volume of a Deluxe kit is 50 square inches and Miss Muffet wants to minimize the amount of space devoted to survival kits on the coach, what is the objective function describing the amount of space taken up by the survival kits?

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The Deluxe survival kit will have a bottle of anti-venom and two cans of spider repellant and one Tuffet.
Miss Muffet has available 42 bottles of anti-venom, 50 cans of spider repellant and 10 tuffets. She must provide at least 5 Deluxe kits, (since 5 of the members insist on sitting on Tuffets to eat their lunch).

Let x denote the number of Basic kits she makes and let y denote the number of Deluxe kits she makes.

(a) Write the constraints given above in terms of x and y.

- *We organize the info in a table:*

	x Basic	*y Deluxe*	*Available*
Anti — Venom	1	1	42
Spider — Rep	1	2	50
Tuffets		1	10
Required		5	

This gives the constraints: (a)
$$\begin{aligned} x + y &\leq 42 \\ x + 2y &\leq 50 \\ y &\leq 10 \\ y &\geq 5 \\ x \geq 0, \quad y &\geq 0 \end{aligned}$$

(b) The volume of a Basic kit is 25 square inches, the volume of a Deluxe kit is 50 square inches and Miss Muffet wants to minimize the amount of space devoted to survival kits on the coach, what is the objective function describing the amount of space taken up by the survival kits?

- *The objective function is* $25x + 50y$.

Question 13, Ex 3, F07

14 (a) Graph the feasible set corresponding to the following set of inequalities on the set of axes provided: (Make sure you label the region corresponding to the feasible set clearly)

$$\begin{array}{ccccc} & & x & \geq & 0 \\ & & y & \geq & 0 \\ y & + & 3x & \geq & 9 \\ y & + & x & \geq & 5 \end{array}$$

(b) Find the vertices of the above feasible set.

(c) Find the minimum of the objective function $5x + 2y$ on the above feasible set.

14 (a) Graph the feasible set corresponding to the following set of inequalities on the set of axes provided: (Make sure you label the region corresponding to the feasible set clearly)

- *We use the table to find intercepts etc..*

Inequality	*Standard Form*	*line*	*intercepts* x (*when* $y = 0$)	y (*when* $x = 0$)	*graph* *F.S.*
$x \geq 0$	$x \geq 0$	$x = 0$ (y *axis*)	0	*N/A*	*Right*(*shade left*)
$y \geq 0$	$y \geq 0$	$y = 0$ (x *axis*)	*N/A*	0	*Above*(*shade below*)
$y + 3x \geq 9$	$y \geq 9 - 3x$	$y = 9 - 3x$	3	9	*Above*(*shade below*)
$y + x \geq 5$	$y \geq 5 - x$	$y = 5 - x$	5	5	*Above*(*shade below*)

(b) Find the vertices of the above feasible set.

(c) Find the <u>minimum</u> of the objective function $5x + 2y$ on the above feasible set.

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$x \geq 0$	$x \geq 0$	$x = 0$ (y *axis*)	0	N/A	*Right*(*shade left*)
$y \geq 0$	$y \geq 0$	$y = 0$ (x *axis*)	N/A	0	*Above*(*shade below*)
$y + 3x \geq 9$	$y \geq 9 - 3x$	$y = 9 - 3x$	3	9	*Above*(*shade below*)
$y + x \geq 5$	$y \geq 5 - x$	$y = 5 - x$	5	5	*Above*(*shade below*)

- *We will draw the feasible set on the blackboard.*

(b) Find the vertices of the above feasible set.

(c) Find the minimum of the objective function $5x + 2y$ on the above feasible set.

14 (a) Graph the feasible set corresponding to the following set of inequalities on the set of axes provided: (Make sure you label the region corresponding to the feasible set clearly)

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$y \geq 0$	$y \geq 0$	$y = 0$ (x *axis*)	N/A	0	*Above*(*shade below*)
$y + 3x \geq 9$	$y \geq 9 - 3x$	$y = 9 - 3x$	3	9	*Above*(*shade below*)
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- *We will draw the feasible set on the blackboard.*

(b) Find the vertices of the above feasible set.

- *Vertices (2, 3), (0, 9), (5, 0).*

(c) Find the minimum of the objective function $5x + 2y$ on the above feasible set.

14 (a) Graph the feasible set corresponding to the following set of inequalities on the set of axes provided: (Make sure you label the region corresponding to the feasible set clearly)

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Inequality	*Standard Form*	*line*	*intercepts* x (*when* $y = 0$)	y (*when* $x = 0$)	*graph F.S.*
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- *We will draw the feasible set on the blackboard.*

(b) Find the vertices of the above feasible set.

- *Vertices (2, 3), (0, 9), (5, 0).*

(c) Find the <u>minimum</u> of the objective function $5x + 2y$ on the above feasible set.

- *We compare the values of the objective function on the vertices:*

(x, y)	$5x + 2y$
$(2, 3)$	$10 + 6 = 16(min)$
$(0, 9)$	$0 + 18 = 18$
$(5, 0)$	$25 + 0 = 25$

Question 14, Ex 2, F07

14(10 pts) In a survey conducted on campus, 20 students were asked how many times they had checked their e-mail on the previous day. The results were as follows:

1, 2, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 4, 4, 4, 4, 5, 10.

(a) Organize the data in the relative frequency table below:

Outcome	Frequency	Relative Frequency

(b) Draw a histogram for the data on the axes provided below:

Question 14, Ex 2, F07

14(10 pts) In a survey conducted on campus, 20 students were asked how many times they had checked their e-mail on the previous day. The results were as follows:

1, 2, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 4, 4, 4, 4, 5, 10.

(a) Organize the data in the relative frequency table below:

Outcome	Frequency	Relative Frequency
1	1	1/20
2	7	7/20
3	6	6/20
4	4	4/20
5	1	1/20
10	1	1/20

(b) Draw a histogram for the data on the axes provided below:

Question 14, Ex 2, F07

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Outcome	Frequency	Relative Frequency
1	1	1/20
2	7	7/20
3	6	6/20
4	4	4/20
5	1	1/20
10	1	1/20

(b) Draw a histogram for the data on the axes provided below:

- *A histogram will be drawn on the blackboard*

Question 15, Ex 2, F07

15(10 points) The rules of a carnival game are as follows:

- You pay \$1 to play the game.
- The game attendant then flips a coin at most 4 times.
- As soon as the game attendant gets 2 heads or 3 tails, he stops flipping the coin.
- If the game attendant gets 2 heads, he gives you \$2 (you win).
- If the game attendant gets 3 tails, he gives you nothing (you lose).

(a) Draw a tree diagram representing the possible outcomes of the game.
(b) What is the probability that you win?
(c) Let X denote the earnings for this game. What are the possible values for X?
(d) Give the probability distribution of X.

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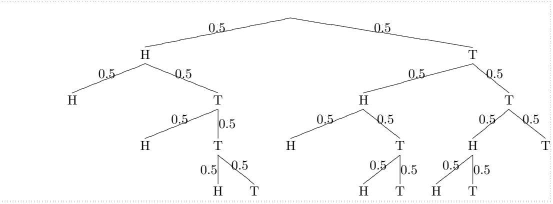
(a) Draw a tree diagram representing the possible outcomes of the game.



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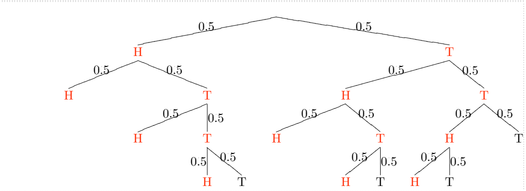

(b) What is the probability that you win? *The winning paths are shown in red above.* $P(Win) = (0.5)^2 + 2(0.5)^3 + 3(0.5)^4 = 0.6875$

(c) Let X denote the earnings for this game. What are the possible values for X?

(d) Give the probability distribution of X.

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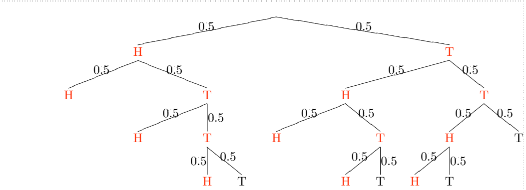

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(d) Give the probability distribution of X.

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- You pay $1 to play the game.
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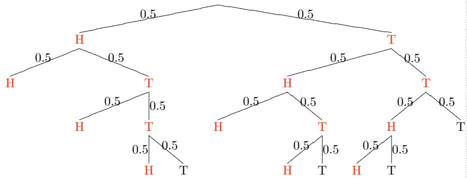

(b) What is the probability that you win? *The winning paths are shown in red above.* $P(Win) = (0.5)^2 + 2(0.5)^3 + 3(0.5)^4 = 0.6875$

(c) Let X denote the earnings for this game. What are the possible values for X? *-$1 (lose), $1 (win)*

(d) Give the probability distribution of X.

k	$Pr(X = k)$
$-\$1$ (*lose*)	$1 - 0.6875 = 0.3125$
$\$1$ (*win*)	0.6875

Question 20, Final, F07

20 Let $A =$

$$\begin{pmatrix} 2 & 3 \\ 1 & 1 \end{pmatrix}$$

Which of the following gives the entry in the 2nd row and 1st column of A^{-1}?

(a) -1 (b) 3 (c) 1 (d) -2 (e) $\frac{1}{3}$

Question 20, Final, F07

20 Let $A =$

$$\begin{pmatrix} 2 & 3 \\ 1 & 1 \end{pmatrix}$$

Which of the following gives the entry in the 2nd row and 1st column of A^{-1}?

(a) -1 (b) 3 (c) 1 (d) -2 (e) $\frac{1}{3}$

- *If ad - bc is not zero, the inverse of the matrix* $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ *is given by*

$$\begin{pmatrix} \frac{d}{ad-bc} & \frac{-b}{ad-bc} \\ \frac{-c}{ad-bc} & \frac{a}{ad-bc} \end{pmatrix}$$

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$$\begin{pmatrix} \frac{d}{ad-bc} & \frac{-b}{ad-bc} \\ \frac{-c}{ad-bc} & \frac{a}{ad-bc} \end{pmatrix}$$

- *Since* $2 \cdot 1 - 1 \cdot 3 = -1 \neq 0$, *the inverse of the matrix* $\begin{pmatrix} 2 & 3 \\ 1 & 1 \end{pmatrix}$ *is given by*

$$\begin{pmatrix} \frac{1}{-1} & \frac{-3}{-1} \\ \frac{-1}{-1} & \frac{2}{-1} \end{pmatrix} = \begin{pmatrix} -1 & 3 \\ 1 & -2 \end{pmatrix}$$

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- *If ad - bc is not zero, the inverse of the matrix* $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ *is given by*

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$$\begin{pmatrix} \frac{1}{-1} & \frac{-3}{-1} \\ \frac{-1}{-1} & \frac{2}{-1} \end{pmatrix} = \begin{pmatrix} -1 & 3 \\ 1 & -2 \end{pmatrix}$$

- *The correct answer is (c).*

Question 21, Final, F07

21 Let

$$A = \begin{pmatrix} 1 & 2 \\ 3 & 1 \\ 0 & 2 \end{pmatrix}, \quad B = \begin{pmatrix} 2 & 1 \\ 5 & 0 \\ 0 & 1 \end{pmatrix}, \quad C = \begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}$$

Calculate $(A - B) \cdot C$.

(a) $\begin{pmatrix} 0 & 1 \\ -1 & 1 \\ 1 & 1 \end{pmatrix}$ (b) $\begin{pmatrix} -1 & 1 \\ -2 & 1 \\ 0 & 1 \end{pmatrix}$ (c) $\begin{pmatrix} 1 & 0 \\ 1 & -1 \\ 1 & 1 \end{pmatrix}$ (d) $\begin{pmatrix} 0 & -1 & 1 \\ 1 & 1 & 1 \end{pmatrix}$ (e) $\begin{pmatrix} 0 & 1 \\ -1 & 1 \end{pmatrix}$

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- A - $B = \begin{pmatrix} 1-2 & 2-1 \\ 3-5 & 1-0 \\ 0-0 & 2-1 \end{pmatrix} = \begin{pmatrix} -1 & 1 \\ -2 & 1 \\ 0 & 1 \end{pmatrix}$.

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Calculate $(A - B) \cdot C$.

(a) $\begin{pmatrix} 0 & 1 \\ -1 & 1 \\ 1 & 1 \end{pmatrix}$ (b) $\begin{pmatrix} -1 & 1 \\ -2 & 1 \\ 0 & 1 \end{pmatrix}$ (c) $\begin{pmatrix} 1 & 0 \\ 1 & -1 \\ 1 & 1 \end{pmatrix}$ (d) $\begin{pmatrix} 0 & -1 & 1 \\ 1 & 1 & 1 \end{pmatrix}$ (e) $\begin{pmatrix} 0 & 1 \\ -1 & 1 \end{pmatrix}$

- $$A \text{ - } B = \begin{pmatrix} 1-2 & 2-1 \\ 3-5 & 1-0 \\ 0-0 & 2-1 \end{pmatrix} = \begin{pmatrix} -1 & 1 \\ -2 & 1 \\ 0 & 1 \end{pmatrix}.$$
- $$(A - B) \cdot C = \begin{pmatrix} -1 & 1 \\ -2 & 1 \\ 0 & 1 \end{pmatrix}_{3\times 2} \cdot \begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}_{2\times 2} = \begin{pmatrix} -1+1 & 0+1 \\ -2+1 & 0+1 \\ 0+1 & 0+1 \end{pmatrix}_{3\times 2}$$
  $$= \begin{pmatrix} 0 & 1 \\ -1 & 1 \\ 1 & 1 \end{pmatrix}_{3\times 2}$$

Question 21, Final, F07

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$$A = \begin{pmatrix} 1 & 2 \\ 3 & 1 \\ 0 & 2 \end{pmatrix}, \quad B = \begin{pmatrix} 2 & 1 \\ 5 & 0 \\ 0 & 1 \end{pmatrix}, \quad C = \begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}$$

Calculate $(A - B) \cdot C$.

(a) $\begin{pmatrix} 0 & 1 \\ -1 & 1 \\ 1 & 1 \end{pmatrix}$ (b) $\begin{pmatrix} -1 & 1 \\ -2 & 1 \\ 0 & 1 \end{pmatrix}$ (c) $\begin{pmatrix} 1 & 0 \\ 1 & -1 \\ 1 & 1 \end{pmatrix}$ (d) $\begin{pmatrix} 0 & -1 & 1 \\ 1 & 1 & 1 \end{pmatrix}$ (e) $\begin{pmatrix} 0 & 1 \\ -1 & 1 \end{pmatrix}$

- A - $B = \begin{pmatrix} 1-2 & 2-1 \\ 3-5 & 1-0 \\ 0-0 & 2-1 \end{pmatrix} = \begin{pmatrix} -1 & 1 \\ -2 & 1 \\ 0 & 1 \end{pmatrix}$.
- $(A - B) \cdot C = \begin{pmatrix} -1 & 1 \\ -2 & 1 \\ 0 & 1 \end{pmatrix}_{3\times 2} \cdot \begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}_{2\times 2} = \begin{pmatrix} -1+1 & 0+1 \\ -2+1 & 0+1 \\ 0+1 & 0+1 \end{pmatrix}_{3\times 2}$
  $= \begin{pmatrix} 0 & 1 \\ -1 & 1 \\ 1 & 1 \end{pmatrix}_{3\times 2}$
- *The correct answer is (a).*

Question 22, Final, F07

22 Let

$$C = \begin{pmatrix} 2 & 1 & 3 \\ 0 & 2 & 4 \end{pmatrix}, \quad D = \begin{pmatrix} 5 & 2 \\ 1 & 0 \\ 2 & 1 \end{pmatrix}.$$

Find the entry in the second row and first column of the matrix $C \cdot D$.

(a) 10 (b) 4 (c) 7 (d) 17 (e) 0

Question 22, Final, F07

22 Let

$$C = \begin{pmatrix} 2 & 1 & 3 \\ 0 & 2 & 4 \end{pmatrix}, \quad D = \begin{pmatrix} 5 & 2 \\ 1 & 0 \\ 2 & 1 \end{pmatrix}.$$

Find the entry in the second row and first column of the matrix $C \cdot D$.

(*a*) 10 (*b*) 4 (*c*) 7 (*d*) 17 (*e*) 0

- $C \cdot D = \begin{pmatrix} 2 & 1 & 3 \\ 0 & 2 & 4 \end{pmatrix}_{2\times 3} \cdot \begin{pmatrix} 5 & 2 \\ 1 & 0 \\ 2 & 1 \end{pmatrix}_{3\times 2}$

$$= \begin{pmatrix} - & - \\ 0 \cdot 5 + 2 \cdot 1 + 4 \cdot 2 & - \end{pmatrix}_{2\times 2} = \begin{pmatrix} - & - \\ 10 & - \end{pmatrix}$$

Question 22, Final, F07

22 Let

$$C = \begin{pmatrix} 2 & 1 & 3 \\ 0 & 2 & 4 \end{pmatrix}, \quad D = \begin{pmatrix} 5 & 2 \\ 1 & 0 \\ 2 & 1 \end{pmatrix}.$$

Find the entry in the second row and first column of the matrix $C \cdot D$.

(a) 10 (b) 4 (c) 7 (d) 17 (e) 0

- $C \cdot D = \begin{pmatrix} 2 & 1 & 3 \\ 0 & 2 & 4 \end{pmatrix}_{2\times 3} \cdot \begin{pmatrix} 5 & 2 \\ 1 & 0 \\ 2 & 1 \end{pmatrix}_{3\times 2}$

  $= \begin{pmatrix} - & - \\ 0 \cdot 5 + 2 \cdot 1 + 4 \cdot 2 & - \end{pmatrix}_{2\times 2} = \begin{pmatrix} - & - \\ 10 & - \end{pmatrix}$
- *The correct answer is (a).*

Question 23, Final, F07

23 Let

$$A = \begin{pmatrix} 5 & 2 \\ 1 & 1 \end{pmatrix}, \quad B = \begin{pmatrix} 2 & 1 \\ 0 & 2 \\ 1 & -1 \end{pmatrix}, \quad C = \begin{pmatrix} 5 & 2 \\ 1 & 0 \\ 2 & 1 \end{pmatrix}, \quad D = \begin{pmatrix} 2 & 1 & 5 \end{pmatrix}.$$

Which of the following statements is true?

(a) A^{-1} does not exist. *False, A^{-1} does exist because* $\det A = 5 - 2 = 3 \neq 0$.

(b) $C \cdot B$ does not exist. *True, because $C_{3\times2}$ and $B_{3\times2}$ do not have compatible dimensions for multiplication.*

(c) $D \cdot C$ does not exist. *False, because $D_{1\times3}$ and $C_{3\times2}$ have compatible dimensions to calculate $D \cdot C$.*

(d) $B \cdot A$ does not exist. *False, because $B_{3\times2}$ and $A_{2\times2}$ have compatible dimensions to calculate $B \cdot A$.*

(e) $(B - C) \cdot A$ does not exist. *False, because $(B - C)_{3\times2}$ and $A_{2\times2}$ have compatible dimensions to calculate $(B - C) \cdot A$.*

Question 25, Final, F07

25 Roadrunner (R) and Coyote (C) play a game. They each have 4 cards, numbered 1, 2, 3 and 4. They each display one card simultaneously. If both numbers are even Coyote gives Roadrunner $1.If both numbers are odd, Roadrunner gives Coyote $1. If the numbers are neither both even nor both odd, the creature displaying the higher number receives $1 from the other creature. Which of the following payoff matrices gives the payoff matrix for Roadrunner for this game?

(a)

		C		
Card #	1	2	3	4
1	−1	1	1	1
2	−1	1	1	1
R 3	−1	−1	1	1
4	−1	−1	−1	−1

(b)

		C		
Card #	1	2	3	4
1	1	1	−1	−1
2	1	1	−1	−1
R 3	1	1	1	−1
4	1	1	1	1

(c)

		C		
Card #	1	2	3	4
1	1	0	0	1
2	0	1	2	3
R 3	0	0	1	2
4	1	1	−1	−1

(d)

		C		
Card #	1	2	3	4
1	−1	0	1	1
2	0	−1	1	−1
R 3	0	0	−1	−1
4	1	1	−1	−1

(e)

		C		
Card #	1	2	3	4
1	−1	−1	−1	−1
2	1	1	−1	1
R 3	−1	1	−1	−1
4	1	1	1	1

Question 25, Final, F07

25 Roadrunner (R) and Coyote (C) play a game. They each have 4 cards, numbered 1, 2, 3 and 4. They each display one card simultaneously. If both numbers are even Coyote gives Roadrunner $1.If both numbers are odd, Roadrunner gives Coyote $1. If the numbers are neither both even nor both odd, the creature displaying the higher number receives $1 from the other creature. Which of the following payoff matrices gives the payoff matrix for Roadrunner for this game?

(a)

Card #	C 1	2	3	4
1	−1	1	1	1
2	−1	1	1	1
R 3	−1	−1	1	1
4	−1	−1	−1	−1

(b)

Card #	C 1	2	3	4
1	1	1	−1	−1
2	1	1	−1	−1
R 3	1	1	1	−1
4	1	1	1	1

(c)

Card #	C 1	2	3	4
1	1	0	0	1
2	0	1	2	3
R 3	0	0	1	2
4	1	1	−1	−1

(d)

Card #	C 1	2	3	4
1	−1	0	1	1
2	0	−1	1	−1
R 3	0	0	−1	−1
4	1	1	−1	−1

(e)

Card #	C 1	2	3	4
1	−1	−1	−1	−1
2	1	1	−1	1
R 3	−1	1	−1	−1
4	1	1	1	1

- *The correct answer is (e). by comparing with the instructions.*

Question 26, Final, F07

26 Rat (R) and Cat (C) play a zero-sum game with payoff matrix for Rat given below. What is the optimal pure strategy for Cat for this game?

$$\begin{pmatrix} 1 & 0 & 0 & 2 & 1 \\ 2 & 1 & 0 & 1 & 2 \\ 3 & 2 & -1 & 4 & 6 \\ -1 & -2 & 1 & -1 & -2 \\ 0 & 1 & -1 & 0 & -5 \end{pmatrix}$$

(a) Col 1 (b) Col 2 (c) Col 3 (d) Col 4 (e) Col 5

Question 26, Final, F07

26 Rat (R) and Cat (C) play a zero-sum game with payoff matrix for Rat given below. What is the optimal pure strategy for Cat for this game?

	1	0	0	2	1
	2	1	0	1	2
	3	2	−1	4	6
	−1	−2	1	−1	−2
	0	1	−1	0	−5
Max	3	2	1	4	6

(*a*) Col 1 (*b*) Col 2 (*c*) Col 3 (*d*) Col 4 (*e*) Col 5

- *We calculate the max. of each column and then choose the minimum of these to give Col 3.*

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(*a*) Col 1 (*b*) Col 2 (*c*) Col 3 (*d*) Col 4 (*e*) Col 5

- *We calculate the max. of each column and then choose the minimum of these to give Col 3.*
- *The correct answer is (c).*