

**On my honor, as an Aggie, I have neither given nor received unauthorized aid on this academic work.**

---

(signature required)

- Read all directions.
- BUBBLE TEST FORM A ON YOUR SCANTRON.
- The scantrons will not be returned, so you MUST mark your answers on this exam.
- No partial credit on scantron questions.
- Be exact, if possible, on all workout problems. If rounding is needed, round to 4 decimal places.
- There are 3 pages with writing on both sides of every page except this one.
- There is a 5 point deduction for any errors in following the directions.
- There will be a deduction of 5 points for any hand grading of your scantron.
- **NO LATE EXAMS!!** Penalty is (at least) 10 points off your score.

A standard deck of 52 cards has 13 cards in 4 different suits. The red suits are hearts and diamonds. The black suits are spades and clubs. The cards in each suit are A, 2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K. The J, Q, and K are face cards.

There are 7 days in a week and 52 weeks in a year.

There are 12 inches in a foot, 3 feet in a yard, and 5280 feet in a mile.

The English alphabet has 26 letters. There are 5 vowels (a, e, i, o and u).

This exam is copyright ©2009 by Janice Epstein. No part of this exam may be reproduced or published in any form without the author's written consent.

1 – 16	/50
page 4	/12
page 5	/18
Page 6	/20
TOTAL	/100

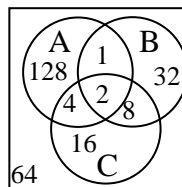
**EXAM PART I - MULTIPLE CHOICE (4 points each)**

1. Five couples go to a football game. How many ways can these couples be seated if each couple sits together?
  - (A) 113400
  - (B) 3628800
  - (C) 3840
  - (D) 240
  - (E) None of these
  
2. How many ways can a 5 question true/false quiz be answered if questions can be left blank?
  - (A) 10
  - (B) 32
  - (C) 243
  - (D) 120
  - (E) None of these
  
3. A farmer harvests potatoes from her garden. Each potato is weighed and she finds that 25% of the potatoes weigh 600 grams or less, 20% of the potatoes weigh more than 800 grams, and 45% of the potatoes weigh less than 700 grams. What is the probability that a potato weighs between 700 and 800 grams (inclusive)?
  - (A) 0.35
  - (B) 0.10
  - (C) 0
  - (D) Need more information
  - (E) None of these
  
4. You have a 12 pack of sodas, 3 of which have a prize under the lid. You choose a sample of 2 sodas to drink. How many ways can you have at least one prize in your sample?
  - (A) 28
  - (B) 27
  - (C) 44
  - (D) 30
  - (E) None of these
  
5. A coffee shop finds that 44% of its customers do not order coffee, 16% order only coffee, and 6% order only a muffin. What is the probability that a randomly selected customer will order coffee or a muffin?
  - (A) 0.22
  - (B) 0.40
  - (C) 0.62
  - (D) 0.56
  - (E) None of these

6. You are arranging Halloween decorations on your windowsill. You have 3 identical pumpkins, 2 identical witches and a skeleton. How many distinguishable ways can these decorations be arranged?

- (A) 60
- (B) 72
- (C) 9
- (D) 720
- (E) None of these

7. Using the Venn diagram to the right, find  $n(B^C \cap (A^C \cup C))$



- (A) 80
- (B) 94
- (C) 88
- (D) 84
- (E) None of these

8. A teacher wishes to buy some gel pens and mechanical pencils for her class. The pens cost \$1.50 each and the pencils are \$1.00 each. If  $x$  is the number of pens and  $y$  is the number of pencils, the corners of the feasible region are at  $(0, 0)$ ,  $(0, 16)$ ,  $(2, 15)$ ,  $(8, 6)$  and  $(10, 0)$ .

How many different solutions are possible for the number of pens and pencils she can buy if she maximizes the money spent?

- (A) 2
- (B) 4
- (C) 7
- (D) infinite
- (E) None of these

9. Two fair six-sided dice are rolled. What is the probability that the sum is greater than 10 or at least one 5 is showing? Note that the answers are reduced fractions.

- (A)  $1/3$
- (B)  $4/9$
- (C)  $17/36$
- (D)  $7/18$
- (E) None of these

**Questions 10 – 16 are worth 2 points each. Bubble in e for number 17 for two points.**

For questions 10 – 12, consider the following sets:

$$U = \{x \mid x \text{ is a lowercase letter in the English alphabet}\}$$

$$T = \{x \mid x \text{ is a letter in the word } \textit{financial}\} \quad S = \{b, a, n, k\} \quad R = \{b, o, y\}$$

10.  $S$  and  $R$  are disjoint.

- (A) TRUE (B) FALSE (C) Need more information to determine the answer

11.  $c \subset (T \cup S)$

- (A) TRUE (B) FALSE (C) Need more information to determine the answer

12.  $R$  has 8 subsets.

- (A) TRUE (B) FALSE (C) Need more information to determine the answer

13. If  $E$  is a subset of  $F$  and  $P(F) = 0$  then  $P(E) = 0$ .  
 (A) TRUE (B) FALSE (C) Need more information to determine the answer

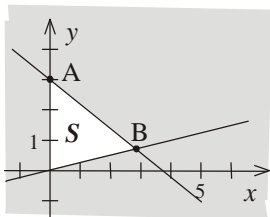
For questions 14 – 16, let  $S = \{s_1, s_2, s_3, \dots, s_{13}\}$  be a uniform sample space for an experiment, with events  
 $A = \{s_1, s_2, s_{13}\}$ ,  $B = \{s_2, s_3, s_{10}\}$ , and  $C = \{s_1\}$ .

Find the following:

14. Which, if any, of the events are simple events?  
 (A) All are simple events (B) none are simple events (A) only  $A$  and  $B$  (B) only  $C$
15.  $P(B \cap C) =$   
 (A) 0 (B)  $\emptyset$  (C) none of these
16.  $P(B \cup A) =$   
 (A)  $\frac{6}{13}$  (B)  $\frac{5}{13}$  (C)  $\{s_1, s_2, s_2, s_3, s_{10}, s_{13}\}$  (D)  $\{s_1, s_2, s_3, s_{10}, s_{13}\}$  (E) none of these

**Free response. Point values are as indicated. Show all your work!**

17. (8 points) Choose the symbols that correspond to the system below.



$$4x + 5y \begin{matrix} \leq \\ \geq \end{matrix} 15 \quad \text{Circle one}$$

$$x - 4y \begin{matrix} \leq \\ \geq \end{matrix} 0 \quad \text{Circle one}$$

What are the exact values of the corners A and B?

A is at \_\_\_\_\_

B is at \_\_\_\_\_

18. (4 points) A sample space contains 4 outcomes,  $S = \{A, B, C, D\}$ . Write the events that do not contain a  $C$  or a  $D$ .

19. (8 points) A bag has 5 pennies, 4 dimes and 6 quarters. Four coins are chosen at random from the bag

a. How many ways can the chosen coins be all quarters?

b. How many ways can the chosen coins have exactly 3 pennies or exactly 1 dime?

20. (10 points) SET UP but do not solve the following linear programming problem:

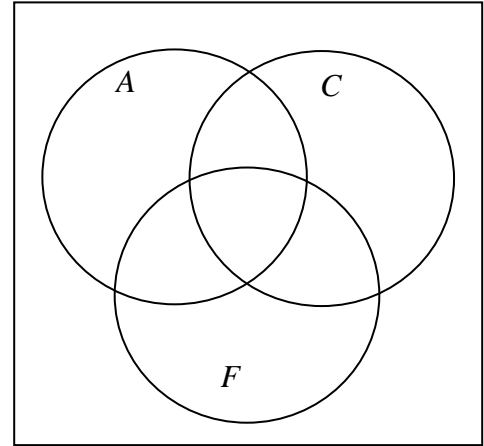
The Au Natural company sells cotton napkins and cotton towels. A package of six napkins sells for \$12 and a package of two towels sells for \$20. Each towel takes 2 square feet of fabric and each napkin takes one square foot of fabric. The company has 180 square yards of fabric available for a production run. The company wants to make at least three times as many napkins as towels. How many napkins and towels should be made to maximize revenue?

**21.** (10 points) Fifty-two people at a home show were surveyed to see if they planned on replacing their kitchen countertops ( $C$ ), their kitchen floor ( $F$ ) or their kitchen appliances ( $A$ ). The following results were found:

- 22 people planned to replace exactly one of these features
- 18 people were planning to replace their kitchen appliances or floor, but not their countertops.
- 6 people planned to only replace their kitchen countertops
- 2 people planned to remodel all three features.
- 25 people planned to replace their countertops.
- 36 people planned to replace their appliances or countertops
- 9 people planned to replace their countertops and floor.

(a) Fill in the Venn diagram with the appropriate information.

(b) Express the statement: "Planned to replace only the kitchen floors" in set notation (using only  $A$ ,  $C$ ,  $F$ ,  $\cap$ , or  $\cup$ ).



**22.** (10 points) A company makes and sells hobby and professional tripods. The hobby tripods ( $x$ ) have a profit of \$20 each and the professional tripods ( $y$ ) have a profit of \$120 each. The company has 75 hours available per week in the assembly shop and each hobby tripod takes 1 hour to assemble and each professional tripod takes 5 hours to assemble ( $x + 5y \leq 75$ ). The company has 48 pounds of aluminum available per week and each hobby tripod uses 2.4 pound of aluminum and each professional tripod uses 1 pound of aluminum ( $2.4x + y \leq 48$ ). How many of each tripod should be made to maximize profits? What is the maximum profit? Is anything leftover? If so, then how much of each resource is left over? The corners of the feasible region are  $(0, 0)$ ,  $(0, 15)$ ,  $(15, 12)$ , and  $(20, 0)$

**EXAM PART I - MULTIPLE CHOICE (4 points each)**

1. Five couples go to a football game. How many ways can these couples be seated if each couple sits together?

- (A) 113400
- (B) 3628800
- (C) 3840**
- (D) 240
- (E) None of these

$$\frac{5!}{\text{arr couples}} \cdot \frac{2!}{\text{1st couple}} \cdot \frac{2!}{\text{2nd}} \cdot \frac{2!}{\text{3rd}} \cdot \frac{2!}{\text{4th}} \cdot \frac{2!}{\text{5th}}$$

2. How many ways can a 5 question true/false quiz be answered if questions can be left blank?

- (A) 10
- (B) 32
- (C) 243**
- (D) 120
- (E) None of these

$$\frac{3}{Q1} \cdot \frac{3}{Q2} \cdot \frac{3}{Q3} \cdot \frac{3}{Q4} \cdot \frac{3}{Q5}$$

T/F/\_

3. A farmer harvests potatoes from her garden. Each potato is weighed and she finds that 25% of the potatoes weigh 600 grams or less, 20% of the potatoes weigh more than 800 grams, and 45% of the potatoes weigh less than 700 grams. What is the probability that a potato weighs between 700 and 800 grams (inclusive)?

- (A) 0.35**
- (B) 0.10
- (C) 0
- (D) Need more information
- (E) None of these

$$\begin{array}{l} x \leq 600\text{gm} \quad 25\% \\ 600 < x < 700\text{gm} \\ 700 \leq x \leq 800\text{gm} \quad ? \\ x > 800\text{gm} \quad 20\% \end{array} \left. \vphantom{\begin{array}{l} x \leq 600\text{gm} \\ 600 < x < 700\text{gm} \\ 700 \leq x \leq 800\text{gm} \\ x > 800\text{gm} \end{array}} \right\} 45\%$$

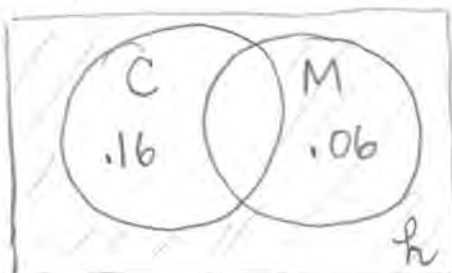
4. You have a 12 pack of sodas, 3 of which have a prize under the lid. You choose a sample of 2 sodas to drink. How many ways can you have at least one prize in your sample?

- (A) 28
- (B) 27
- (C) 44
- (D) 30**
- (E) None of these

$$\frac{C(3,1) \cdot C(9,1)}{1 \text{ prize } 1 \text{ not}} + \frac{C(3,2) \cdot C(9,0)}{2 \text{ prizes } 0 \text{ not}}$$

5. A coffee shop finds that 44% of its customers do not order coffee, 16% order only coffee, and 6% order only a muffin. What is the probability that a randomly selected customer will order coffee or a muffin?

- (A) 0.22
- (B) 0.40
- (C) 0.62**
- (D) 0.56
- (E) None of these



$$\begin{aligned} .06 + h &= .44 \\ \rightarrow h &= .38 \text{ neither} \\ 1 - .38 &= .62 \text{ do} \end{aligned}$$

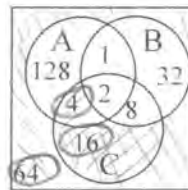
6. You are arranging Halloween decorations on your windowsill. You have 3 identical pumpkins, 2 identical witches and a skeleton. How many distinguishable ways can these decorations be arranged?

- (A) 60
- (B) 72
- (C) 9
- (D) 720
- (E) None of these

$$\frac{6!}{3! \cdot 2! \cdot 1!}$$

7. Using the Venn diagram to the right, find  $n(B^c \cap (A^c \cup C))$

- (A) 80
- (B) 94
- (C) 88
- (D) 84
- (E) None of these



8. A teacher wishes to buy some gel pens and mechanical pencils for her class. The pens cost \$1.50 each and the pencils are \$1.00 each. If  $x$  is the number of pens and  $y$  is the number of pencils, the corners of the feasible region are at  $(0, 0)$ ,  $(0, 16)$ ,  $(2, 15)$ ,  $(8, 6)$  and  $(10, 0)$ .

How many different solutions are possible for the number of pens and pencils she can buy if she maximizes the money spent?

- (A) 2
- (B) 4
- (C) 7
- (D) infinite
- (E) None of these

$$M = 1.5x + 1y \rightarrow \text{Max} = 18 = 1.5x + y \quad 2 \leq x \leq 8$$

$$\text{or } y = 18 - \frac{3}{2}x, \text{ solutions } (2, 15), (4, 12), (6, 9), (8, 6)$$

4

9. Two fair six-sided dice are rolled. What is the probability that the sum is greater than 10 or at least one 5 is showing? Note that the answers are reduced fractions.

- (A) 1/3
- (B) 4/9
- (C) 17/36
- (D) 7/18
- (E) None of these

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

12/36

> 10

Questions 10 – 16 are worth 2 points each. Bubble in e for number 17 for two points.

For questions 10 – 12, consider the following sets:

$$U = \{x \mid x \text{ is a lowercase letter in the English alphabet}\}$$

$$T = \{x \mid x \text{ is a letter in the word } \textit{financial}\} \quad S = \{b, a, n, k\} \quad R = \{b, o, y\}$$

10.  $S$  and  $R$  are disjoint.

- (A) TRUE
- (B) FALSE
- (C) Need more information to determine the answer

both have a "b"

11.  $e \in (T \cup S)$

- (A) TRUE
- (B) FALSE
- (C) Need more information to determine the answer

C ∈ T ∪ S or {c} ⊂ T ∪ S

12.  $R$  has 8 subsets.

- (A) TRUE
- (B) FALSE
- (C) Need more information to determine the answer

13. If  $E$  is a subset of  $F$  and  $P(F) = 0$  then  $P(E) = 0$ .

- (A) TRUE (B) FALSE (C) Need more information to determine the answer



For questions 14 – 16, let  $S = \{s_1, s_2, s_3, \dots, s_{13}\}$  be a uniform sample space for an experiment, with events

$$A = \{s_1, s_2, s_{13}\}, B = \{s_2, s_3, s_{10}\}, \text{ and } C = \{s_1\}.$$

Find the following:

14. Which, if any, of the events are simple events?

- (A) All are simple events (B) none are simple events (C) only  $A$  and  $B$  (D) only  $C$

15.  $P(B \cap C) =$

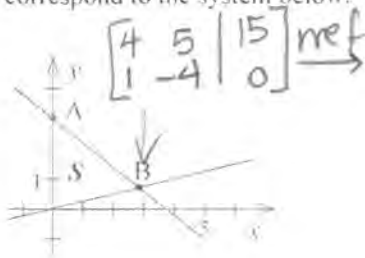
- (A) 0 (B)  $\emptyset$  (C) none of these

16.  $P(B \cup A) =$

- (A)  $\frac{6}{13}$  (B)  $\frac{5}{13}$  (C)  $\{s_1, s_2, s_2, s_3, s_{10}, s_{13}\}$  (D)  $\{s_1, s_2, s_3, s_{10}, s_{13}\}$  (E) none of these

**Free response. Point values are as indicated. Show all your work!**

17. (8 points) Choose the symbols that correspond to the system below.



$$4x + 5y \begin{matrix} \leq \\ \geq \end{matrix} 15 \text{ Circle one}$$

$$x - 4y \begin{matrix} \leq \\ \geq \end{matrix} 0 \text{ Circle one}$$

What are the exact values of the corners A and B?

A is at  $(0, 3)$

B is at  $(20/7, 5/7)$

18. (4 points) A sample space contains 4 outcomes,  $S = \{A, B, C, D\}$ . Write the events that do not contain a C or a D.

$\emptyset, \{A\}, \{B\}, \{A, B\}$

19. (8 points) A bag has 5 pennies, 4 dimes and 6 quarters. Four coins are chosen at random from the bag

a. How many ways can the chosen coins be all quarters?

$$\frac{C(6,4)}{4Q's} \cdot \frac{C(9,0)}{0QC} = 15$$

b. How many ways can the chosen coins have exactly 3 pennies or exactly 1 dime?

$$\frac{C(5,3)}{3P} \cdot \frac{C(10,1)}{1DC} + \frac{C(4,1)}{1D} \cdot \frac{C(11,3)}{3DC} - \frac{C(5,3)}{3P} \cdot \frac{C(4,1)}{1D} = 720$$

20. (10 points) SET UP but do not solve the following linear programming problem:

The Au Natural company sells cotton napkins and cotton towels. A package of six napkins sells for \$12 and a package of two towels sells for \$20. Each towel takes 2 square feet of fabric and each napkin takes one square foot of fabric. The company has 180 square yards of fabric available for a production run. The company wants to make at least three times as many napkins as towels. How many napkins and towels should be made to maximize revenue?

$$\begin{aligned} x &= \# \text{ of napkins made} \\ y &= \# \text{ of towels made} \\ \text{Max } R &= 2x + 10y \end{aligned}$$



Subject to

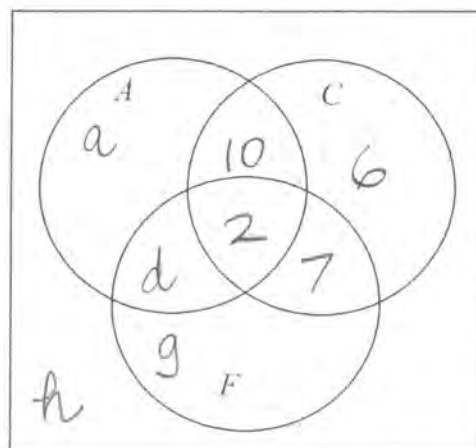
$$x + 2y \leq 180 \text{ sq yd} * \frac{9 \text{ sq ft}}{\text{sq yd}}$$

$$x \geq 3y$$

$$x \geq 0, y \geq 0$$

21. (10 points) Fifty-two people at a home show were surveyed to see if they planned on replacing their kitchen countertops (C), their kitchen floor (F) or their kitchen appliances (A). The following results were found:

- 22 people planned to replace exactly one of these features
- 18 people were planning to replace their kitchen appliances or floor, but not their countertops.
- ~~X~~ people planned to only replace their kitchen countertops #1
- ~~X~~ people planned to remodel all three features. #2
- ~~X~~ people planned to replace their countertops. #4
- 36 people planned to replace their appliances or countertops
- ~~X~~ people planned to replace their countertops and floor. #3



(a) Fill in the Venn diagram with the appropriate information.

(b) Express the statement: "Planned to replace only the kitchen floors" in set notation (using only A, C, F,  $\cap$ ,  $\cup$ , or  $\complement$ ).

$$A^c \cap C^c \cap F$$

$$52 = a + 10 + 6 + d + 2 + 7 + g + h \Rightarrow 27 = a + d + g + h$$

$$22 = a + 6 + g$$

$$18 = a + d + g$$

$$36 = a + 10 + 6 + d + 2 + 7$$

$$\begin{aligned} 16 &= a + g \\ 18 &= a + d + g \\ 11 &= a + d \\ \hline \text{net} \rightarrow & \begin{aligned} a &= 9 \\ d &= 2 \\ g &= 7 \\ h &= 9 \end{aligned} \end{aligned}$$

22. (10 points) A company makes and sells hobby and professional tripods. The hobby tripods (x) have a profit of \$20 each and the professional tripods (y) have a profit of \$120 each. The company has 75 hours available per week in the assembly shop and each hobby tripod takes 1 hour to assemble and each professional tripod takes 5 hours to assemble ( $x + 5y \leq 75$ ). The company has 48 pounds of aluminum available per week and each hobby tripod uses 2.4 pound of aluminum and each professional tripod uses 1 pound of aluminum ( $2.4x + y \leq 48$ ). How many of each tripod should be made to maximize profits? What is the maximum profit? Is anything leftover? If so, then how much of each resource is left over? The corners of the feasible region are (0, 0), (0, 15), (15, 12), and (20, 0)

corner	$P = 20x + 120y$
(0, 0)	0
(0, 15)	1800 MAX
(15, 12)	1740
(20, 0)	400

Make 0 hobby and 15 prof. tripods for a max profit of \$1800. All the labor hours are used and  $48 - 15 = 33$  lb of Al are left over

$$0 + 5(15) = 75 \text{ hours}$$

$$2.4(0) + 15 = 15 \text{ lb Al}$$