1. Suppose a red die and a green die are tossed and the numbers on the uppermost sides are observed. What is the probability that the numbers add up to 4 ?

(a) $\frac{1}{36}$ (b) $\frac{2}{36}$ (c) $\frac{3}{36}$ (d) $\frac{4}{36}$ (e) $\frac{5}{36}$

2. Suppose you are asked to choose a whole number between 1 and 13 inclusive. What is the probability that you will pick either an odd number or a multiple of 3?

(a) $\frac{2}{13}$ (b) $\frac{9}{13}$ (c) $\frac{11}{13}$ (d) $\frac{121}{169}$ (e) $\frac{7}{13}$

3. Let E and F be independent events, with $P(E) = \frac{1}{4}$ and $P(F) = \frac{1}{2}$. Find $P(E \cup F)$

(a) $\frac{5}{8}$ (b) $\frac{3}{4}$ (c) $\frac{1}{2}$ (d) 1 (e) $\frac{1}{4}$

4. Given that $P(E) = 0.6$, $P(F) = 0.5$ and $P(E \cap F) = 0.2$ find $P(E' \mid F)$

(a) $\frac{2}{5}$ (b) $\frac{3}{10}$ (c) $\frac{1}{3}$ (d) $\frac{3}{5}$ (e) $\frac{1}{10}$

5. At a certain college 75% of the students go home for Spring break, while the rest travel somewhere else. Of those who travel, $\frac{1}{2}$ go to Florida, $\frac{1}{4}$ go to California and the rest go to Alaska. Furthermore, $\frac{3}{4}$ of those who go to Florida get sunburn and $\frac{1}{2}$ of those who go to California get sunburn. Those who go to Alaska (obviously!) or home (mom!) do not get sunburn. After Spring break a student is selected at random and found NOT to have sunburn. What is the probability that the student went home for Spring break?

(a) $\frac{1}{2}$ (b) $\frac{6}{7}$ (c) $\frac{1}{2}$ (d) $\frac{7}{8}$ (e) $\frac{3}{32}$

6. A married couple decide to have four children.Assume that each sex is equally likely to be born, and that each birth is independent of the others. What is the probability that the couple will have more girls than boys?

(a) $\frac{3}{4}$ (b) $\frac{5}{8}$ (c) $\frac{3}{16}$ (d) $\frac{7}{8}$ (e) $\frac{5}{16}$

7. Suppose E anf F are independent events. Which of the following statements is NOT true?

(a) E and F' are independent
(b) E' and F are independent
(c) E and E' are independent
(d) E' and F' are independent
(e) E and $F \cup F'$ are independent

8. A fair coin is tossed three times and you are told that "heads" has come up at least twice. What is the probability that all three tosses were "heads"?

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) $\frac{1}{8}$ (d) $\frac{2}{3}$ (e) $\frac{3}{8}$

9. Let $P(E) = 0.2$, $P(F) = 0.5$ and $P(E \cap F) = 0.1$. Which of the following probabilities equals 0.8 ? (There is more than one correct answers. Select one.)

(a) $P(E \mid F)$ (b) $P(E \cup F)$ (c) $P(E' \mid F')$
(d) $P(E' \cup F')$ (e) $P(E' \mid F)$

10. A company uses three machines to produce light bulbs. Machine I produces 50% of the company's bulbs, Machine II produces 30%, the rest are produced by Machine III. The following tables shows the ratio of defective output for each machine:

Machine number	**ratio of defective bulbs**
I	10%
II	$\frac{1}{4}$
III	$\frac{1}{2}$

A bulb is selected at random and found to be defective. What is the probability that it was produced by Machine I ?

(a) $\frac{1}{20}$ (b) $\frac{1}{4}$ (c) 40% (d) $\frac{2}{9}$ (e) $\frac{1}{10}$

11. An urn contains 5 red balls and 2 white balls. Balls are drawn from the urn at random, one at a time without replacement, until a white ball is drawn. What is the probability of drawing exactly four balls from the urn?

(a) $\frac{1}{7}$ (b) $\binom{5}{3}^3 \cdot \binom{2}{1}$ (c) $\frac{\binom{5}{3} \cdot \binom{2}{1}}{\binom{7}{4}}$

(d) 1 (e) $\binom{5}{3} \cdot \binom{2}{1}$

12. 60 % of the students at a certain university are female. 20% of the female students are vegetarians, and 10% of the male students are vegetarians. A friend tells you she has a vegetarian relative who is a student at that university. What is the probability that your friend's relative is a male?

(a) 0.6 (b) $\frac{1}{5}$ (c) 25% (d) $\frac{2}{3}$ (e) $\frac{4}{52}$

13. A certain soccer goal keeper catches 30% of the penalty kicks against her team. Three penalty kicks are shot independently at the goal keeper. What is the probability she catches exactly one?

(a) 0.147 (b) $(0.3)^2$ (c) 0.27

(d) $\binom{3}{2} \cdot (0.3) \cdot (0.7)$ (e) $\binom{3}{1} \cdot (0.3) \cdot (0.7)^2$

14. An experiment consists of tossing a fair coin nine times. What is the probability that the coin shows "heads" no more than once?

(a) $9 \cdot \left(\frac{1}{2}\right)^9$ (b) $\frac{2}{9}$ (c) $\frac{1}{81}$

(d) $10 \cdot \left(\frac{1}{2}\right)^9$ (e) 0

15. Two persons A and B are competing in a tournament which ends once a person has won two games. Each game is independent of the others, and games cannot end in a tie. The probability that person A wins any game is 0.6 . What is the probability that A wins the tournament?

(a) 0.648 (b) 0.48 (c) 0.36 (d) $\binom{3}{2} \cdot (0.6)^2 \cdot (0.4)$ (e) 0.8

16. The table below shows the percents of total output and of defective output for four microchip assembly lines. A microchip is selected at random from the output and found NOT to be defective. Which assembly line is most likely to have produced it?

Assembly line number	percent of total output	percent of defectives
I	20%	5%
II	25%	12%
III	25%	15%
IV	30%	25%

(a) I (b) II (c) III (d) IV

(e) none of the above

17. A store has fifteen cartons of eggs. Five of the cartons have broken eggs in them. A shopper inspects three cartons, one carton at a time at random (she does not inspect the same carton twice!) and will buy the first good one (no broken eggs) she finds, if any. Otherwise she will not buy any eggs. What is the probability she will not buy any eggs?

(a) $\frac{1}{5}$ (b) $\frac{47}{1264}$ (c) $\frac{1}{3}$ (d) $\frac{2}{21}$ (e) $\frac{2}{91}$

18. An island contains an equal number of 1-headed, 2-headed and 3-headed dragons. A hunter returns from the island with a dragonhead as her trophy (she may not have killed a dragon, however.) Assuming the hunter cut at random the first head she could find, what is the probability her trophy came from a 1-headed dragon?

(a) $\frac{1}{3}$ (b) $\frac{1}{6}$ (c) $\frac{1}{2}$ (d) $\frac{1}{4}$ (e) $\frac{1}{5}$

19. Which of the following four events has the lowest probability?

A = {exactly 4 heads are obtained when a fair coin is tossed 8 times}
B = {exactly 3 heads are obtained when a fair coin is tossed 6 times}
C = {exactly 2 heads are obtained when a fair coin is tossed 4 times}
D = {exactly 1 head is obtained when a fair coin is tossed 2 times}
(Assume all tosses are independent of each other.)

(a) A (b) B (c) C (d) D
(e) the four events have the same probability.

20. See Cover sheet (the one to be handed in) for a description of this question.