The Conditional and Circuits I
Contemporary Math (MAT-130)

Rewrite each statement using the if…then connective. Rearrange or add words as necessary.

1. If you build it they will come.
2. I go to the movies every Tuesday.
3. No person under the age of 17 has a driver's license.
4. The sky is the color blue.
5. Every child wants candy.
6. If the glove doesn't fit you must acquit.
7. We will go to the beach if it is sunny.
8. No penguins live in the North Pole.
9. A tautology is always true.
10. You are taking Mat-130 if you are doing this worksheet.

Let p represent the statement "It is raining", let q represent the statement "He is blond", and let r represent the statement "They are going to the mall." Express each compound statement in words.

11. $p \rightarrow q$
12. $\sim r \rightarrow p$
13. $q \rightarrow \sim p$
14. $r \rightarrow (p \wedge q)$
15. $(q \vee r) \rightarrow \sim p$
16. $r \wedge (\sim q \rightarrow \sim p)$
17. $\sim q \vee (\sim p \rightarrow r)$

Let p represent the statement "The store is closed", let q represent the statement "The walls are red", and let r represent the statement "She is twelve." Express each compound statement in symbols.

18. If she is twelve then the store is closed.
19. If the walls are not red then she is twelve.
20. If the store is not closed then the walls are not red.
21. If the store is closed and she is not twelve then the walls are not red.
22. She is twelve and if the walls are not red then the store is closed.
23. The walls are red or if the store is open then she is not twelve.
24. If she is not twelve or the store is not closed then the walls are red.
25. If the store is closed or she is not twelve then the walls are not red and she is twelve.

Find the truth value of each statement. Let p and q represent true statement and r represent a false statement.

26. $p \rightarrow q$
27. $r \rightarrow p$
28. $q \rightarrow \sim p$
29. $\sim r \rightarrow \sim q$

30. $(r \wedge \sim q) \rightarrow \sim r$
31. $\sim(p \rightarrow r) \rightarrow \sim q$
32. $(\sim r \rightarrow \sim q) \rightarrow \sim(q \vee \sim p)$
33. $\sim r \rightarrow [q \rightarrow (\sim p \rightarrow r)]$
34. $\sim(q \vee \sim r) \rightarrow (\sim p \wedge \sim r)$
35. $\sim[(p \rightarrow r) \vee (\sim q \rightarrow \sim r)]$

Construct a truth table for each statement.

36. $p \rightarrow q$
37. $\sim p \rightarrow q$
38. $\sim(p \vee q) \wedge (p \rightarrow \sim q)$
39. $(p \wedge q) \rightarrow r$
40. $[\sim p \rightarrow \sim(r \rightarrow q)] \vee p$

Write the negation of each statement. (Hint: The negation of $p \rightarrow q$ is $p \wedge \sim q$)

41. If the truck is too heavy then the bridge will collapse.
42. If it is raining then we will not go swimming.
43. If it is not a weekday then I don't go to work.

Write each statement as an equivalent statement that does not use the if… connective. (Hint: $p \rightarrow q$ is equivalent to $\sim p \vee q$)

44. If it is too big then I will get a smaller one.
45. If I don't get an A on the test then I will not pass.
46. If you don't have enough money in your account then the check will bounce.

Use truth tables to decide which of the pairs of statements are equivalent.

47. $p \rightarrow q; \sim p \vee q$
48. $\sim(p \rightarrow q); \sim p \rightarrow \sim q$
49. $\sim p \rightarrow q; \sim q \rightarrow p$
50. $p \wedge q; \sim(p \rightarrow \sim q)$

Solutions:

1. If you build it then they will come.
2. If it is Tuesday then I go to the movies.
3. If a person has a driver's license then they are not under the age of 17.
4. If it is the sky then the color is blue.
5. If it is a child then it wants candy.
6. If the glove doesn't fit then you must acquit.
7. If it is sunny then we will go to the beach.
8. If it is the North Pole then no penguins live there.
9. If it is a tautology then it is always true.
10. If you are doing this work sheet then you are taking Mat-130.
11. If it is raining then he is blond.
12. If they are not going to the mall then it is raining.
13. If he is blond then it is not raining.
14. If they are going to the mall then it is raining and he is blond.
15. If he is blond or they are going to the mall then it is not raining.
16. They are going to the mall and if he is not blond then it is not raining.
17. He is not blond or if it is not raining then they are going to the mall.
18. $r \rightarrow p$
19. $\sim q \rightarrow r$
20. $\sim p \rightarrow \sim q$
21. $(p \wedge \sim r) \rightarrow \sim q$
22. $r \wedge (\sim q \rightarrow p)$
23. $q \vee (\sim p \rightarrow \sim r)$
24. $(\sim r \vee \sim p) \rightarrow q$
25. $(p \vee \sim r) \rightarrow (\sim q \wedge r)$
26. T
27. T
28. F
29. F
30. T
31. F
32. T
33. T
34. T
35. F
36. TFTT
37. TTTF
38. FFFT
39. TFTTTTTT

40. TTTTFFTF
41. The truck is too heavy and the bridge will not collapse.
42. It is raining and we will go swimming.
43. It is not a weekday and I go to work.
44. It is not too big or I will get a smaller one.
45. I get an A on the test or I will not pass.
46. You have enough money in your account or the check will bounce.
47. TFTT; TFTT; equivalent
48. FTFF; TTFT; not equivalent
49. TTTF; TTTF; equivalent
50. TFFF; TFFF; equivalent