For # 1-6, Let $p =$ she wears a skirt and $q =$ she looks cute.

Write each of the following in symbols.

1. If she wears a skirt, then she doesn’t look cute.
2. She wears a skirt and she looks cute.
3. She doesn’t wear a skirt or she doesn’t look cute.

Write the following in words.

4. $\sim p \rightarrow \sim q$
5. $\sim (p \land \sim q)$
6. $p \land \sim q$

For # 7-8, write a) an equivalent statement and b) the negation for the statements below.

7. All science teachers are rich.
8. Some islands have sandy beaches.

For # 9-12, assume the $p$ and $q$ are false, and $r$ is true. Find the truth value of each statement.

9. $q \rightarrow (r \rightarrow \sim p)$
10. $\sim p \rightarrow (q \land r)$
11. $(p \land q) \lor \sim r$
12. $(p \land \sim q) \rightarrow (\sim q \lor r)$

Construct a truth table for each of the following.

13. $(q \land \sim p) \lor \sim q$
14. $p \rightarrow (p \lor q)$
15. $\sim p \land (q \lor r)$

16. For the given statement: If you are tired, you do not run; write
   a. The converse:
   b. The inverse:
   c. The contrapositive:
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For #17-19, Write each statement in “If…then” form.

17. It will rain if it becomes cloudy.
18. Popeye eats okra only if spinach is not available.
19. Being tall is necessary for playing pro football.

Use a truth table to determine whether each argument is Valid or Invalid.

\[
\begin{array}{ccc}
q \land \sim p & p \rightarrow \sim q & \sim p \lor q \\
\sim p & q & \sim p \\
q & \sim q & p \\
\end{array}
\]

For #23-26, match the argument with the law that justifies its validity or fallacy.

23. If the sky is clear, the sun is shining.  
The sun is not shining.  
The sky is not clear.  
A. Direct Reasoning
24. If it is not a rational number, then it is not an integer.  
It is a rational number.  
It is an integer.  
B. Contrapositive Reasoning
25. If Paws is a cat, then he’ll eat catnip.  
If he eats catnip, then he’ll act crazy.  
If Paws is a cat, then he’ll act crazy.  
C. Transitive Reasoning
26. If I eat peppers, I can’t sleep.  
I couldn’t sleep.  
I ate peppers.  
D. Fallacy of the converse

Use an Euler diagram to determine if the following syllogisms are valid or invalid.

27. All car salesmen are sincere.  
Joe is not sincere.  
Joe is not a car salesman.  
28. All children love candy.  
Suzy is a child.  
Suzy loves candy.  
29. Some dogs are nice.  
Tobi is not nice.  
Tobi is not a dog.
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ANSWERS:

1. \( p \rightarrow \sim q \)
2. \( p \land q \)
3. \( \sim p \lor \sim q \)
4. If she does not wear a skirt, then she does not look cute.
5. It is not true that: she wears a skirt and she does not look cute.

-Or-

She does not wear a skirt or she looks cute.

6. She wears a skirt and she does not look cute.
7. a) There are no science teachers that are not rich. b) Some science teachers are not rich.
8. a) There exists at least one island that has a sandy beach. b) No islands have sandy beaches.
9. True
10. False
11. False
12. True
13. If she does not wear a skirt, then she does not look cute.

\[
\begin{array}{|c|c|c|c|c|c|}
\hline
p & q & \sim p & (q \land \sim p) & \sim q & (q \land \sim p) \lor \sim q \\
\hline
T & T & F & F & F & F \\
T & F & F & F & T & T \\
F & T & T & F & F & T \\
F & F & T & T & T & T \\
\hline
\end{array}
\]

14. If it becomes cloudy, then it will rain.

\[
\begin{array}{|c|c|c|c|c|}
\hline
p & q & (p \lor q) & p \rightarrow (p \lor q) \\
\hline
T & T & T & T \\
T & F & T & T \\
F & T & T & T \\
F & F & F & T \\
\hline
\end{array}
\]

15. If Popeye eats okra, then spinach is not available.

\[
\begin{array}{|c|c|c|c|c|c|}
\hline
p & q & r & \sim p & (q \lor r) & \sim p \land (q \lor r) \\
\hline
T & T & T & F & T & F \\
T & T & F & F & T & F \\
T & F & T & F & T & F \\
T & F & F & F & F & F \\
F & T & T & T & T & T \\
F & T & F & T & T & T \\
F & F & T & T & T & T \\
F & F & F & T & F & F \\
\hline
\end{array}
\]

16. a. If you do not run, then you are tired.
   b. If you are not tired, then you run.
   c. If you run, then you are not tired.

17. If it becomes cloudy, then it will rain.
18. If Popeye eats okra, then spinach is not available.
19. If you play pro football, then you are tall.
20. Valid
21. Valid
22. Invalid
23. B
24. E
25. C

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26. D  
27. Valid  
28. Valid  
29. Invalid