1. Given the premises $a \rightarrow b$ and $a$, which is a logical conclusion?

(1) $a$  (2) $\sim a$  (3) $b$  (4) $\sim b$

2. Given the premises $p \rightarrow \sim q$ and $p$, which is a logical conclusion?

(1) $p$  (2) $\sim p$  (3) $q$  (4) $\sim q$

In 3 – 6: Let $r$ represent “It rains.” Let $s$ represent “It snows.” Let $v$ represent “Vegetables grow.”

a. Using $r$, $s$, $v$ and the proper logic connectives, express the given premises in symbolic form.

b. Write the conclusion of the argument in symbolic form.

3. If it rains, then vegetables grow.

It rains.

4. If it snows, then vegetables do not grow.

It snows.

5. It does not snow if it rains.

It rains.

6. If it rains and it doesn’t snow, then vegetables grow.

It rains and it doesn’t snow.

In 7 – 9: Write a valid conclusion for the given set of premises

7. If two points are given, then a straight line can be drawn containing the points.

Points A and B are given.

8. If $x$ is an integer, then $x$ is a real number.

$x$ is the integer 5.

9. Any friend of Jim’s is a friend of mine

Alex is Jim’s friend.

In 10 – 12: State whether or not the conclusion is **valid** based on the Law of Detachment.

10. If I understand logic, then I can reason correctly. I understand logic.

    **Conclusion:** I can reason correctly.

11. You can use the machine if you have exact change. You use the machine.

    **Conclusion:** You have exact change.

12. A square is a rectangle. If a figure is a rectangle, then it has four right angles.

    **Conclusion:** A square has four right angles.

In 13 – 16: Write a valid conclusion for the given set of premises or tell why no conclusion is possible.

13. You can buy a luxury car if you are rich. Mr. Lopez is rich.

14. If I had the time and the energy, then I’d walk to work. I have the time.

15. **(H)** If a point is a midpoint of a line segment, then that point divides the line segment into two congruent segments. $M$ is the midpoint of $\overline{AB}$.

16. **(H)** If two angles are right angles, then the angles are congruent. $\angle A$ and $\angle B$ are congruent angles.

17. **(H)** If two angles are congruent, then the angles have the same measure. $\angle C \equiv \angle D$. 
In 18 – 22: Write the contrapositive of the given conditional statement.

18. If winter is here, then spring will soon follow.
19. If it is not raining, then Leah will not take her umbrella.
20. If Ali is sick, then she will not go to school.
21. Linda is not happy if people are late to dinner.

22. Which statement is logically equivalent to \( \sim p \rightarrow r \)?
   (1) \( p \rightarrow r \)  (2) \( p \rightarrow \sim r \)  (3) \( \sim r \rightarrow p \)  (4) \( r \rightarrow p \)

23. Which statement is logically equivalent to the statement “If it is cold, then we go skiing”?
   (1) If we go skiing, then it’s cold.
   (2) If we do not go skiing, then it’s cold
   (3) If it is not cold, then we do not go skiing
   (4) If we do not go skiing, then it is not cold

24. Which statement is logically equivalent to the statement “You will get sick if you eat green apples”?
   (1) If you get sick, then you have eaten green apples
   (2) If you don’t get sick, then you have not eaten green apples
   (3) If you don’t eat green apples, then you won’t get sick
   (4) You’ve eaten green apples if you have gotten sick

In 26 – 30: Tell whether the two given statements are logically equivalent or not equivalent

25. \( r \rightarrow t \)  \( \sim r \rightarrow \sim t \)
26. \( t \rightarrow \sim b \)  \( b \rightarrow \sim t \)
27. \( \sim p \rightarrow q \)  \( q \rightarrow \sim p \)

29. If two angles are vertical angles, then they are congruent.
   If two angles are congruent, then they are vertical angles.

30. Sam will reach home plate if Doug hits a triple.
   If Sam does not reach home plate, then Doug did not hit a triple.

(H) Prove of the Law of the Contrapositive is valid: