

Translate into Predicate Logic: Answers

1. Every clever student is ambitious.

$$(\forall x)((C(x) \& S(x)) \rightarrow A(x))$$

2. Every ambitious student is clever.

$$(\forall x)((A(x) \& S(x)) \rightarrow C(x))$$

3. Every student is both clever and ambitious.

$$(\forall x)(S(x) \rightarrow (C(x) \& A(x)))$$

4. Every student is either clever or not ambitious.

$$(\forall x)(S(x) \rightarrow (C(x) \vee \neg A(x)))$$

5. Every student who is ambitious is clever.

$$(\forall x)(S(x) \rightarrow (A(x) \rightarrow C(x)))$$

6. Every student who is clever is ambitious.

$$(\forall x)(S(x) \rightarrow (C(x) \rightarrow A(x)))$$

7. Some clever students are ambitious.

$$(\exists x)((C(x) \& S(x)) \& A(x))$$

8. Some clever students are not ambitious.

$$(\exists x)((C(x) \& S(x)) \& \neg A(x))$$

9. Not every clever student is ambitious.

$$\neg(\forall x)((C(x) \& S(x)) \rightarrow A(x))$$

10. Not every ambitious student is clever.

$$\neg(\forall x)((A(x) \& S(x)) \rightarrow C(x))$$

Translation key:

| | |
|--------|----------------------|
| $C(x)$ | x is clever. |
| $S(x)$ | x is a student. |
| $A(x)$ | x is ambitious. |
| $P(x)$ | x is a person. |
| $R(x)$ | x is a professor. |
| $F(x)$ | x is friendly. |
| $H(x)$ | x is happy. |
| $E(x)$ | x passes the exam. |
| $I(x)$ | x fails the exam. |
| $T(x)$ | x studies. |

11. Some ambitious students are not clever.

$$(\exists x)((A(x) \& S(x)) \& \neg C(x))$$

12. No ambitious student is clever.

$$\neg(\exists x)((A(x) \& S(x)) \& C(x))$$

13. No clever student is ambitious.

$$\neg(\exists x)((C(x) \& S(x)) \& A(x))$$

14. No student is either clever or ambitious.

$$\neg(\exists x)(S(x) \& (C(x) \vee A(x)))$$

15. No student is both clever and ambitious.

$$\neg(\exists x)(S(x) \& (C(x) \& A(x)))$$

16. Every ambitious person is a clever student.

$$(\forall x)((A(x) \& P(x)) \rightarrow (C(x) \& S(x)))$$

17. No ambitious person is a clever student.

$$\neg(\exists x)((A(x) \& P(x)) \& (C(x) \& S(x)))$$

18. Some ambitious persons are not clever students.

$$(\exists x)((A(x) \& P(x)) \& \neg(C(x) \& S(x)))$$

19. Not every ambitious person is a clever student.

$$\neg(\forall x)((A(x) \& P(x)) \rightarrow (C(x) \& S(x)))$$

20. Not all clever persons are students.

$$\neg(\forall x)((C(x) \& P(x)) \rightarrow S(x))$$

21. Unless every professor is friendly, no student is happy.

$$\neg(\forall x)(R(x) \rightarrow F(x)) \rightarrow \neg(\exists x)(S(x) \& H(x))$$

22. Every student is happy, only if every professor is friendly.

$$(\forall x)(S(x) \rightarrow H(x)) \rightarrow (\forall y)(R(y) \rightarrow F(y))$$

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| $R(x)$ | x is a professor. |
| $F(x)$ | x is friendly. |
| $H(x)$ | x is happy. |
| $E(x)$ | x passes the exam. |
| $I(x)$ | x fails the exam. |
| $T(x)$ | x studies. |

23. No student is unhappy, unless every professor is unfriendly.

$$\neg(\forall x)(R(x) \rightarrow \neg F(x)) \rightarrow \neg(\exists x)(S(x) \& \neg H(x))$$

24. If everyone passes the exam, then everyone will be happy.

$$(\forall x)S(x) \rightarrow (\forall x)H(x)$$

25. If anyone passes the exam, then everyone will be happy.

$$(\forall x)(S(x) \rightarrow (\forall y)H(y))$$

26. If everyone fails the exam, then no one will be happy.

$$(\forall x)I(x) \rightarrow \neg(\exists x)H(x)$$

27. If anyone fails the exam, then no one will be happy.

$$(\forall x)(I(x) \rightarrow \neg(\exists y)H(y))$$

28. The only students who pass the exam are the ones who study.

$$\neg(\exists x)((S(x) \& E(x)) \& \neg T(x))$$

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