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1. Which one of the following statements is a proposition?

(a) $5 + 7 = 10$

(b) $x + 2 = 11$

(c) Answer this question.

(d) This sentence is false.

(e) Who won the baseball game?

2. The contrapositive of *"If you get an A on the final exam, then you'll get an A for the course"* is

(a) *If you got an A for the course, then you got an A on the final exam.*

(b) *If you get an A on the final exam, then you won't get an A for the course.*

(c) *If you don't get an A on the final exam, then you won't get an A for the course.*

(d) *If you don't get an A on the final exam, then you'll get an A for the course.*

(e) *If you don't get an A for the course, then you didn't get an A on the final exam.*

3. How many rows will a truth table for the compound proposition $(p \lor q) \leftrightarrow (p \land s \land q)$ have?

(a) 3   (b) 5   (c) 6   (d) 8   (e) 32

4. Let p and q be the propositions

$$p : \textit{It is below freezing.}$$
$$q : \textit{It is snowing.}$$

Which statement is the proposition $\neg q \to \neg p$?

(a) *If it is not snowing, then it is not below freezing.*

(b) *It is not snowing and it is not below freezing.*

(c) *It is not snowing and it is below freezing.*

(d) *It is snowing or it is below freezing.*

(e) *It is not snowing and it is below freezing.*

5. Again, let p and q be the propositions

$$p : \text{It is below freezing.}$$
$$q : \text{It is snowing.}$$

Which statement is not equivalent to the proposition $q \to p$?

(a) *If it is not below freezing, then it is not snowing.*

(b) *If it is snowing, then it is below freezing.*

(c) *It is either not snowing or it is below freezing.*

(d) *If it is below freezing, then it is snowing.*

(e) *It is necessary that it be below freezing in order for it to be snowing.*

6. Consider the following propositional functions

$$p(x) : x \text{ has feathers}$$
$$q(x) : x \text{ can fly}$$
$$r(x) : x \text{ lays eggs}$$
$$s(x) : x \text{ is a bird}$$

Which is the statement *"All birds have feathers and lay eggs but not all birds can fly."*

(a) $\exists x(s(x) \land p(x) \land r(x) \land \neg q(x))$

(b) $\forall x(\neg q(x) \to s(x)) \lor (p(x) \lor q(x))$

(c) $\exists x(\neg q(x) \to s(x)) \lor (p(x) \lor q(x))$

(d) $\forall x(s(x) \to (p(x) \land r(x))) \land \exists x(s(x) \land \neg q(x))$

(e) $\forall x(s(x) \to ((p(x) \land r(x)) \lor \neg q(x)))$

7. Which of the following propositions is true?

(a) $\forall n \in \mathbb{R} \ (n^2 \geq n)$

(b) $\forall n \in \mathbb{Z} \ (n^2 \geq n)$

(c) $\exists n \in \mathbb{Z} \ (n^2 < n)$

(d) $\exists n \in \mathbb{R} \ (n^2 < 0)$

8. Which of the following propositions is false?

(a) $\exists n \in \mathbb{R} \ (n^2 < n)$

(b) $\forall n \in \mathbb{Z} \ (n^2 = 1 \ \rightarrow \ n = 1)$

(c) $\forall n \in \mathbb{N} \ (n^2 = 1 \ \rightarrow \ n = 1)$

(d) $\forall n \in \mathbb{Z} \ (n^2 = n \ \rightarrow \ (n = 1 \vee n = 0))$

(e) $\exists n \in \mathbb{R} \ (n^2 = n)$

9. Which one of the following propositions is not satisfiable?

(a) $\neg p \rightarrow p$

(b) $(p \rightarrow q) \wedge (p \rightarrow \neg q)$

(c) $(p \vee \neg q) \wedge (q \vee \neg r) \wedge (r \vee \neg p)$

(d) $(p \wedge \neg q) \wedge (\neg p \vee q)$

10. Which one of the following propositions is not a tautology?

(a) $p \vee \neg p$

(b) $(p \wedge q) \rightarrow p$

(c) $\neg(p \wedge q) \leftrightarrow (\neg p \vee \neg q)$

(d) $(p \rightarrow q) \leftrightarrow (\neg p \vee q)$

(e) $(p \vee q) \rightarrow q$