

1. 10 pts. Show that the set $\{6, 11, 16, 21, 26, \dots\}$ is infinite by placing it in a one-to-one correspondence with a proper subset of itself. Include a pairing of the n th terms in the sets.
2. 10 pts. Show that the set $S = \{\frac{1}{3}, \frac{1}{6}, \frac{1}{9}, \frac{1}{12}, \frac{1}{15}, \dots\}$ has cardinal number $\aleph_0$ by establishing a one-to-one correspondence between S and the set of counting numbers. Include a pairing of the n th terms in the sets.
3. 10 pts. each Write the negation of each statement.
 - (a) All particle physicists think small.
 - (b) Some mathematicians do not write rigorous proofs.
 - (c) No tax decrease pays for itself.
4. 10 pts. each Let

p : *Conservative viewpoints always lose in the long run.*
 q : *Slavery is accepted.*
 r : *Child labor is legal.*

Write the following statements in words.

- (a) $\neg p \leftrightarrow q$
- (b) $p \rightarrow (\neg q \wedge \neg r)$.

5. 10 pts. each Let

p : *Poison Ivy was foiled last week.*
 q : *The Clock King's time is up.*
 r : *Batman is on vacation.*
 s : *The Mad Hatter is off his meds.*

Write the following in symbolic form.

- (a) If Batman is not on vacation, then Poison Ivy was foiled last week or the Clock King's time is up.
- (b) The Clock King's time is up if and only if Batman is on vacation or Poison Ivy was foiled last week.
- (c) It is false that the Mad Hatter is not off his meds and Poison Ivy was not foiled last week.
- (d) Poison Ivy was foiled last week and Batman is on vacation, or the Clock King's time is up and the Mad Hatter is off his meds.

6. 10 pts. each Make a truth table for each statement.
- (a) $\neg(q \vee \neg p)$
 - (b) $\neg p \wedge (q \vee r)$
 - (c) $(\neg q \rightarrow p) \leftrightarrow \neg q$
7. 10 pts. Use a truth table to determine whether the statements $\neg(p \rightarrow \neg q)$ and $p \wedge q$ are equivalent.
8. 10 pts. Use one of DeMorgan's laws to write an equivalent statement for the sentence: "It is not the case that entropy always increases in an open thermodynamic system or radiocarbon dating is not reliable."
9. 10 pts. Use the fact that $p \rightarrow q$ is equivalent to $\neg p \vee q$ to rewrite the statement "Either the clowns in Congress will listen to the people or the system doesn't work."
10. 10 pts. Write the contrapositive and also the converse of the statement "If you refuse to release all your tax returns until after election day, then you have something incriminating to hide."
11. 20 pts. Write each statement below in symbols. Then use truth tables or established logical equivalencies to determine which of the three statements are equivalent.
- i. The package was sent by Federal Express, or the package was not sent by UPS but the package arrived on time.
 - ii. The package arrived on time, if and only if it was sent by Federal Express or it was not sent by UPS.
 - iii. If the package was not sent by Federal Express, then the package was not sent by UPS but the package arrived on time.