- **Q1.** For each of the following propositions, determine its truth value, and write its negation (in English).
 - a. There are no black flies in Maine. (False)

Negation: It is not the case that there are no black Flies in Maine.

Another possible way to negate:

There is at least one black Fly in Maine.

b. All unicorns have rainbow-coloured manes. (False -assuming definition of "unicorn" includes toy unicorns)

Negation: It is not the case that all unicorns have rainbow-coloured manes.

Another possible way to negate:

There exists at least one unicorn that does not have a rainbow-coloured mane.

Q2. Let p, q, and r be the following propositions:

p: Grizzly bears have been seen in the area.

 $q: \;\;$ Hiking is safe on the trail.

r: Berries are ripe along the trail.

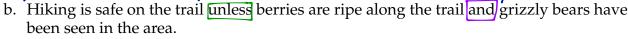
Write each of the following compound propositions using the variables p, q, and r, and appropriate logical connectives:

a. If berries are ripe along the trail, then (hiking is safe if and only if grizzly bears have not been seen in the area).

Initial Simplification: if r, then (q if and only if 7p)

Final Answer: $r \rightarrow (q \leftrightarrow \tau_p)$

h Hiking is safe on the trail wheel howing are sing along the trail and grizzly hours have



initial simplification: qualess r and p

answer: qvrnp Note: by precedence, this means qv(rnp)

c. Grizzly bears have been seen in the area, but hiking is safe.



answer: -p/9

d. Either hiking is safe or berries are ripe along the trail, but not both.

Initial Simplification: either q or r but not both

Final Answer: q + r

d. A necessary condition for hiking to be safe is that grizzly bears have not been seen in the area.

initial simplification: A necessary condition for q is 7p

translation: $q \rightarrow 7p$ (If q is true, then all that is necessary for q must also be true).

e. A sufficient condition for grizzlies to have been seen in the area is that berries are ripe along the trail.

initial simplification: A sufficient condition for up is r

translation r -> 1p

Q3.	Construct a truth table for each of the following compound propositions and determin
	whether it is a tautology, contradiction, or contingency:

a.
$$p \oplus p$$

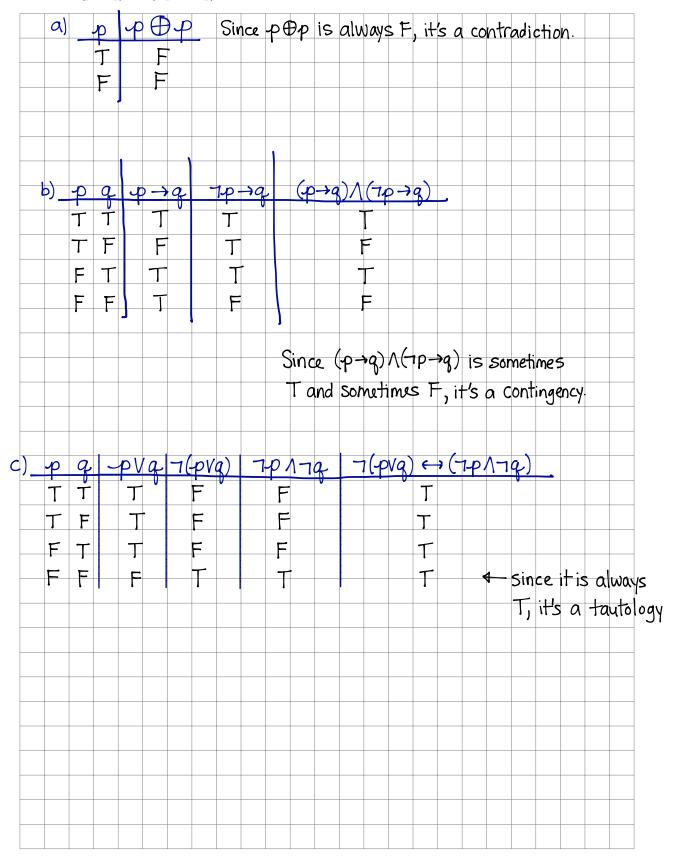
d.
$$\neg (p \lor q) \leftrightarrow (\neg p \to q)$$

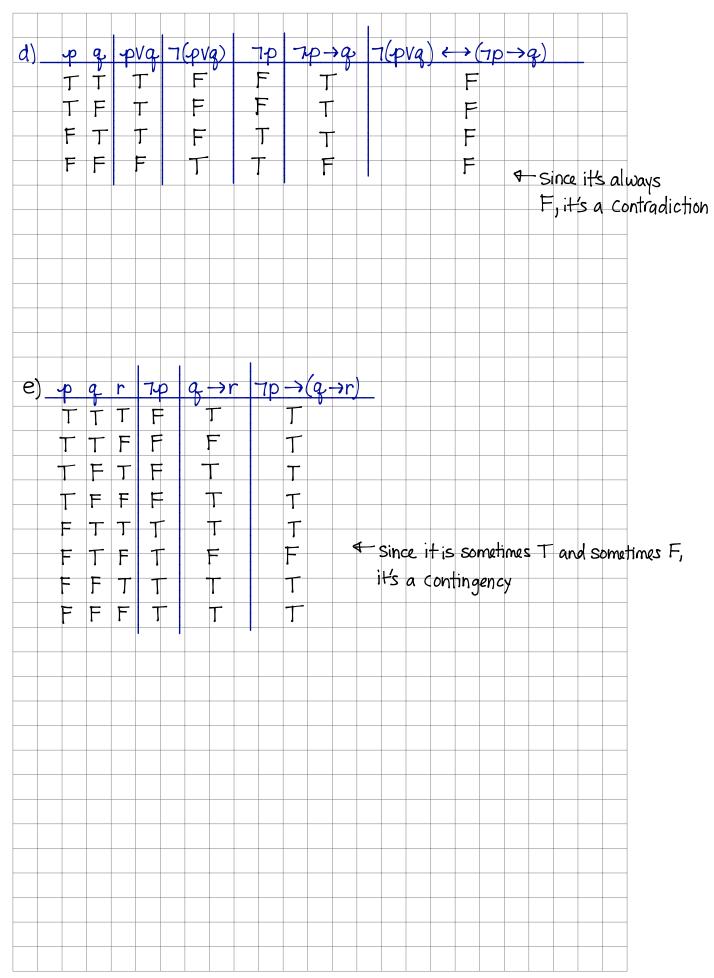
e. $\neg p \to (q \to r)$

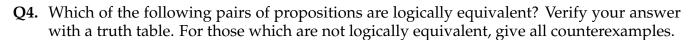
b.
$$(p \to q) \land (\neg p \to q)$$

e.
$$\neg p \to (q \to r)$$

c.
$$\neg (p \lor q) \leftrightarrow (\neg p \land \neg q)$$







a.
$$A \oplus B$$
 and $\neg (A \leftrightarrow B)$

b.
$$p \to c$$
 and $\neg p \lor c$

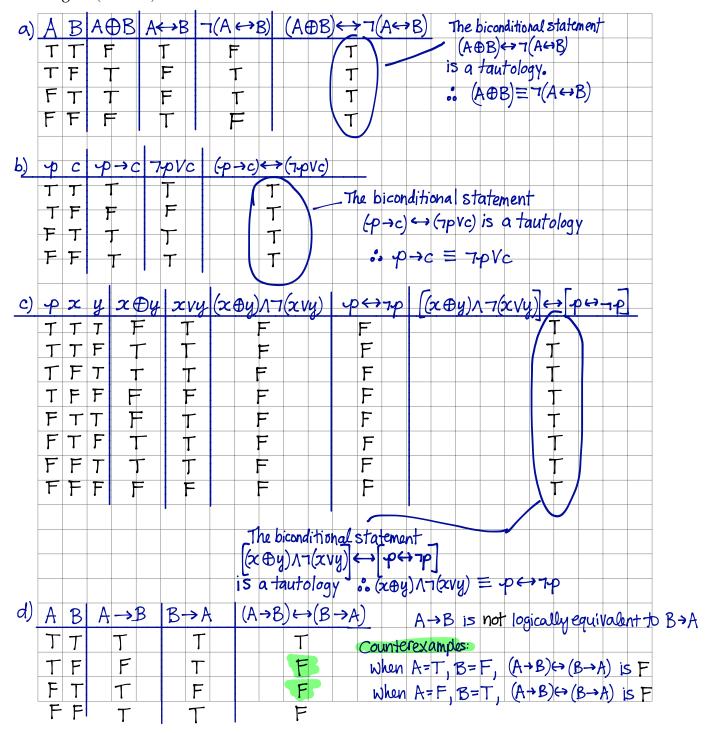
c.
$$((x \oplus y) \land \neg(x \lor y))$$
 and $(p \leftrightarrow \neg p)$.

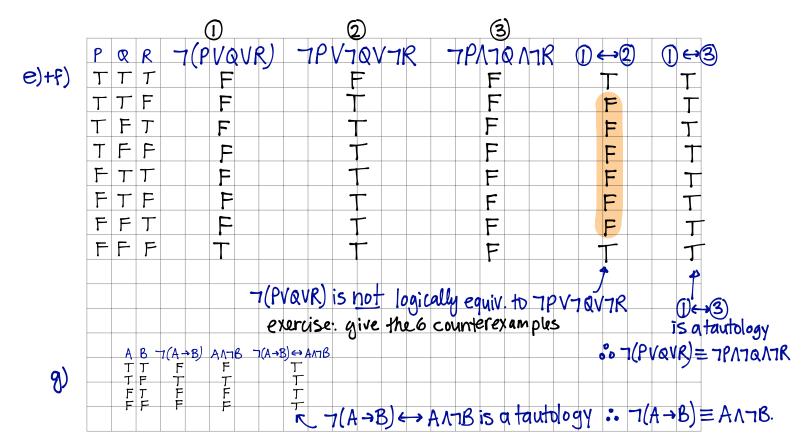
d.
$$A \rightarrow B$$
 and $B \rightarrow A$.

e.
$$\neg (P \lor Q \lor R)$$
 and $\neg P \lor \neg Q \lor \neg R$.

f.
$$\neg (P \lor Q \lor R)$$
 and $\neg P \land \neg Q \land \neg R$.

g.
$$\neg (A \rightarrow B)$$
 and $A \land \neg B$.





Q5. Considering Q4 f and g, write the negation of each of the following propositions in English.

a. You are at least 12 years old, or you are taller than 5 feet, or you have a golden ticket. a

Negation: 7(avbvc) = 7a17b17c

you are less than 12 years old and you are ≤ 5 feet tall, and you do not have a golden ticket.

b. In order for you to ride the roller coaster, it is necessary that you are at least 12 years old, or you are taller than 5 feet, or you have a golden ticket.

q: avbvc from (16a) You can ride the roller coaster.

Q2b says P→q Negation: $\neg(\rho \rightarrow q) \equiv \rho \land \neg q$ or $\rho \rightarrow avbvc$ $\neg(\rho \rightarrow avbvc) \equiv \rho \land \neg a \land \neg b \land \neg c$

Negation: you can ride the roller coaster, and you are < 12 years old, and you are < 5 feet tall, and you do not have a golden ticket.
*bonus: write the converse of Q5b as well as the contrapositive, and each of their

respective negations.