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1.

a. - Let R be the proposition ‘it is red’
- Let B be the proposition ‘it is blue’
- Let G be the proposition ‘it is green’

$R \rightarrow \neg(B \land G)$

b. - Let R be the proposition ‘it is red’
- Let B be the proposition ‘it is blue’
- Let G be the proposition ‘it is green’
- Let W be the proposition ‘ it is white’

$W \lor (\mathbf{R} \land \mathbf{B} \land \mathbf{G})$

c. - Let R be the proposition ‘it is red’
- Let B be the proposition ‘it is blue’
- Let G be the proposition ‘it is green’
- Let K be the proposition ‘it is balck’

$K \leftrightarrow \neg(\mathbf{R} \lor B \lor \mathbf{G})$

2.

a. $\neg (p \land (\neg p \lor (q \rightarrow r)))$

p	**q**	**r**	**q → r (s)**	**¬p (t)**	**t ∨ s (u)**	**p ∧ u (v)**	**¬v**
T	T	T	T	F	T	T	**F**
T	T	F	F	F	F	F	**T**
T	F	T	T	F	T	T	**F**
T	F	F	T	F	T	T	**F**
F	T	T	T	T	T	F	**T**
F	T	F	F	T	T	F	**T**
F	F	T	T	T	T	F	**T**
F	F	F	T	T	T	F	**T**

∴ This is a Contingency

b. $(p \vee (q \leftrightarrow (\neg q \wedge (p \vee r))))$

p	**q**	**r**	**p ∨ r (s)**	**¬q (t)**	**t ∧ s (u)**	**q ↔ u(v)**	**p ∨ v**
T	T	T	T	F	F	F	**T**
T	T	F	T	F	F	F	**T**
T	F	F	T	T	T	F	**T**
T	F	F	T	T	T	F	**T**
F	T	T	T	F	F	F	**F**
F	T	F	F	F	F	F	**F**
F	F	T	T	T	T	F	**F**
F	F	F	F	T	F	T	**T**

∴ This is a Contingency

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

p	q	r	p ↔ r (s)	r **∨ s** (t)	r **∧ t** (u)	¬u (v)	q **∧** v
T	T	T	T	T	T	F	**F**
T	T	F	F	F	F	T	**T**
T	F	T	T	T	T	F	**F**
T	F	F	F	F	F	T	**F**
F	T	T	F	T	T	F	**F**
F	T	F	T	T	F	T	**T**
F	F	T	F	T	T	F	**F**
F	F	F	T	T	F	T	**F**

∴ This is a Contingency

d. $\neg (r \lor \neg(p \to (p \land q)))$

p	q	r	p **∧ q** (s)	p → s (t)	¬t (u)	r **∨ u** (v)	¬v
T	T	T	T	T	F	T	**F**
T	T	F	T	T	F	F	**T**
T	F	T	F	F	T	T	**F**
T	F	F	F	F	T	T	**F**
F	T	T	F	T	F	T	**F**
F	T	F	F	T	F	F	**T**
F	F	T	F	T	F	T	**F**
F	F	F	F	T	F	F	**T**

∴ This is a Contingency

3.

a. $(p \land (p \to \neg p))$

= (p ∧ (¬p ∨ ¬p)) by Implication Equivalence

= p ∧ (¬p)by Idempotent

= False by Negation

∴ This is a contradiction

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

= (¬(¬p) ∨ (p ∨ q))by Implication Equivalence

= (p ∨ (p ∨ q)) by Double Negation

= (p ∨ p) ∨ qby Associativity

= p ∨ q by Idempotent

∴ This is a contingency

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

= (q ↔ True) by Negation

= (q → True) ∧ (True → q) by Biconditional Equivalence

= (¬q ∨ True) ∧ (True → q) by Implication Equivalence

= (¬q ∨ True) ∧ (¬True ∨ q) by Implication Equivalence

= True ∧ (¬True ∨ q) by Domination

= True ∧ (False ∨ q)

= True ∧ q by Identity

= q by Identity

∴ This is a contingency

d. $(\neg q \lor (q \land p))$
= (¬q ∨ q) ∧ (¬q ∨ p) by Distributive
= True ∧ (¬q ∨ p) by Negation
= ¬q ∨ p by Identity
∴ This is a contingency

4. (p → ¬(q ∧ ¬p)) → (¬q ∨ p)
= ¬(q ∧ ¬p)

5. (p → ¬(q ∧ ¬p)) → (¬q ∨ p)

p	q	¬p (r)	q ∧ r (s)	¬s (t)	p → t (u)	¬q (v)	v ∨ p (w)	u → w
T	T	F	F	**T**	T	F	T	**T**
T	F	F	F	**T**	T	T	T	**T**
F	T	T	T	**F**	T	F	F	**F**
F	F	T	F	**T**	T	T	T	**T**

The *t* column is equal to ¬(q ∧ ¬p) which is the final equation in the proper format and the truth table said column and the one for the final output are equivalent. Therefore the two equations ¬(q ∧ ¬p) and (p → ¬(q ∧ ¬p)) → (¬q ∨ p) are equivalent

6. (p → ¬(q ∧ ¬p)) → (¬q ∨ p)
= (¬p ∨ ¬(q ∧ ¬p)) → (¬q ∨ p) by Implication Equivalence
= ¬(¬p ∨ ¬(q ∧ ¬p)) ∨ (¬q ∨ p) by Implication Equivalence
= ¬(¬p ∨ ¬q ∨ ¬(¬p)) ∨ (¬q ∨ p) by De Morgan's Law
= ¬(¬p ∨ p ∨ ¬q) ∨ (¬q ∨ p) by Double Negation
= ¬(True ∨ ¬q) ∨ (¬q ∨ p) by Negation
= ¬True ∨ (¬q ∨ p) by Domination
= False ∨ (¬q ∨ p)
= (¬q ∨ p) by Identity
= ¬(¬(¬q ∨ p)) by Double Negation
= ¬(¬(¬q) ∧ ¬p) by De Morgan's Law
= ¬(q ∧ ¬p)

7.
a. Every animal that exists is both a giraffe and eats meat.
b. There exists an animal that is either is not a giraffe that eats meat or is not a lion.
c. For all animals that exist if it eats meat or is a lion then if it is not a giraffe it is a lion.