Question 1:

(p Λ q) => (q => r)

¬ (p Λ q) V (q => r)

¬p V ¬q V ¬q V r

¬p V ¬q V r

P => (¬q V r)

P => (q => r)

Question 2:

1.

* ­­­­∀x [child(x) => love(x, Santa)]
* ­­­­∀x [love(x, Santa) => ∀y {reindeer(y) => love(x, y)}]
* reindeer(Rudolph) Λ redNose(Rudolph)
* ­­­­∀x [redNose(x) => {weird(x) V clown(x)}]
* ¬∃x {reindeer(x) Λ clown(x)}
* ∀x {weird(x) => ¬love(scrooge, x)}
* ¬child(Scrooge)

2.

* ­­­­∀x [{Austinite(x) Λ ¬conservative(x)} => ∃y {love(x, y) Λ armadillo(y)}]
* ­­­­∀x [wear(x) => Aggie(x)]
* ­­­­∀x [Aggie(x) => ∀y {dog(y) => love(x, y)}]
* ¬∃x [{­­­­∀y (dog(y) => love(x, y))} Λ ∃z {armadillo(z) Λ love(x, z)}]
* Austinite(Clem) Λ wear(Clem)
* ∃x [Austinite(x) Λ conservative(x)]

Question3

Assume F stands for friend of Victor, M stands fir murderer, T stands for saying truth and A, B, C stands for Alice, Barney and Caddy respectively.

1.

* ¬M(A) Λ F(B) Λ ¬F(C)
* ¬M(B) Λ ¬ F(B)
* ¬M(C) Λ F(B)

2.

* ∀x [F(x) => ¬M(x)]
* ∀x [M(x) => ∃y {M(y) Λ (x=y)}]
* ∀x [¬M(x) => T(x)]

3.   
all sentences in (1) are in CNF.

CNF in (2):  
[¬F(A) V ¬M(A)] Λ [¬F(B) V ¬M(B)] Λ [¬F(C) V ¬M(C)]

¬M(A) Λ ¬M(B) Λ ¬M(C)

[M(A) V T(A)] Λ [M(B) V T(B)] Λ [M(C) V T(C)]

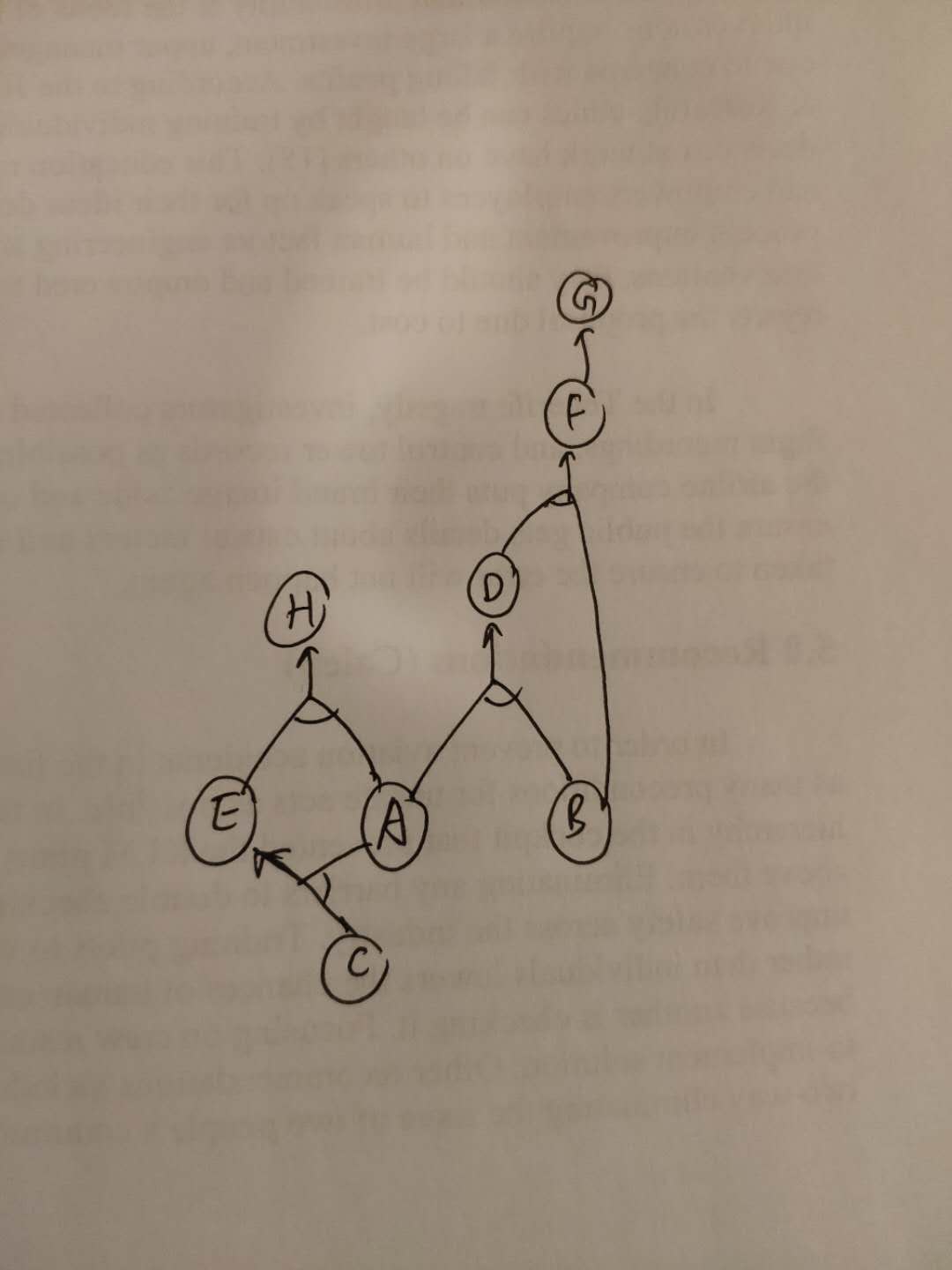
4. M(C)

5. F(C)

6. satisfiable

Question 4

1. H is true



A is true (provided)

B is true (provided)

D is true

F is true

G is true

C is true (provided)

E is true

H is true

2. Q is true

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True(Q) => True(R) V True(P) V True(N Λ M)

True(N) => True(D) (yes)

True(M) => True(C) V True(A) (yes)

Since N and M are true, we can know Q is true

Question 5:

1 (a)

A close up of text on a whiteboard

Description automatically generated

Sequence:

NY & BOS: 2.98

NY & DC: 4.10

LA & SF: 5.60

SLC & DEN: 6.99

MIA & ATL: 8.90

DC & ATL: 8.96

SLC & LA: 9.19

SEA & SF: 9.8

DEN & ATL: 21.55

(b)

(NY, BOS, DC, MIA, ATL), (SLC, DEN, LA, SF), (SEA)

2

(a) c1: BOS, NY, DC,

c2: MIA, SLC, SEA, SF, LA, DEN, ATL

(b) c1: (41, 74.03)

c2: (37.07, 106.33)

(c) c1: BOS, NY, DC, MIA, ATL

c2: SLC, SEA, SF, LA, DEN