Question 1.

(a). MGU : $\theta = \{x/A, y/A, z/B\}$

(b). MGU doesn't exist.

(c). MGU: $\theta = \{x/B, y/A\}$

(d). MGU: $\theta = \{x/John, y/John\}$

(e). MGU doesn't exist.

Question 2:

(a) i. $\forall f\ (Is\_food(f)) \Rightarrow Likes(John, f)$

ii. $Is\_food(Apples)$

iii. $Is\_food(Chicken)$

iv. $\forall f[\exists p(Eats(p,f) \wedge \neg Killed(p,f))] \Rightarrow Is\_food(f)$

v. $\forall p[\exists t\ (Killed(p,t))] \Rightarrow \neg Alive(p)$

vi. $Eats(Bill, Peanuts) \wedge Alive(Bill)$

vii. $\forall t\ Eats(Bill, t) \Rightarrow Eats(Sue, t)$

(b). i. $\forall f\ (Is\_food(f)) \Rightarrow Likes(John, f)$

↳ $\forall f(\neg Is\_food(f) \vee Likes(John, f))$

↳ $\neg Is\_food(f) \vee Likes(John, f)$

ii. $Is\_food(Apple)$

iii. $Is\_food(Chicken)$

iv. $\forall f(\exists p(Eats(p,f) \wedge \neg Killed(p,f))) \Rightarrow Is\_food(f)$

↳ $\forall f([\neg \exists p(Eats(p,f) \wedge \neg Killed(p,f))] \vee Is\_food(f))$

↳ $\forall f(\forall p\ \neg Eats(p,f) \vee Killed(p,f)) \vee Is\_food(f))$

↳ $\neg Eats(p,f) \vee Killed(p,f) \vee Is\_food(f)$

v. $\forall p[\exists t\ (Killed(p,t))] \Rightarrow \neg Alive(p)$

↳ $\forall p\ [\neg \exists t\ Killed(p,t)] \vee \neg Alive(p)$

↳ $\forall p\ [\forall t \neg Killed(p,t)] \vee \neg Alive(p)$

↳ $\neg$ Killed (p, t) $\vee$ $\neg$ Alive (p)

vi. Eats (Bill, Peanuts) $\wedge$ Alive (Bill)

vii. $\forall t$ Eats (Bill, t) $\Rightarrow$ Eats (Sue, t)

↳ $\forall t \neg$ Eats (Bill, t) $\vee$ Eats (Sue, t)

↳ $\neg$ Eats (Bill, t) $\vee$ Eats (Sue, t)

Thus, the CNF is:

$(\neg$ Is_food $(f_1) \vee$ Likes (John, $f_1)) \wedge$ Is_food (Apples) $\wedge$ Is_food (Chicken)

$\wedge (\neg$ Eats $(P_2, f_2) \vee$ Killed $(P_2, f_2) \vee$ Is_food $(f_2))$

$\wedge (\neg$ Killed $(P_3, t_3) \vee \neg$ Alive $(P_3))$

$\wedge$ Eats (Bill, Peanuts) $\wedge$ Alive (Bill)

$\wedge (\neg$ Eats (Bill, $t_4) \vee$ Eats (Sue, $t_4))$

cc) Δ:

1. $\neg$ Is_food $(f_1) \vee$ Likes (John, f_1)
2. Is_food (Apples)
3. Is_food (Chicken)
4. $\neg$ Eats $(P_2, f_2) \vee$ Killed $(P_2, f_2) \vee$ Is_food (f_2)
5. $\neg$ Killed $(P_3, t_3) \vee \neg$ Alive (P_3)
6. Eats (Bill, Peanuts)
7. Alive (Bill)
8. $\neg$ Eats (Bill, $t_4) \vee$ Eats (Sue, t_4)
9. Killed (Bill, Peanuts) $\vee$ Is_food (Peanuts) from 4, 6. $\theta = \{P_2$/Bill, f_2/Peanuts$\}$
10. $\neg$ Alive (Bill) $\vee$ Is_food (Peanuts) from 5, 9. $\theta = \{P_3$/Bill, t_3/Peanuts$\}$
11. Is_food (Peanuts) from 7, 10, $\theta = \{\}$
12. Likes (John, Peanuts) from 1. 11, $\theta = \{f_1$/Peanuts$\}$

By 12, we see that John likes Peanuts.

(d). Δ:
1. $\neg$ Is_food(f_1) $\vee$ Likes(John, f_1)
2. Is_food(Apples)
3. Is_food(Chicken)
4. $\neg$ Eats(P_2, f_2) $\vee$ Killed(P_2, f_2) $\vee$ Is_food(f_2)
5. $\neg$ Killed(P_3, t_3) $\vee$ $\neg$ Alive(P_3)
6. Eats(Bill, Peanuts)
7. Alive(Bill)
8. $\neg$ Eats(Bill, t_4) $\vee$ Eats(Sue, t_4)

9. Eats(Sue, Peanuts) by 6, 8. $\theta = \{ t_4 / \text{Peanuts} \}$

Thus by 9, we see Sue eats Peanuts.

(e). Three new rules / facts:

① $\forall p \; \forall t \; \neg$ Eats(P, t) $\Rightarrow$ Die(P)

↳ $\forall p \; \forall t$ Eats(P, t) $\vee$ Die(P)

↳ Eats(P, t) $\vee$ Die(P)

② $\forall p$ Die(P) $\Rightarrow \neg$ Alive(P)

↳ $\forall p \; \neg$ Die(P) $\vee \neg$ Alive(P)

↳ $\neg$ Die(P) $\vee \neg$ Alive(P)

③ Alive(Bill)

Δ:
1. $\neg$ Is_food(f_1) $\vee$ Likes(John, f_1)
2. Is_food(Apples)
3. Is_food(Chicken)
4. $\neg$ Eats(P_2, f_2) $\vee$ Killed(P_2, f_2) $\vee$ Is_food(f_2)
5. $\neg$ Killed(P_3, t_3) $\vee$ $\neg$ Alive(P_3)
6. $\neg$ Eats(Bill, t_4) $\vee$ Eats(Sue, t_4)
7. Eats(P_5, t_5) $\vee$ Die(P_5)
8. $\neg$ Die(P_6) $\vee \neg$ Alive(P_6)
9. Alive(Bill)

10. $\neg Die(Bill)$ by 8, 9. $\theta = \{P_6 / Bill\}$

11. $\neg Killed(Bill, t_3)$ by 5, 9, $\theta = \{P_3 / Bill\}$

12. $Eats(Bill, t_5)$ by 7, 10, $\theta = \{P_5 / Bill\}$

13. $\neg Eats(Bill, f_2) \vee Is\_food(f_2)$ by 4, 11, $\theta = \{P_2 / Bill, t_3 / f_2\}$

⋮

After trying all combinations of resolution, we cannot get an explicit term $Eats(Sue, food)$, where food is some known constant. Thus, what does sue eat is undecisable.

Further explaination: From the content, we can only observe that Bill does eat something, so that he won't die, and hence Sue also eats something. However, we are not able to determine a unifier θ to substitute t_5 by a constant in $Eats(Bill, t_5)$. Thus we only know Sue eats something (as Bill eats t_5). but we do not know exactly what she eats.