Translate the following sentences into the language of sentential logic using the abbreviations given to you. (These problems are worth 2 points each.)

1. “Angela isn’t being threatened.”
   \(~Ta~)

2. “Melissa, the angel, is fleeing.”
   \(Am \land Fm~)

3. “Juan, Melissa and Angela are not all demons.”
   \(~((Dj \land Dm) \land Da)~)

4. “Someone is being threatened.”
   \(\exists x(Px \land Tx)~)

5. “Not everyone who is threatened, flees.”
   \(\neg \forall x((Px \land Tx) \supset Fx)~)

6. “All serpents are demons.”
   \(\forall x(Sx \supset Dx)~)

7. “Demons never flee when threatened.”
   \(\forall x((Dx \land Tx) \supset \neg Fx)~)

8. “If Juan flees, there is a serpent demon in existence.”
   \(Fj \supset \exists x(Sx \land Dx)~)

9. “No fleeing demons are serpents.”
   \(\neg \exists x(Dx \land (Fx \land Sx))~)

10. “Unless threatened, angels never flee.”
    \(\forall x(Ax \supset (\neg Tx \supset \neg Fx))~)

11. “The serpent-demon Juan is threatened.”
(Sj & Dj) & Tj

12. “An angel flees only if it is threatened.”
\( \forall x (Ax \supset (Fx \supset Tx)) \)

13. “Not everybody is an angel or demon.”
\(~\forall y (Py \supset (Ay \lor Dy)) \)

14. “Angels flee if threatened, unlike demons, who never do so.”
\( \forall x (Ax \supset (Tx \supset Fx)) \land \forall x (Dx \supset (Tx \supset \neg Fx)) \)

15. “Both angels and demons flee when threatened.”
\( \forall x (((Ax \lor Dx) \land Tx) \supset Fx) \lor \forall x ((Ax \land Tx) \supset Fx) \land \forall x ((Dx \land Tx) \supset Fx) \)

16. “Unless an angel is threatened, Juan the serpent flees.”
\(~\exists x (Ax \land Tx) \supset (Sj \land Fj) \)

17. “Neither Juan nor Angela are demons, but someone is.”
\(~(Dj \lor Da) \land \exists x (Px \land Dx) \)

18. “Unless no angels are serpents, there will be serpents that are demons as well.”
\(~\exists x (Ax \land Sx) \supset \exists x (Sx \land Dx) \)

19. “Juan is not a demon, nor is Angela; they are angels instead.”
\((\neg Dj \land \neg Da) \land (Aj \land Aa) \)

20. “All angels are threatened if there is some demon that is not a serpent.”
\( \exists x (Dx \land \neg Sx) \supset \forall x (Ax \land Tx) \)
Use the truth tree method to determine whether the following argument is valid. List a separate translation before doing the tree if the argument is in English. Number all lines. Label all derived lines with the rule and the line from which they were derived. Use the notation provided for your translations.

21. Every woman has a right to fair treatment.
   Thus, women exist.

   \[ W_x = x \text{ is a woman} \]
   \[ R_x = x \text{ has a right to fair treatment} \]

   \[ \forall x (W_x \supset R_x) \]
   \[ \exists x W_x \]

   1. \[ \forall x (W_x \supset R_x) \]
   2. \[ \neg \exists x W_x \]
   3. \[ \forall x \neg W_x \quad 2, \exists \]
   4. \[ \neg W_a \quad 3, \forall \]
   5. \[ W_a \supset R_a \quad 1, \forall \]
   6. \[ \neg W_a \quad R_a \quad 5, \exists \]
   \[ \text{Invalid} \]

22. \[ \neg \exists x (E_x \& F_x) \]
    \[ \neg \exists x (F_x \& G_x) \]
    \[ \neg \exists x (E_x \& G_x) \]

   1. \[ \neg \exists x (E_x \& F_x) \]
   2. \[ \neg \exists x (F_x \& G_x) \]
   3. \[ \neg \neg \exists x (E_x \& G_x) \]
   4. \[ \exists x (E_x \& G_x) \quad 3, \neg \neg \]
   5. \[ E_a \& G_a \quad 4, \exists \]
   6. \[ E_a \quad 5, \& \]
   7. \[ G_a \quad 5, \& \]
   \[ \sqrt{8}. \quad \forall x \sim (E_x \& F_x) \quad 1, \exists \]
   \[ \sqrt{9}. \quad \forall x \sim (F_x \& G_x) \quad 2, \exists \]
   10. \[ \neg (E_a \& F_a) \quad 8, \forall \]
   11. \[ \neg (F_a \& G_a) \quad 9, \forall \]
   \[ \sqrt{12}. \quad \neg E_a \quad \neg F_a \quad 10, \neg \& \]
   \[ \sqrt{13}. \quad \neg F_a \quad \neg G_a \quad 11, \neg \& \]
   \[ \text{Invalid} \]
23. All elephants are mammals.  
No elephants can fly.  
Thus, no mammals can fly.

Ex = x is an elephant  
Mx = x is a mammal  
Fx = x can fly

∀x(Ex ⊃ Mx)  
~∃x(Ex & Fx)  
∴ ~∃x(Mx & Fx)

1. ∀x(Ex ⊃ Mx)  
2. ~∃x(Ex & Fx)  
3. ~∃x(Mx & Fx)  
4. ∃x(Mx & Fx)  
5. Ma & Fa  
6. Ma  
7. Fa  
8. ∀x ~(Ex & Fx)  
9. ~∃(Ex & Fx)  
10. ~Ex ~Fx  
11. Ea ⊃ Ma  
12. ~Ex Ma  
Invalid
\[ \forall y (M_y \supset F_y) \supset \exists z (P_z \& Q_z) \]
\[ \neg \exists x (P_x \& Q_x) \]
\[ \exists x (M_x \& \neg F_x) \]

1. \[ \forall y (M_y \supset F_y) \supset \exists z (P_z \& Q_z) \]
2. \[ \neg \exists x (P_x \& Q_x) \]
3. \[ \neg \exists x (M_x \& \neg F_x) \]
4. \[ \neg \forall y (M_y \supset F_y) \]
5. \[ \exists z (P_z \& Q_z) \]
6. \[ \exists x (M_x \& \neg F_x) \]

\[ \neg (M_a \supset F_a) \]
7. \[ \neg (M_a \& \neg F_a) \]
8. \[ M_a \]
9. \[ \neg F_a \]
10. \[ \neg (M_a \& \neg F_a) \]
11. \[ \neg M_a \]

Valid

\[ \neg \exists x (P_x \& Q_x) \]
\[ \exists x (M_x \& \neg F_x) \]