1. Fallacy, the store could be closed another day.

2. Argument by contraposition: $D(x)$ = x is a dog
   $E(x)$ = x eats meat
   $D(x) \rightarrow E(x)$
   f = Fluffy
   $\neg E(f) \rightarrow \neg D(f)$

3.
   (i) $p \rightarrow \neg q$ (premise)
   (ii) $p \vee u$ (premise)
   (iii) q (premise)
   (iv) $((r \wedge t) \vee p) \vee \neg u$ (premise)
   (v) $\neg p$ (Modus Tollens) (i), (iii)
   (vi) u (Disjunctive Syllogism) (ii), (v)
   (vii) $((r \wedge t) \vee p)$ (Disjunctive Syllogism) (iv), (vi)
   (viii) $r \wedge t$ (Disjunctive Syllogism) (v), (vii)
   (ix) $r \wedge t$ (Conclusion)

4. Ramses = r

   Sylvester = s

   (i) $L(x) \wedge A(x) \rightarrow H(x, y)$ (premise)
   (ii) $L(r)$ (premise)
   (iii) $\neg H(r, s)$ (premise)
   (iv) $\neg H(r, s) \rightarrow \neg(L(r) \wedge (A(s))$ (Modus Tollens) (i), (ii), (iii)
   (v) $\neg L(r) \vee \neg A(s)$ (De Morgan) (iv)
   (vi) $A(s)$ (Disjunctive Syllogism) (ii), (v)

5. Let a be an even number, and b be an odd number. By definition, a = 2x and b = (2y + 1) for some integers x and y. Now ab = (2x)(2y + 1) = 4xy + 2x = 2(2xy + x). Next, let k = 2xy + x. Finally, ab = 2k by definition is even.

6. To prove by contraposition, we must prove that if $\frac{1}{x}$ is rational then so is x. By definition of rational, if $\frac{1}{x}$ is rational, then it is equivalent to some $\frac{a}{b}$, where a and b are nonzero integers. $\frac{1}{x} = \frac{a}{b}$ is equivalent to x = $\frac{b}{a}$ which is a rational number. Therefore, when x is irrational, so is $\frac{1}{x}$.

7. Setting n = 16 proves existence of a positive integer that satisfies $2n + 1 \geq 33$

8. The question can be simplified to find k by comparing the denominator values. The larger the denominator, the smaller the value of the fraction, so we rewrite the comparison to: $n+2 \geq k + 1 > n$. There are then two cases to consider:

    (i) If n is even: select k = n so that k is also even. By plugging in n into k, it can be concluded that, $n+2 \geq k + 1 > n = n + 2 \geq n + 1 > n$ is true for all integers n.

    (ii) If n is odd: select k = n + 1, so that k is even. By plugging n + 1 into k, it can be conclude that, $n+2 \geq k + 1 > n = n + 2 \geq n + 2 > n$ is true for all positive integers n.

9. *Extra credit:*

```python
import math
print("Name: William Jedynak")
print("ID  : 1227139214")
range1 = 2
range2 = 100000
closest = 3
for q in range(range1, range2 + 1):
    pLow = math.floor(1.4 * q)
    pHigh = math.ceil(1.5 * q)
    for p in range(pLow, pHigh):
        if abs(2 - pow(p/q, 2)) < closest:
            closest = abs(2 - pow(p/q, 2))
            pair = p, q
            print("More accurate approximation of sqrt(2) found: ((" + str(p) + "/" + str(q) + ")^2 - 2) for a difference of: " + str(closest))
print("Most accurate approximation of sqrt(2) is: (" + str(pair[0]) + "/" + str(pair[1]) + ") = " + str(pair[0] / pair[1]))
```

Main

```
"C:\Users\WillJedynak\OneDrive\ASU Online\Fall 2022\Session B\MAT 243\Homework\Homework 2\Python\venv\Scripts\python.exe" "C:\Users\WillJedynak
Name: William Jedynak
ID  : 1227139214
More accurate approximation of sqrt(2) found: ((2/2)^2 - 2) for a difference of: 1.0
More accurate approximation of sqrt(2) found: ((4/3)^2 - 2) for a difference of: 0.2222222222222232
More accurate approximation of sqrt(2) found: ((7/5)^2 - 2) for a difference of: 0.04000000000000026
More accurate approximation of sqrt(2) found: ((17/12)^2 - 2) for a difference of: 0.006944444444444642
More accurate approximation of sqrt(2) found: ((24/17)^2 - 2) for a difference of: 0.006920415224913157
More accurate approximation of sqrt(2) found: ((41/29)^2 - 2) for a difference of: 0.0011890606420930094
More accurate approximation of sqrt(2) found: ((99/70)^2 - 2) for a difference of: 0.0002040816326531747
More accurate approximation of sqrt(2) found: ((140/99)^2 - 2) for a difference of: 0.0002040608101214758
More accurate approximation of sqrt(2) found: ((239/169)^2 - 2) for a difference of: 3.501277966488914e-05
More accurate approximation of sqrt(2) found: ((577/408)^2 - 2) for a difference of: 6.007304882871267e-06
More accurate approximation of sqrt(2) found: ((816/577)^2 - 2) for a difference of: 6.007286838860537e-06
More accurate approximation of sqrt(2) found: ((1393/985)^2 - 2) for a difference of: 1.0306887576749801e-06
More accurate approximation of sqrt(2) found: ((3363/2378)^2 - 2) for a difference of: 1.7683828668069168e-07
More accurate approximation of sqrt(2) found: ((4756/3363)^2 - 2) for a difference of: 1.7683827158165855e-07
More accurate approximation of sqrt(2) found: ((8119/5741)^2 - 2) for a difference of: 3.034065154672305e-08
More accurate approximation of sqrt(2) found: ((19601/13860)^2 - 2) for a difference of: 5.2056328136984575e-09
More accurate approximation of sqrt(2) found: ((47321/33461)^2 - 2) for a difference of: 8.931455575122982e-10
More accurate approximation of sqrt(2) found: ((114243/80782)^2 - 2) for a difference of: 1.53239199107702e-10
Most accurate approximation of sqrt(2) is: (114243/80782) = 1.4142135624272734

Process finished with exit code 0
```