In [4]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import re
import math
```

In [5]:
```
df = pd.read_csv("Moon Mission 3 Data Python.csv")
df['Parameter']
```

Out[5]:
```
0                 Lunar Polar Orbit
1                      Mission life
2                         Structure
3                           Dry Mass
4                   Propellant Mass
5                    Total PM Mass
6                 Power Generation
7                    Communication
8                 Attitude Sensors
9               Propulsion System
10                       undefined
11    # Lander Module dataframe
12                       undefined
13                      Parameter
14                                
15                     Mission life
16                             Mass
17                            Power
18                         Payloads
19               Dimensions (mm3)
20                   Communication
21                      Landing site
22                       undefined
23             # Rover dataframe
24                       undefined
25                      Parameter
26                                
27                     Mission life
28                             Mass
29                            Power
30                         Payloads
31               Dimensions (mm3)
32                   Communication
Name: Parameter, dtype: object
```

In [6]:
```
data = {"Parameter": [ 'Lunar Polar Orbit',
                       'Mission life',
                       'Structure',
                       'Dry Mass',
                       'Propellant Mass',
                       'Total PM Mass',
                       'Power Generation',
                       'Communication',
                       'Attitude Sensors',
                       'Propulsion System'],

        "Specification": [ 'From 170 x 36500 km to lunar polar orbit',
                           'Carrying Lander Module & Rover upto ~100 x 100...',
                           'Modified version of I-3 K',
                           '448.62 kg (including pressurant)',
                           '1696.39 kg',
                           '2145.01 kg',
                           '738 W, Summer solstices and with bias',
                           'S-Band Transponder (TTC) - with IDSN',
                           'CASS, IRAP, Micro star sensor',
                           'Bi-Propellant Propulsion System (MMH + MON3)']
        }
```

In [7]:
```
propulsion_df = pd.DataFrame(data)
propulsion_df
```

Out[7]:

	Parameter	Specification
0	Lunar Polar Orbit	From 170 x 36500 km to lunar polar orbit
1	Mission life	Carrying Lander Module & Rover upto ~100 x 100...
2	Structure	Modified version of I-3 K
3	Dry Mass	448.62 kg (including pressurant)
4	Propellant Mass	1696.39 kg
5	Total PM Mass	2145.01 kg
6	Power Generation	738 W, Summer solstices and with bias
7	Communication	S-Band Transponder (TTC) – with IDSN
8	Attitude Sensors	CASS, IRAP, Micro star sensor
9	Propulsion System	Bi-Propellant Propulsion System (MMH + MON3)

In [8]:
```
data = {"Parameter": [  'Mission life',
                        'Mass',
                        'Power',
                        'Payloads',
                        'Dimensions (mm3)',
                        'Communication',
                        'Landing site'],

        "Specification": [ '1 Lunar day (14 Earth days)',
                           '1749.86 kg including Rover',
                           '738 W (Winter solstice)',
                           '3',
                           '2000 x 2000 x 1166',
                           'ISDN, Ch-2 Orbiter, Rover',
                           '69.367621 S, 32.348126 E' ]
        }
```

In [9]:
```
lander_df = pd.DataFrame(data)
lander_df
```

Out[9]:

	Parameter	Specification
0	Mission life	1 Lunar day (14 Earth days)
1	Mass	1749.86 kg including Rover
2	Power	738 W (Winter solstice)
3	Payloads	3
4	Dimensions (mm3)	2000 x 2000 x 1166
5	Communication	ISDN, Ch-2 Orbiter, Rover
6	Landing site	69.367621 S, 32.348126 E

In [10]:
```
data = {"Parameter": [  'Mission life',
                        'Mass',
                        'Power',
                        'Payloads',
                        'Dimensions (mm3)',
                        'Communication'],

        "Specification": [ '1 Lunar day',
                           '26 kg',
                           '50W',
                           '2',
                           '917*750*397',
                           'Lander']
        }
```

In [11]:
```
rover_df = pd.DataFrame(data)
rover_df
```

Out[11]:

	Parameter	Specification
0	Mission life	1 Lunar day
1	Mass	26 kg
2	Power	50W
3	Payloads	2
4	Dimensions (mm3)	917*750*397
5	Communication	Lander

In [12]:
```
def extract_numerical_value(spec):
    numeric_pattern = r'(\d+(\.\d+)?)'
    custom_numeric_pattern = r'[~+]?[.,]?[\d]+(?),\d\d\d|[\.]?\d*(?:[eE][-+]?\d+)?'
    combined_pattern = r"|(numeric_pattern)|(custom_numeric_pattern)|"

    matches = re.findall(combined_pattern,spec)

    if matches:
        return float(matches[0][0])
    else:
        return None
```

In [13]:
```
propulsion_df["numerical value"] = propulsion_df["Specification"].apply(extract_numerical_value)
propulsion_df
```

Out[13]:

	Parameter	Specification	numerical value
0	Lunar Polar Orbit	From 170 x 36500 km to lunar polar orbit	170.00
1	Mission life	Carrying Lander Module & Rover upto ~100 x 100...	100.00
2	Structure	Modified version of I-3 K	-3.00
3	Dry Mass	448.62 kg (including pressurant)	448.62
4	Propellant Mass	1696.39 kg	1696.39
5	Total PM Mass	2145.01 kg	2145.01
6	Power Generation	738 W, Summer solstices and with bias	738.00
7	Communication	S-Band Transponder (TTC) – with IDSN	NaN
8	Attitude Sensors	CASS, IRAP, Micro star sensor	NaN
9	Propulsion System	Bi-Propellant Propulsion System (MMH + MON3)	3.00

In [14]:
```
lander_df["numerical value"] = lander_df["Specification"].apply(extract_numerical_value)
lander_df
```

Out[14]:

	Parameter	Specification	numerical value
0	Mission life	1 Lunar day (14 Earth days)	1.000000
1	Mass	1749.86 kg including Rover	1749.860000
2	Power	738 W (Winter solstice)	738.000000
3	Payloads	3	3.000000
4	Dimensions (mm3)	2000 x 2000 x 1166	2000.000000
5	Communication	ISDN, Ch-2 Orbiter, Rover	-2.000000
6	Landing site	69.367621 S, 32.348126 E	69.367621

In [15]:
```
rover_df["numerical value"] = rover_df["Specification"].apply(extract_numerical_value)
rover_df
```

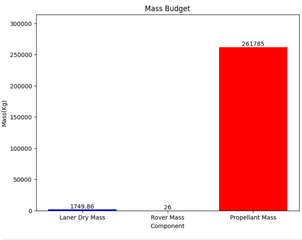
Out[15]:

	Parameter	Specification	numerical value
0	Mission life	1 Lunar day	1.0
1	Mass	26 kg	26.0
2	Power	50W	50.0
3	Payloads	2	2.0
4	Dimensions (mm3)	917*750*397	917.0
5	Communication	Lander	NaN

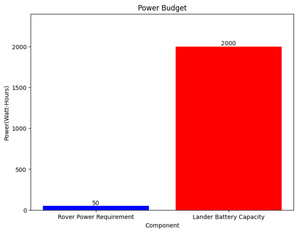
In [16]:
```
rover_mass = 26
lander_dry_mass = 1749.86
total_mass = rover_mass + lander_dry_mass
required_delta_v = 1500
isp_lander_engine = 300

propellent_mass_required = total_mass * math.exp(required_delta/isp_lander_engine)-total_mass
propellent_mass_required = round(propellent_mass_required)
```

In [17]:
```
rover_power_requirement = 50
lander_battery_capacity = 2000

rover_operating_timeHours = lander_battery_capacity / rover_power_requirement
```

In [18]:
```
labels = ['Laner Dry Mass','Rover Mass','Propellant Mass']
mass_values = [lander_dry_mass,rover_mass,propellent_mass_required]

plt.figure(figsize=(8,6))
plt.bar(labels,mass_values,color=['blue','black','red'])
plt.xlabel('Component')
plt.ylabel('Mass(Kg)')
plt.title('Mass Budget')
plt.ylim(0,max(mass_values)*1.2)

for i,v in enumerate(mass_values):
    plt.text(i,v,str(v),ha = 'center',va = 'bottom')

plt.show()
```



In [19]:
```
labels = ['Rover Power Requirement','Lander Battery Capacity']
power_values = [rover_power_requirement,lander_battery_capacity]

plt.figure(figsize=(8,6))
plt.bar(labels,power_values,color=['blue','red'])
plt.xlabel('Component')
plt.ylabel('Power(Watt-Hours)')
plt.title('Power Budget')
plt.ylim(0,max(power_values)*1.2)

for i,v in enumerate(power_values):
    plt.text(i,v,str(v),ha = 'center',va = 'bottom')

plt.show()
```


Power Budget
2000
50
2000
1500
1000
500
0
Power(Watt-Hours)
Rover Power Requirement
Lander Battery Capacity
Component