In [2]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error
from sklearn.model_selection import train_test_split

import warnings
warnings.filterwarnings('ignore')
```

In [3]:

```
car_data = pd.read_csv('fuel_efficiency_data.csv')
print(car_data.tail(7))
print(car_data.describe())
```

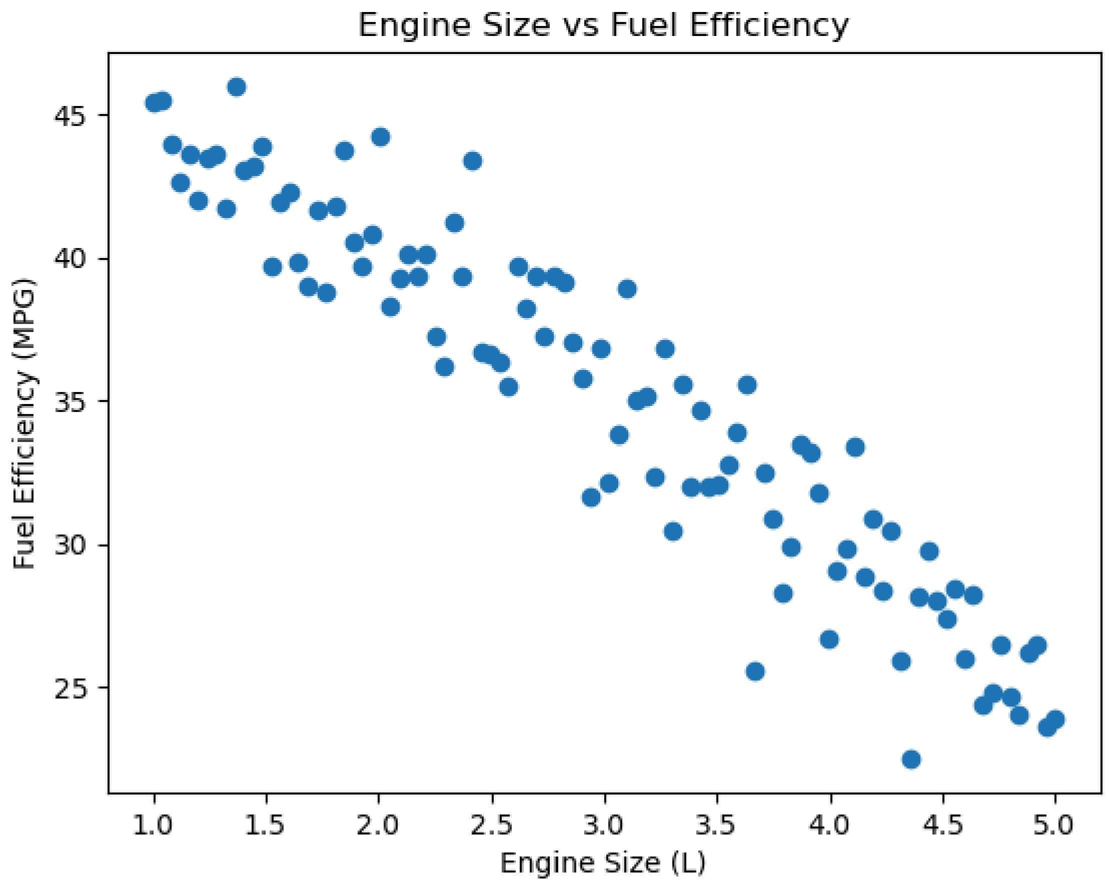
```
    Engine_Size_Liters  Fuel_Efficiency_MPG
93            4.757576            26.483313
94            4.797980            24.691054
95            4.838384            24.029591
96            4.878788            26.206605
97            4.919192            26.501588
98            4.959596            23.633990
99            5.000000            23.923769
       Engine_Size_Liters  Fuel_Efficiency_MPG
count          100.000000           100.000000
mean             3.000000            35.116328
std              1.172181             6.290352
min              1.000000            22.505760
25%              2.000000            29.886659
50%              3.000000            35.666563
75%              4.000000            39.902106
max              5.000000            45.990208
```

In [4]:

```
indp_vars = car_data[['Engine_Size_Liters']]
dep_var = car_data['Fuel_Efficiency_MPG']
```

In [5]:

```
plt.scatter(indp_vars, dep_var)
plt.xlabel("Engine Size (L)")
plt.ylabel("Fuel Efficiency (MPG)")
plt.title("Engine Size vs Fuel Efficiency")
plt.show()
```

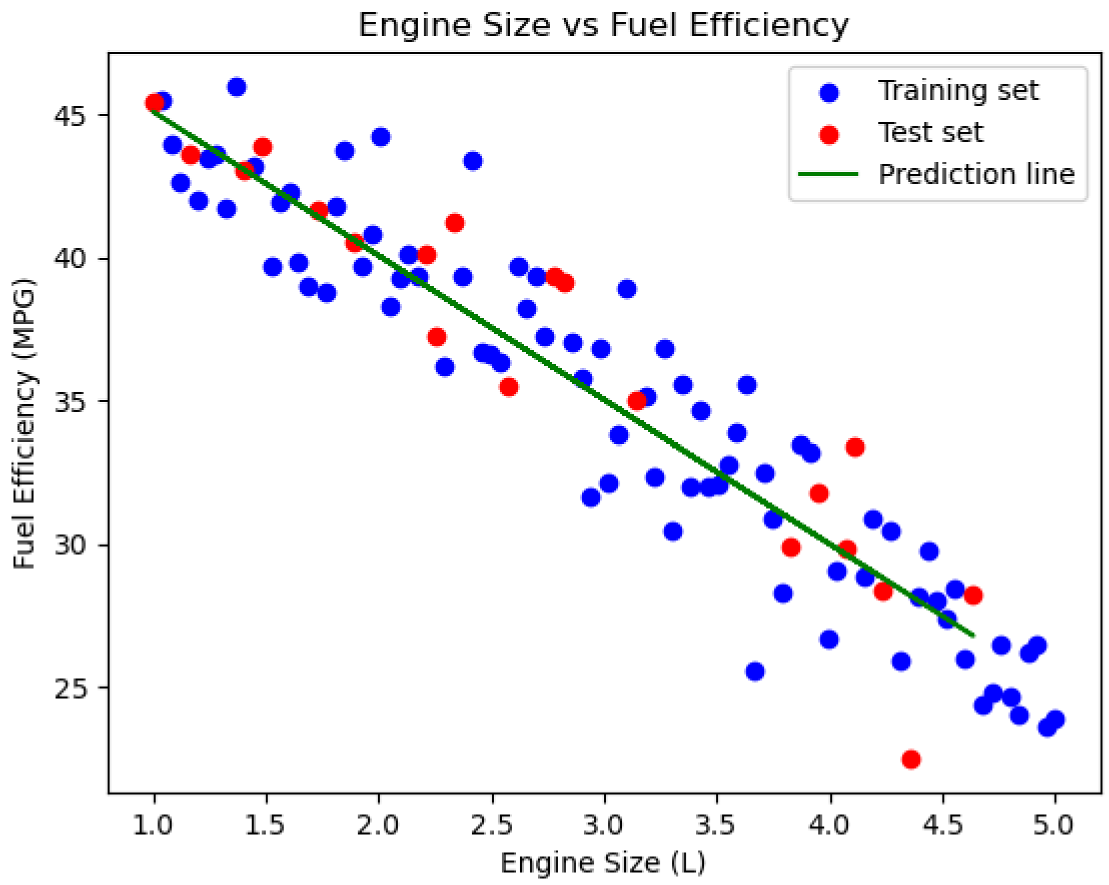


In [6]:
```
train_x, test_x, train_y, test_y = train_test_split(indp_vars, dep_var, test_size=0.2, random_state=42)
lr_model = LinearRegression()
lr_model.fit(train_x, train_y)
pred = lr_model.predict(test_x)
```

In [7]:
```
mse = mean_squared_error(pred, test_y)
print("Mean Squared Error:", mse)
```

```
Mean Squared Error: 4.570596048538351
```

In [8]:
```
plt.scatter(train_x, train_y, color='blue', label='Training set')
plt.scatter(test_x, test_y, color='red', label='Test set')
plt.plot(test_x, pred, color="green", label="Prediction line")
plt.legend()
plt.xlabel("Engine Size (L)")
plt.ylabel("Fuel Efficiency (MPG)")
plt.title("Engine Size vs Fuel Efficiency")
plt.show()
```



In [10]:

```
new_entry = input("Please enter an engine size in liters: ")
new_entry = np.array([[float(new_entry)]])
pred_new = lr_model.predict(new_entry)
print("Predicted Fuel Efficiency (MPG):", pred_new)
```

```
Predicted Fuel Efficiency (MPG): [35.02751255]
```

In [ ]:

In [11]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score, mean_absolute_error, mean_squared_error
```

In [12]:

```
df = pd.read_csv("student_performance.csv")
```

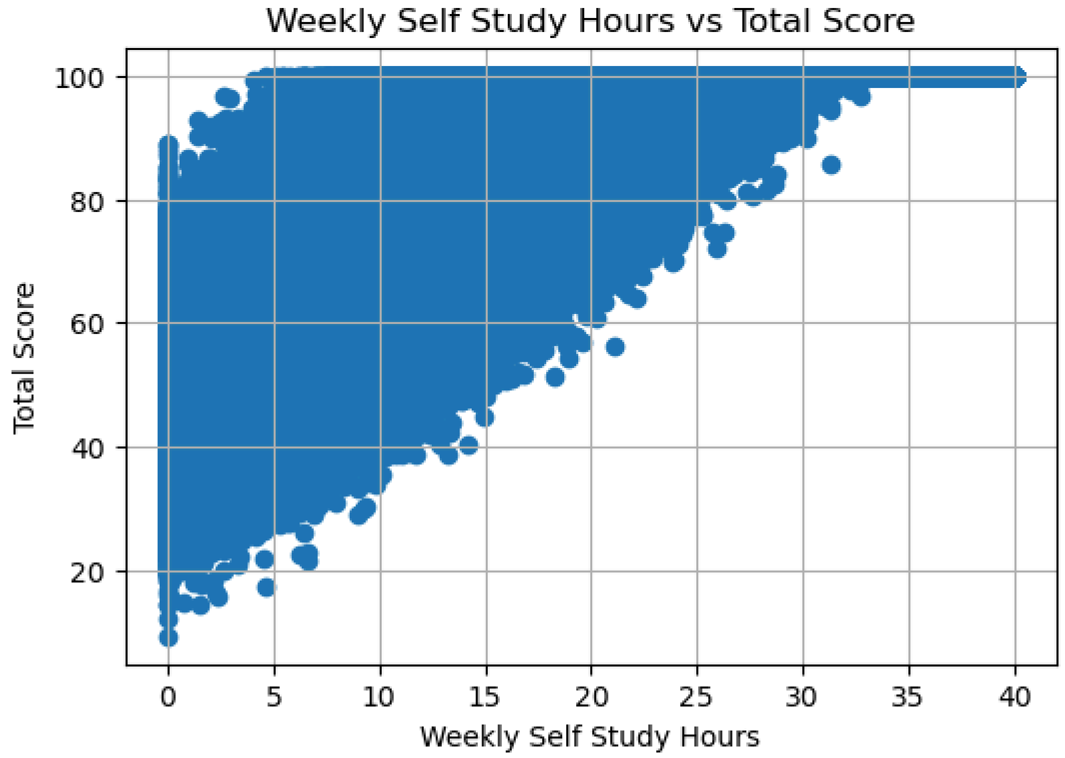
In [13]:

```
print(df.head())
print(df.info())
print(df.describe())
```

```
   student_id  weekly_self_study_hours  attendance_percentage  \
0           1                     18.5                   95.6   
1           2                     14.0                   80.0   
2           3                     19.5                   86.3   
3           4                     25.7                   70.2   
4           5                     13.4                   81.9   

   class_participation  total_score grade  
0                  3.8         97.9     A  
1                  2.5         83.9     B  
2                  5.3        100.0     A  
3                  7.0        100.0     A  
4                  6.9         92.0     A  
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000000 entries, 0 to 999999
Data columns (total 6 columns):
 #   Column                   Non-Null Count    Dtype  
---  ------                   --------------    -----  
 0   student_id               1000000 non-null  int64  
 1   weekly_self_study_hours  1000000 non-null  float64
 2   attendance_percentage    1000000 non-null  float64
 3   class_participation      1000000 non-null  float64
 4   total_score              1000000 non-null  float64
 5   grade                    1000000 non-null  object 
dtypes: float64(4), int64(1), object(1)
memory usage: 45.8+ MB
None
           student_id  weekly_self_study_hours  attendance_percentage  \
count  1000000.000000           1000000.000000         1000000.000000   
mean    500000.500000                15.029127              84.711046   
std     288675.278933                 6.899431               9.424143   
min          1.000000                 0.000000              50.000000   
25%     250000.750000                10.300000              78.300000   
50%     500000.500000                15.000000              85.000000   
75%     750000.250000                19.700000              91.800000   
max    1000000.000000                40.000000             100.000000   

       class_participation     total_score  
count       1000000.000000  1000000.000000  
mean              5.985203       84.283845  
std               1.956421       15.432969  
min               0.000000        9.400000  
25%               4.700000       73.900000  
50%               6.000000       87.500000  
75%               7.300000      100.000000  
max              10.000000      100.000000  
```

In [14]:

```python
plt.figure(figsize=(6,4))
plt.scatter(df['weekly_self_study_hours'], df['total_score'])
plt.title('Weekly Self Study Hours vs Total Score')
plt.xlabel('Weekly Self Study Hours')
plt.ylabel('Total Score')
plt.grid(True)
plt.show()
```



In [15]:
```
corr = df['weekly_self_study_hours'].corr(df['total_score'])
print(f"Pearson correlation: {corr:.4f}")
```

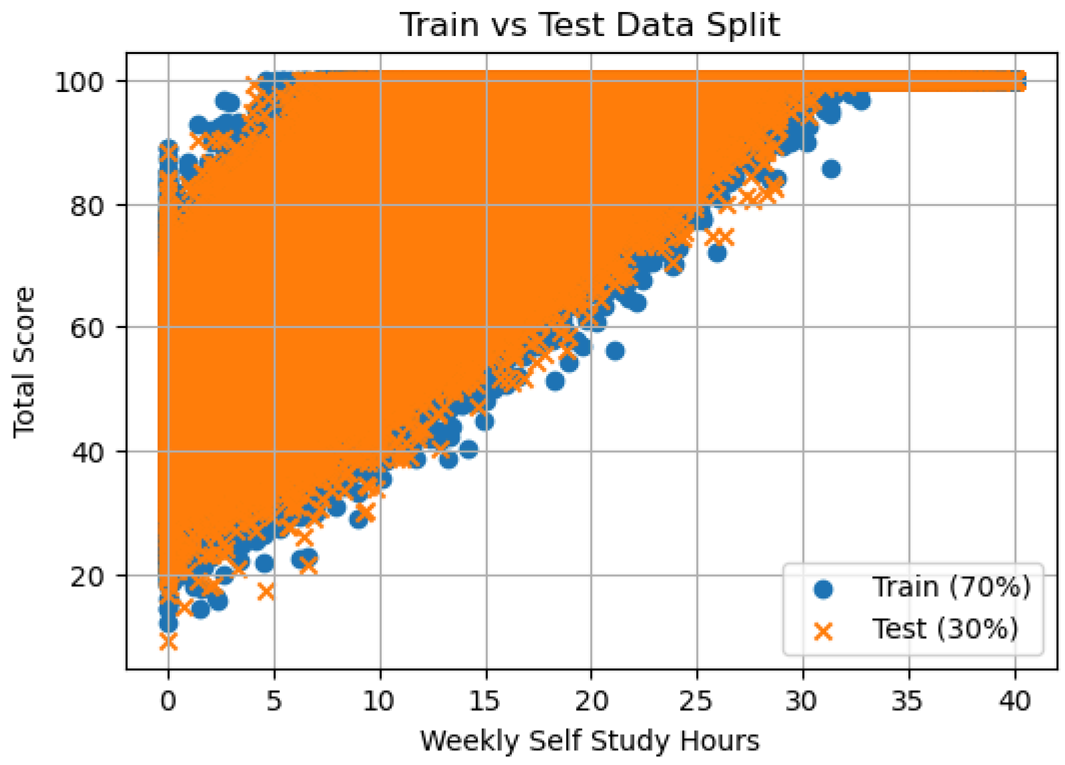
```
Pearson correlation: 0.8122
```

In [16]:
```
X = df[['weekly_self_study_hours']]   # independent variable
y = df['total_score']                 # dependent variable
```

In [17]:
```
X_train, X_test, y_train, y_test = train_test_split(
    X, y, test_size=0.3, random_state=42
)
print("Train size:", X_train.shape, "Test size:", X_test.shape)
```

```
Train size: (700000, 1) Test size: (300000, 1)
```

In [18]:
```
plt.figure(figsize=(6,4))
plt.scatter(X_train, y_train, label='Train (70%)')
plt.scatter(X_test, y_test, marker='x', label='Test (30%)')
plt.xlabel('Weekly Self Study Hours')
plt.ylabel('Total Score')
plt.title('Train vs Test Data Split')
plt.legend()
plt.grid(True)
plt.show()
```



In [19]:
```
model = LinearRegression()
model.fit(X_train, y_train)

print(f"Intercept: {model.intercept_:.2f}")
print(f"Slope: {model.coef_[0]:.2f}")
print(f"Equation: total_score = {model.intercept_:.2f} + {model.coef_[0]:.2f} * weekly_self_study_hours")
```

```
Intercept: 56.97
Slope: 1.82
Equation: total_score = 56.97 + 1.82 * weekly_self_study_hours
```

In [20]:
```
y_pred = model.predict(X_test)
```

In [21]:
```
r2 = r2_score(y_test, y_pred)
mae = mean_absolute_error(y_test, y_pred)
mse = mean_squared_error(y_test, y_pred)
rmse = np.sqrt(mse)

print("Evaluation metrics on Test Set:")
print(f"R^2: {r2:.4f}")
print(f"MAE: {mae:.2f}")
print(f"MSE: {mse:.2f}")
print(f"RMSE: {rmse:.2f}")
```

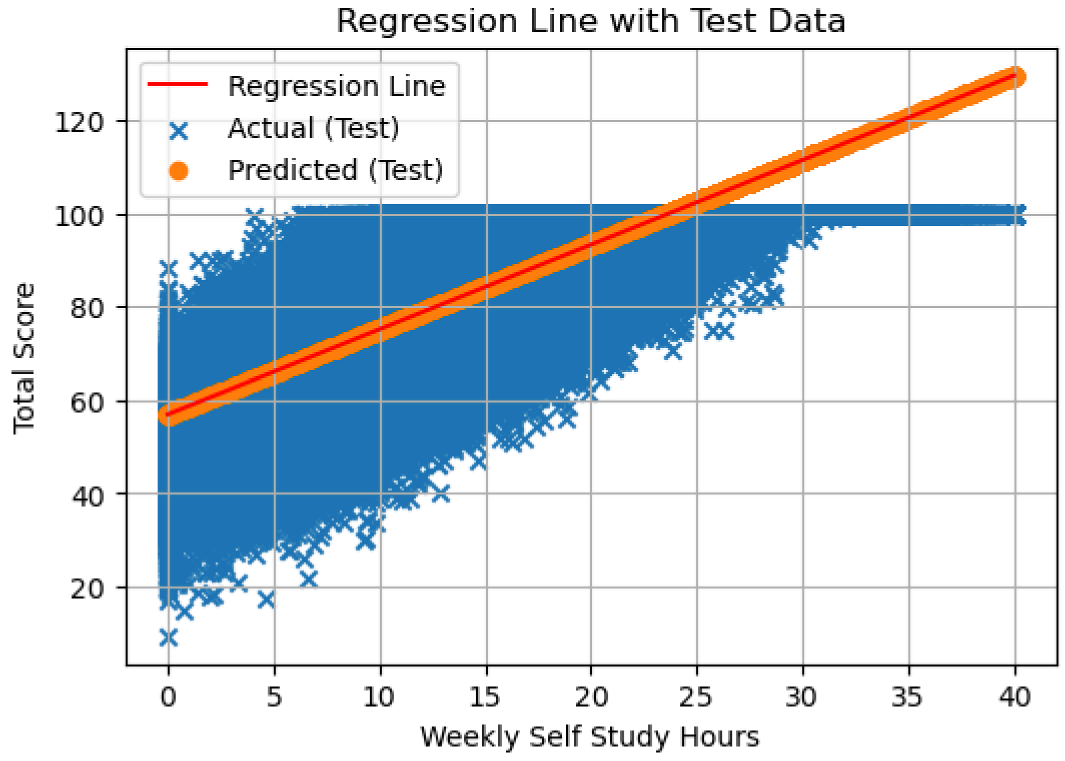
```
Evaluation metrics on Test Set:
R^2: 0.6599
MAE: 7.16
MSE: 80.83
RMSE: 8.99
```

In [22]:
```
results = pd.DataFrame({
    'weekly_self_study_hours': X_test['weekly_self_study_hours'],
    'Actual total_score': y_test,
    'Predicted total_score': y_pred,
    'Residual': y_test - y_pred
})
print(results.sort_values('weekly_self_study_hours'))
```

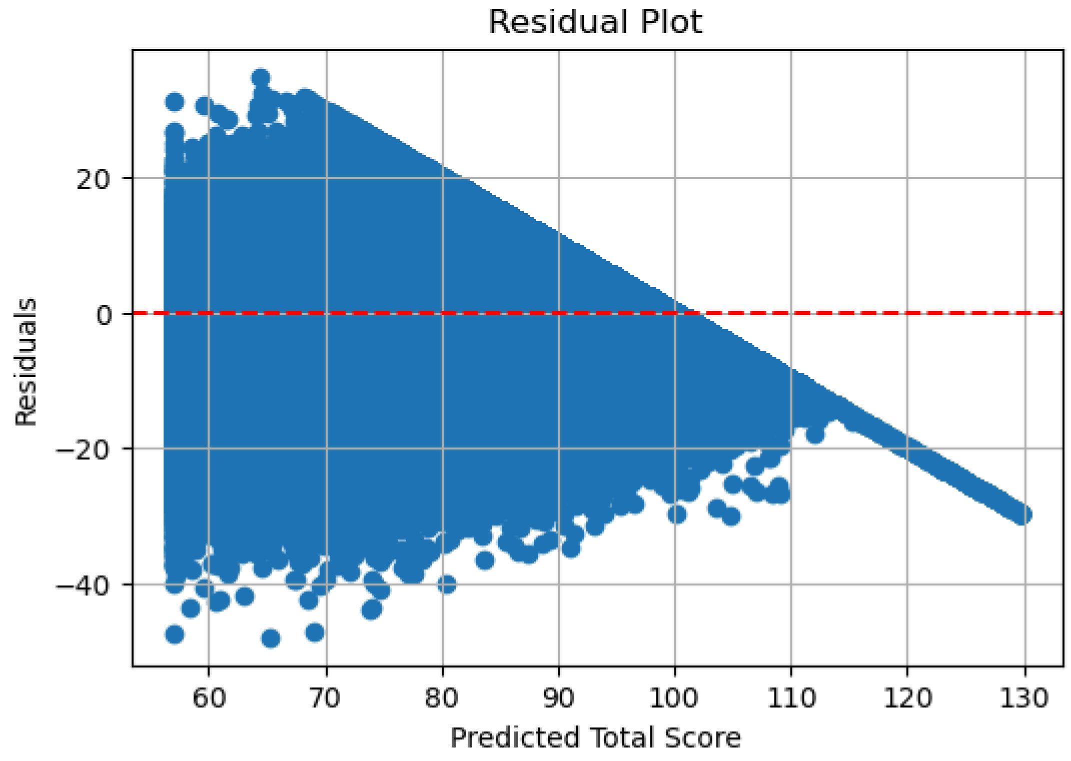
```
        weekly_self_study_hours  Actual total_score  Predicted total_score  \
645760                      0.0                51.6              56.970614   
543201                      0.0                53.6              56.970614   
826288                      0.0                48.3              56.970614   
318861                      0.0                60.6              56.970614   
79662                       0.0                38.6              56.970614   
...                         ...                 ...                    ...   
264709                     40.0               100.0             129.643047   
425349                     40.0               100.0             129.643047   
428200                     40.0               100.0             129.643047   
52813                      40.0               100.0             129.643047   
215056                     40.0               100.0             129.643047   

         Residual  
645760  -5.370614  
543201  -3.370614  
826288  -8.670614  
318861   3.629386  
79662  -18.370614  
...           ...  
264709 -29.643047  
425349 -29.643047  
428200 -29.643047  
52813  -29.643047  
215056 -29.643047  

[300000 rows x 4 columns]
```

In [23]:

```
plt.figure(figsize=(6,4))
# Regression line
X_range = np.linspace(df['weekly_self_study_hours'].min(), df['weekly_self_study_hours'].max(), 200).reshape(-1,1)
plt.plot(X_range, model.predict(X_range), color='red', label='Regression Line')
# Actual vs predicted points
plt.scatter(X_test, y_test, marker='x', label='Actual (Test)')
plt.scatter(X_test, y_pred, marker='o', label='Predicted (Test)')
plt.xlabel('Weekly Self Study Hours')
plt.ylabel('Total Score')
plt.title('Regression Line with Test Data')
plt.legend()
plt.grid(True)
plt.show()
```



In [24]:
```
plt.figure(figsize=(6,4))
plt.scatter(y_pred, y_test - y_pred)
plt.axhline(0, color='red', linestyle='--')
plt.xlabel('Predicted Total Score')
plt.ylabel('Residuals')
plt.title('Residual Plot')
plt.grid(True)
plt.show()
```



In [ ]: