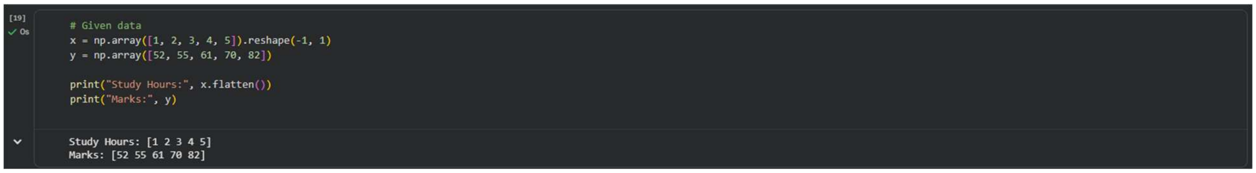
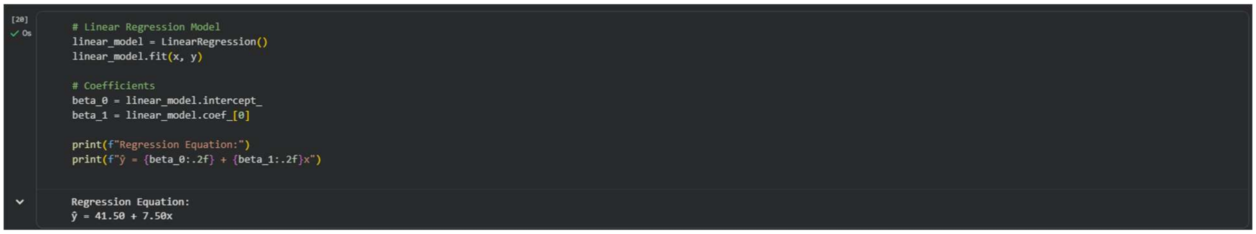
1) A.



```
# Given data
x = np.array([1, 2, 3, 4, 5]).reshape(-1, 1)
y = np.array([52, 55, 61, 70, 82])

print("Study Hours:", x.flatten())
print("Marks:", y)
```

```
Study Hours: [1 2 3 4 5]
Marks: [52 55 61 70 82]
```

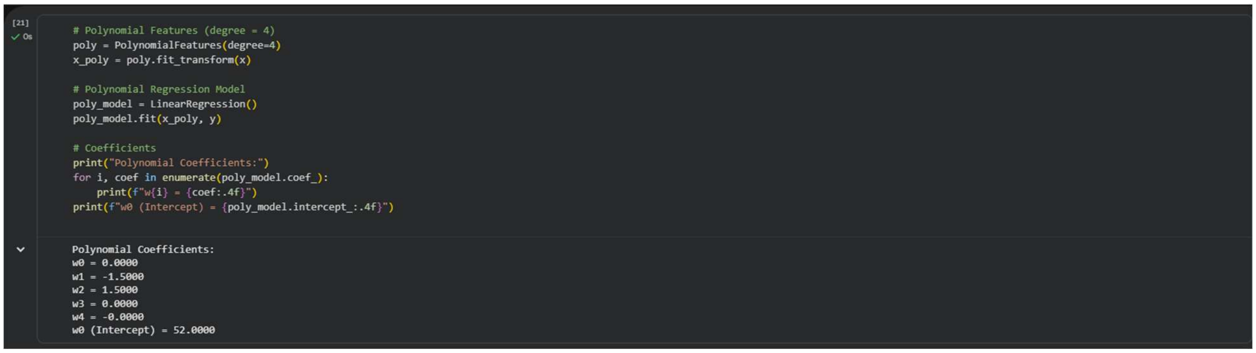
B.



```
# Linear Regression Model
linear_model = LinearRegression()
linear_model.fit(x, y)

# Coefficients
beta_0 = linear_model.intercept_
beta_1 = linear_model.coef_[0]

print(f"Regression Equation:")
print(f"ŷ = {beta_0:.2f} + {beta_1:.2f}x")
```

```
Regression Equation:
ŷ = 41.50 + 7.50x
```

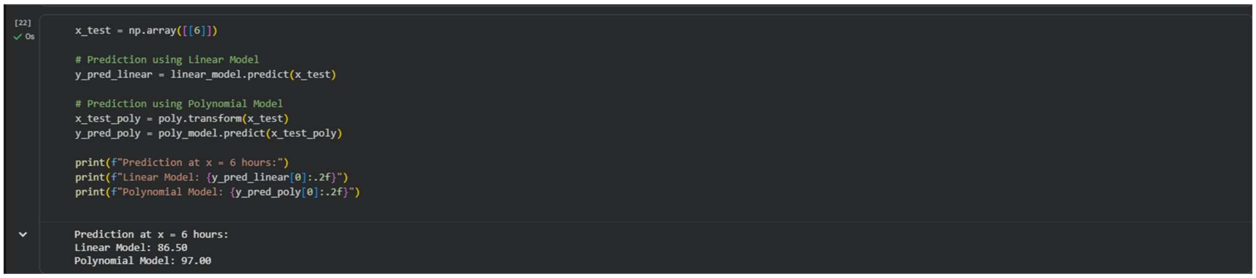
2) A.



```
# Polynomial Features (degree = 4)
poly = PolynomialFeatures(degree=4)
x_poly = poly.fit_transform(x)

# Polynomial Regression Model
poly_model = LinearRegression()
poly_model.fit(x_poly, y)

# Coefficients
print("Polynomial Coefficients:")
for i, coef in enumerate(poly_model.coef_):
    print(f"w{i} = {coef:.4f}")
print(f"w0 (Intercept) = {poly_model.intercept_:.4f}")
```

```
Polynomial Coefficients:
w0 = 0.0000
w1 = -1.5000
w2 = 1.5000
w3 = 0.0000
w4 = -0.0000
w0 (Intercept) = 52.0000
```

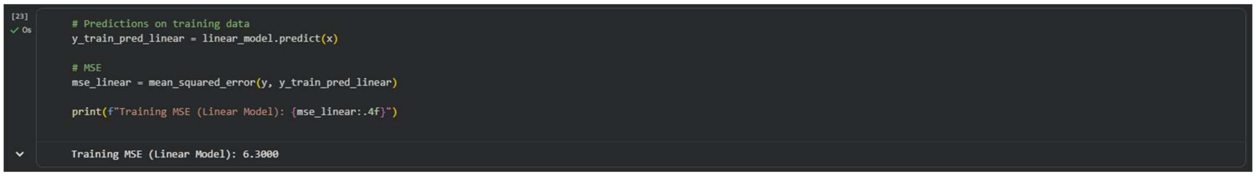
b.



```
x_test = np.array([[6]])

# Prediction using Linear Model
y_pred_linear = linear_model.predict(x_test)

# Prediction using Polynomial Model
x_test_poly = poly.transform(x_test)
y_pred_poly = poly_model.predict(x_test_poly)

print(f"Prediction at x = 6 hours:")
print(f"Linear Model: {y_pred_linear[0]:.2f}")
print(f"Polynomial Model: {y_pred_poly[0]:.2f}")
```

```
Prediction at x = 6 hours:
Linear Model: 86.50
Polynomial Model: 97.00
```

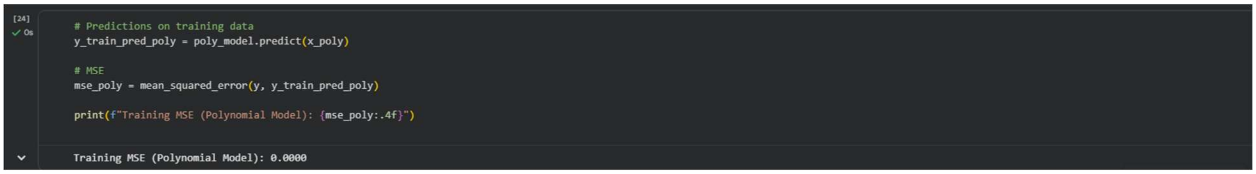
3) A.



```
# Predictions on training data
y_train_pred_linear = linear_model.predict(x)

# MSE
mse_linear = mean_squared_error(y, y_train_pred_linear)

print(f"Training MSE (Linear Model): {mse_linear:.4f}")
```

```
Training MSE (Linear Model): 6.3000
```

b.



```
# Predictions on training data
y_train_pred_poly = poly_model.predict(x_poly)

# MSE
mse_poly = mean_squared_error(y, y_train_pred_poly)

print(f"Training MSE (Polynomial Model): {mse_poly:.4f}")
```

```
Training MSE (Polynomial Model): 0.0000
```

4)

Bias–Variance Analysis

• **Higher Bias:**
Model A (Linear Regression)
Reason: It is too simple to capture the non-linear relationship.

• **Higher Variance:**
Model B (Polynomial Regression – Degree 4)
Reason: It closely fits the training data and may overfit, making it sensitive to data changes.