ASSIGNMENT 1 (Solution)- Modeling a Simple Physics Equation in OMEdit

---

FreeFallModel – Solution (OMEdit / Modelica Code)

---

1. Complete Modelica Code

Create a new model in OMEdit named:

```
FreeFallModel
```

Paste the following code:

```
model FreeFallModel

  parameter Real g = -9.81;       // gravitational acceleration (m/s^2)
  parameter Real m = 1;           // mass of object (kg)
  parameter Real h0 = 100;        // initial height (m)



  Real h(start = h0);             // height (m)
  Real v(start = 0);              // velocity (m/s)
  Real a;                         // acceleration (m/s^2)

equation

  a = g;                          // constant acceleration due to gravity
  der(v) = a;                     // acceleration is derivative of velocity
  der(h) = v;                     // velocity is derivative of height

end FreeFallModel;
```

---

2. Explanation of Each Section

Parameters

g = -9.81
Represents gravity acting downward.

m = 1
Mass of object (not used in equation because mass cancels in free fall).

h0 = 100
Initial height in meters.

Variables

h
Height of object (changes over time).

v
Velocity of object.

a
Acceleration.

Equations

a = g
Acceleration is constant.

der(v) = a
Velocity changes due to acceleration.

der(h) = v
Height changes according to velocity.

These are declarative equations (not step-by-step instructions).

---

3. Simulation Instructions

In OMEdit:

1. Click Check Model
2. Click Simulate
3. Set simulation time:

Start time = 0
Stop time = 5 seconds

---

4. Plot the Following Variables

Plot:

h
v
a

---

5. Expected Results

Acceleration

Constant at:

-9.81 m/s²

Graph is a straight horizontal line.

Velocity

Linearly decreasing over time.

Because:

v = g × time

Graph is straight line with negative slope.

Height

Parabolic curve decreasing over time.

Because:

$h = h0 + 0.5 \times g \times t^2$

Graph is a downward-opening parabola.

---

6. Time to Hit Ground

Object hits ground when:

$h = 0$

From physics:

$t = \text{sqrt}(2h0 / 9.81)$

For $h0 = 100$ m:

$t \approx 4.51$ seconds

You should observe height reaching zero near this time.

---

7. Parameter Modification Results

Case 1: Increase Initial Height

If $h0 = 200$:

- Acceleration remains same
- Velocity profile same slope
- Impact time increases

Because gravity does not change.

Case 2: Change Mass

If m = 10 or m = 100:

• Motion remains identical
• Acceleration unchanged

Reason:

In free fall:

m * a = m * g
Mass cancels → a = g