```
% Name: Saleh Al Alsheikh
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% Date: 5/5/2026
% HW6
% clear;
% clc;
format short g
```

```
% Problem 1
% Gravitational Force
% ==========================

% Given data
G  = 6.672e-11;      % N.m^2/kg^2
m1 = 800;            % satellite mass (kg)
m2 = 5.98e24;        % earth mass (kg)

Re = 6378e3;         % Earth radius in meters
h  = 38000e3;        % orbit height in meters

r = Re + h;          % distance from earth center

% Call function
F = gravForce(m1,m2,r);

fprintf('Problem 1:\n');
```

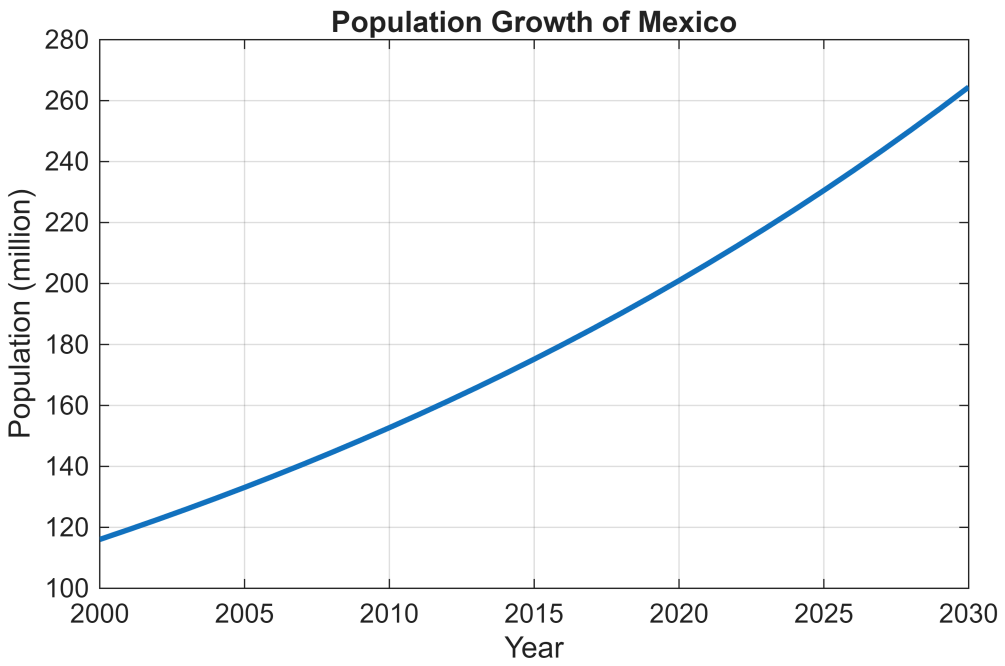
```
Problem 1:
```

```
fprintf('Gravitational Force = %.3e N\n\n',F);
```

```
Gravitational Force = 1.621e+02 N
```

```
%% ==========================
% Problem 2
% Exponential Growth
% ==========================

A0  = 67;      % million
At1 = 79;      % million
t1  = 1986;

t = 2000:2030;

% Call function
At = expGD(A0,At1,t1,t);

% Plot
figure;
```

```
plot(t,At,'LineWidth',2);
grid on;
xlabel('Year');
ylabel('Population (million)');
title('Population Growth of Mexico');
```




```
% Maximum population
[maxPop, idx] = max(At);
maxYear = t(idx);

fprintf('Problem 2:\n');
```

```
Problem 2:
```

```
fprintf('Maximum Population = %.2f million\n',maxPop);
```

```
Maximum Population = 264.45 million
```

```
fprintf('Corresponding Year = %d\n\n',maxYear);
```

```
Corresponding Year = 2030
```

```
%% =========================
% Problem 3
% Thermal Conductivity & Heat Capacity
% =========================

% Constants vectors
c1 = [-1.69e-4 , 9.81e-5 , -3.28e-8 , 0];
c2 = [27.89 , 4.78e-3 , 0 , -13302];
```

```
% Temperature vector
T = 300:50:750;

% Call function
[k,Cp] = property(T,c1,c2);

% Table
Result = table(T',k',Cp',...
    'VariableNames',{'Temperature_K','Conductivity','HeatCapacity'});

disp('Problem 3:');
```

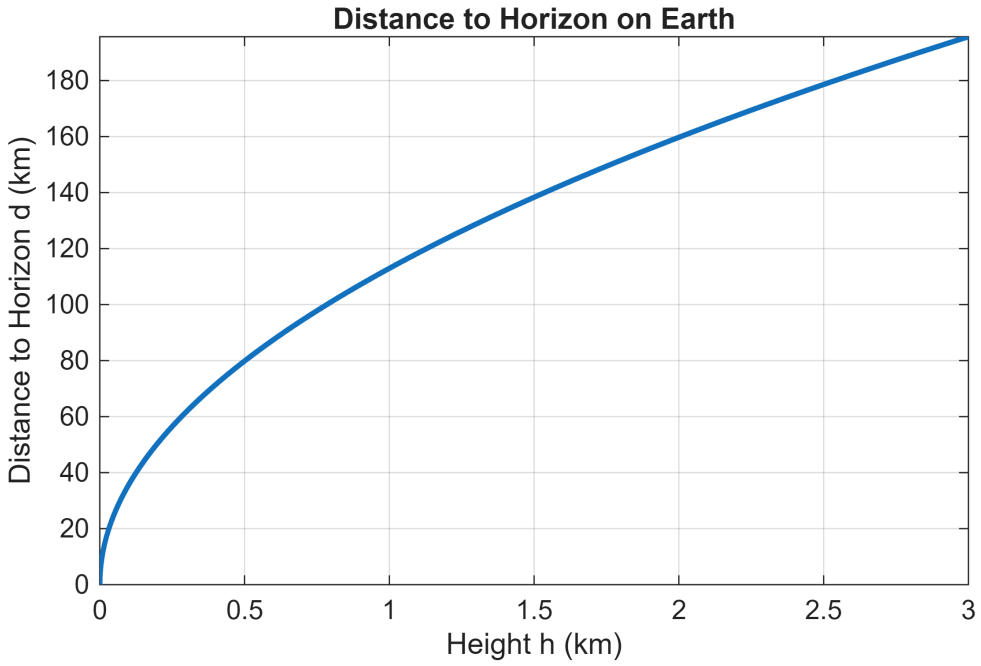
```
Problem 3:
```

```
disp(Result);
```

```
    Temperature_K    Conductivity    HeatCapacity
    _____________    ____________    ____________

        300            0.026309         29.176
        350            0.030148         29.454
        400            0.033823         29.719
        450            0.037334         29.975
        500            0.040681         30.227
        550            0.043864         30.475
        600            0.046883         30.721
        650            0.049738         30.966
        700            0.052429         31.209
        750            0.054956         31.451
```

```
%% =========================
% Problem 4
% Distance to Horizon
% =========================

% Earth and Mars radius
rEarth = 6377.85;
rMars  = 3393.31;

% Function handle
d = @(r,h) sqrt(2*r.*h + h.^2);

% Heights
h = 0:0.5:3;

% Distances
dEarth = d(rEarth,h);
dMars  = d(rMars,h);

% Plot for Earth
figure;
fplot(@(x) d(rEarth,x), [0 3],'LineWidth',2);
grid on;
```

```
xlabel('Height h (km)');
ylabel('Distance to Horizon d (km)');
title('Distance to Horizon on Earth');
```




```
% Distance for h = 1.5 km
d15 = d(rEarth,1.5);

fprintf('Problem 4:\n');
```

```
Problem 4:
```

```
fprintf('Distance to horizon for h = 1.5 km = %.3f km\n\n',d15);
```

```
Distance to horizon for h = 1.5 km = 138.332 km
```

```
% Table
PlanetTable = table(h',dEarth',dMars',...
    'VariableNames',{'Height_km','Earth_d_km','Mars_d_km'});

disp(PlanetTable);
```

Height_km	Earth_d_km	Mars_d_km
0	0	0
0.5	79.863	58.254
1	112.95	82.387
1.5	138.33	100.91
2	159.74	116.52
2.5	178.59	130.28
3	195.64	142.72

```
%% =========================
% Function Definitions
% =========================

function F = gravForce(m1,m2,r)

G = 6.672e-11;
F = (G*m1*m2)/(r^2);

end

% ==================================

function At = expGD(A0,At1,t1,t)

k = log(At1/A0)/(t1-1980);

At = A0 .* exp(k.*(t-1980));

end

% ==================================

function [k,Cp] = property(T,c1,c2)

% Conductivity
a1 = c1(1);
b1 = c1(2);
c_1 = c1(3);
d1 = c1(4);

k = a1 + b1.*T + c_1.*T.^2 + d1./(T.^2);

% Heat capacity
a2 = c2(1);
b2 = c2(2);
c_2 = c2(3);
d2 = c2(4);

Cp = a2 + b2.*T + c_2.*T.^2 + d2./(T.^2);

end
```