Copyright

```
close all; format compact; clc;
fprintf("Engineer: Rodrigo Becerril Ferreyra\n");
fprintf("Company: California State University, Long Beach\n");
fprintf("Project Name: Exam 1\n");
fprintf("Date: 01 October 2020\n");
```

```
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```
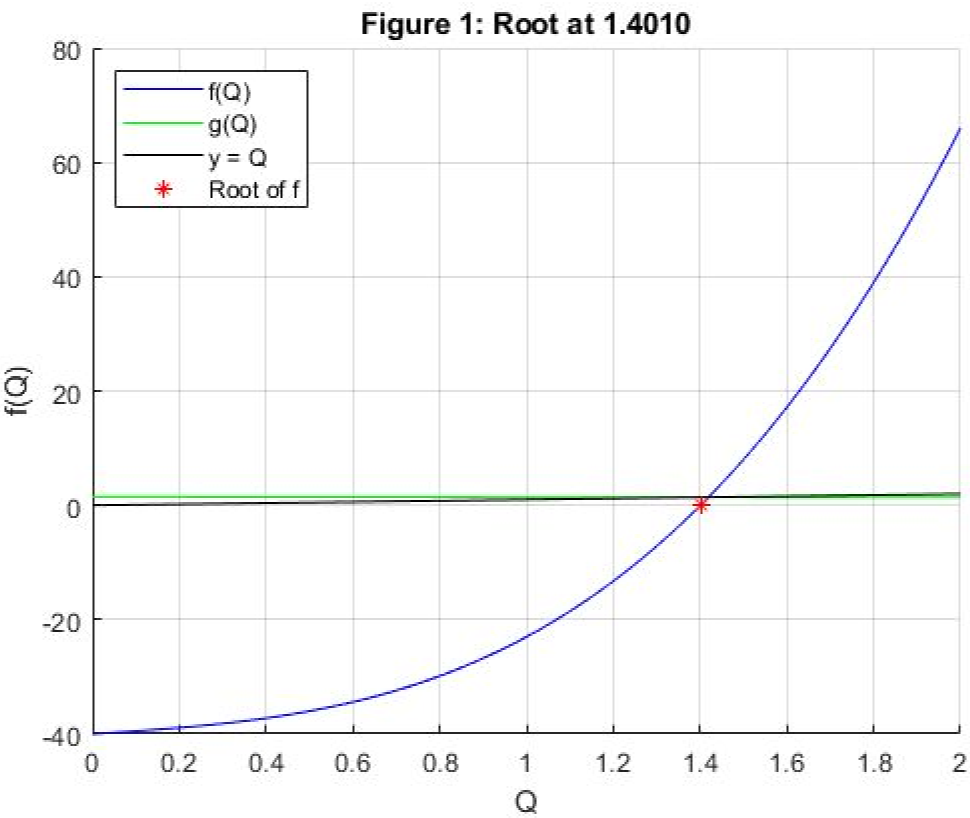

Problem 1

Fixed point method

```
clear variables;
fprintf("\nProblem 1\n");

% Root finding
f = @(Q) 12.*Q.^3 + 5.*Q - 40;
g = @(Q) ((40 - 5.*Q)./12).^(1/3);

iters = 25; x = 0;
last_x = x; x = g(x);

fprintf("(%-6s, %-6s) %s\n", "x", "g(x)", "Iteration");
fprintf("(%6.4f, %6.4f) %d\n", last_x, x, 25 - iters);
while (abs(last_x - x) >= 1e-4) && (iters > 0) % If one fails, it exits
    last_x = x; x = g(x);
    iters = iters - 1;
    fprintf("(%6.4f, %6.4f) %d\n", last_x, x, 25 - iters);
end

% Plotting
figure(); hold on;
Q = linspace(0, 2, 101);
f_Q = f(Q);
g_Q = g(Q);
y = Q;

plot(Q, f_Q, 'b-', Q, g_Q, 'g-', Q, y, 'k-', x, f(x), 'r*');
grid on;
legend("f(Q)", "g(Q)", "y = Q", "Root of f", "Location", "northwest");
title(sprintf("Figure 1: Root at %6.4f", x));
xlabel("Q"); ylabel("f(Q)");
hold off;
```

```
Problem 1
(x      , g(x)   ) Iteration
(0.0000, 1.4938) 0
(1.4938, 1.3944) 1
(1.3944, 1.4014) 2
(1.4014, 1.4009) 3
(1.4009, 1.4010) 4
```



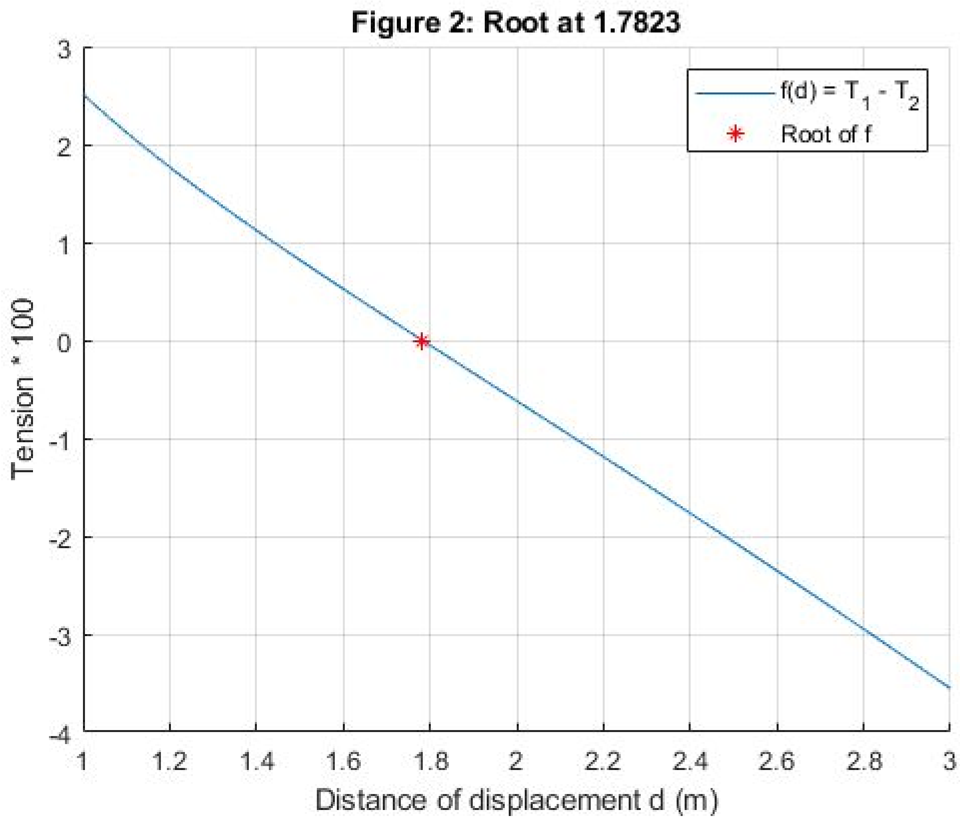
Problem 2

Bisection method

```
clear variables;
fprintf("\nProblem 2\n");

% Root finding
f = @(d) ((100.*sqrt(9 + d.^2))./d) - (400.*(sqrt(9 + d.^2) - 3));
a = 1; b = 3;
c = (a + b)/2; last_c = c + 1; % this is so that the loop runs at least once
iters = 25;
fprintf("%-6c %-6c %-6c Iterations\n", 'a', 'b', 'c');
while (abs(last_c - c) >= 1e-4) && (iters > 0)

    last_c = c;

    switch(sign(f(c)*f(a)))
        case 1
            a = c;
        case -1
            b = c;
    end

    c = (a + b)/2;
    fprintf("%6.4f %6.4f %6.4f %d\n", a, b, c, 25-iters);
    iters = iters - 1;

end

% Plotting
figure(); hold on;
d = linspace(1, 3, 101);
f_d = f(d);
plot(d, f_d./100);
plot(c, f(c)/100, 'r*');
grid on;
xlabel("Distance of displacement d (m)");
ylabel("Tension * 100");
title(sprintf("Figure 2: Root at %6.4f", c));
legend("f(d) = T_1 - T_2", "Root of f");
hold off;
```

Problem 2

a	b	c	Iterations
1.0000	2.0000	1.5000	0
1.5000	2.0000	1.7500	1
1.7500	2.0000	1.8750	2
1.7500	1.8750	1.8125	3
1.7500	1.8125	1.7813	4
1.7813	1.8125	1.7969	5
1.7813	1.7969	1.7891	6
1.7813	1.7891	1.7852	7
1.7813	1.7852	1.7832	8
1.7813	1.7832	1.7822	9
1.7822	1.7832	1.7827	10
1.7822	1.7827	1.7825	11
1.7822	1.7825	1.7823	12
1.7822	1.7823	1.7823	13

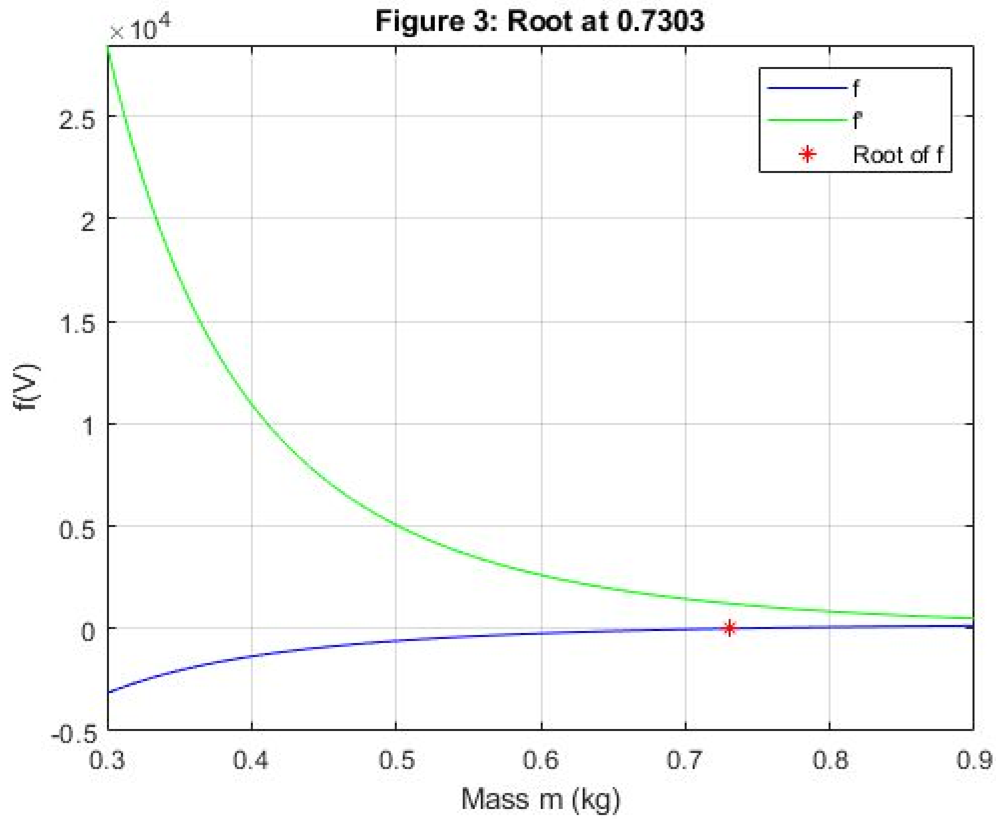


Problem 3

Newton--Raphson method

```
clear variables;
fprintf("\nProblem 3\n");

% Root finding
P = 1; R = 0.0820; m = 22.415; a = 1.36; b = 0.0318; n = 1; T = 273;
f  = @(V) (P + (m.^2 * a)./(V.^2)).*(V - m*b) - n*R*T;
fp = @(V) (P.*V.^3 - a*m^2.*V + 2*a*b*m^3)./(V.^3);

x = 0.4;
last_x = x; x = x - f(x)/fp(x);

iters = 25;

fprintf("(%-6s, %-6s) %s\n", "x(n-1)", "x(n)", "Iteration");
fprintf("(%6.4f, %6.4f) %d\n", last_x, x, 25 - iters);
while (abs(last_x - x) >= 1e-4) && (iters > 0)
    last_x = x; x = x - f(x)/fp(x);
    iters = iters - 1;
    fprintf("(%6.4f, %6.4f) %d\n", last_x, x, 25 - iters);
end

% Graphing
domain = linspace(0.3, 0.9, 101);
figure(); plot(domain, f(domain), 'b-', domain, fp(domain), 'g-', x, f(x),
'r*');
grid on; legend("f", "f'", "Root of f", "Location", "northeast");
xlabel("Mass m (kg)"); title(sprintf("Figure 3: Root at %6.4f", x));
ylabel("f(V)");
axis([0.3, 0.9, -0.5e4, fp(0.3)]);
```

```
Problem 3
(x(n-1), x(n)   ) Iteration
(0.4000, 0.5241) 0
(0.5241, 0.6390) 1
(0.6390, 0.7098) 2
(0.7098, 0.7291) 3
(0.7291, 0.7303) 4
(0.7303, 0.7303) 5
```

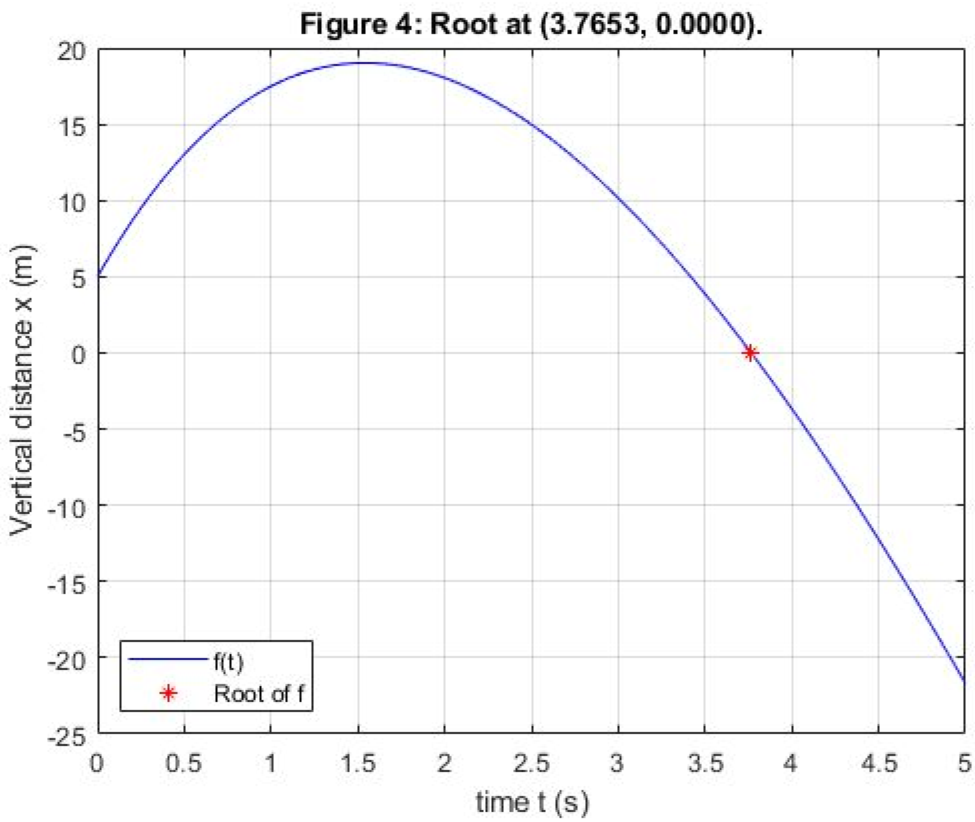


Problem 4

Secant method

```
clear variables;
fprintf("\nProblem 4\n");

% Root finding
p = 0.35; x0 = 5; v0 = 20; vr = 9.8/p;
f = @(t) (1/p) * (v0 + vr) .* (1 - exp(-p.*t)) - vr.*t + x0;

x0 = 2; x1 = 2.5;
x = x1 - f(x1)*((x1 - x0)/(f(x1) - f(x0)));

fprintf("%-6s %-6s %-6s %s\n", "x_root", "x1", "x0", "Iteration");
fprintf("%6.4f %6.4f %6.4f\n", x, x1, x0);

iters = 25;
while (abs(x - x1) >= 1e-4) && (iters > 0)
    x0 = x1; x1 = x;
    x = x1 - f(x1)*((x1 - x0)/(f(x1) - f(x0)));
    iters = iters - 1;
    fprintf("%6.4f %6.4f %6.4f %d\n", x, x1, x0, 25 - iters);
end

% Graphing
domain = linspace(0, 5, 101);
figure(); plot(domain, f(domain), 'b-', x, f(x), 'r*');
grid on; legend("f(t)", "Root of f", "Location", "southwest");
xlabel("time t (s)"); ylabel("Vertical distance x (m)");
title(sprintf("Figure 4: Root at (%6.4f, %6.4f).", x, f(x)));
```

```
Problem 4
x_root x1     x0     Iteration
4.9414 2.5000 2.0000
3.5293 4.9414 2.5000 1
3.7322 3.5293 4.9414 2
3.7666 3.7322 3.5293 3
3.7653 3.7666 3.7322 4
3.7653 3.7653 3.7666 5
```

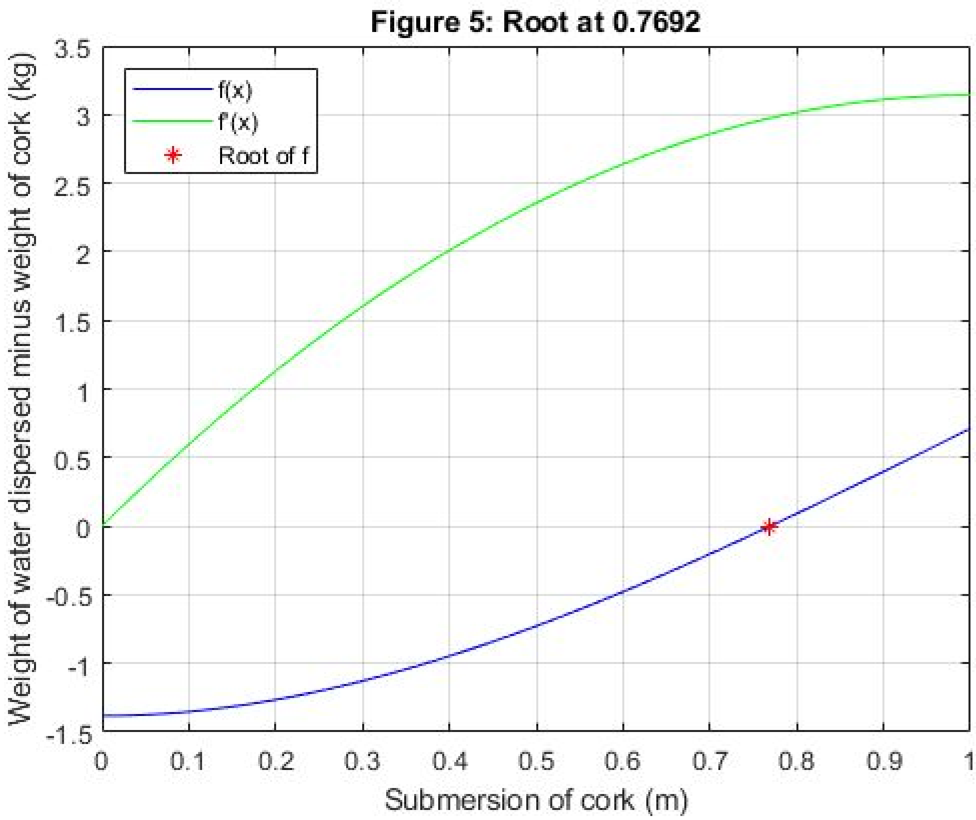


Problem 5

Newton--Raphson method

```
clear variables;
fprintf("\nProblem 5\n");

% Root finding
R = 1; p = 0.33;
f = @(x) (pi.*x.*(3.*(R^2 - (R - x).^2) + x.^2)./6) - (4/3 * pi * R^3 * p);
fp = @(x) -pi.*x.*(x - 2*R);

x = 0.75;
last_x = x; x = x - (f(x)/fp(x));

iters = 25;
fprintf("(%-6s, %-6s) %s\n", "x(n-1)", "x(n)", "Iteration");
fprintf("(%6.4f, %6.4f) %d\n", last_x, x, 25 - iters);

while (abs(x - last_x) >= 1e-4) && (iters > 0)
    last_x = x; x = x - (f(x)/fp(x));
    iters = iters - 1;
    fprintf("(%6.4f, %6.4f) %d\n", last_x, x, 25 - iters);
end

% Graphing
domain = linspace(0, 1, 101);
figure(); plot(domain, f(domain), 'b-', domain, fp(domain), 'g-', x, f(x),
'r*');
grid on;
xlabel("Submersion of cork (m)");
ylabel("Weight of water dispersed minus weight of cork (kg)");
title(sprintf("Figure 5: Root at %6.4f", x));
legend("f(x)", "f'(x)", "Root of f", "Location", "northwest");
```

```
Problem 5
(x(n-1), x(n)  ) Iteration
(0.7500, 0.7693) 0
(0.7693, 0.7692) 1
```



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