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```
clc

f_test = @(x) 5*x.^4 - 8*x.^3;
a = -5;
b = 9.25;

% Calculate the answer using Gauss-Legendre Quadrature (5 points)
GQ_Ans = GaussQuad(f_test, a, b, 5);
fprintf('%.7e\n', GQ_Ans);

% Calculate the absolute error between the exact answer and Gauss-Legendre result
error = abs(exa_Ans - GQ_Ans);
fprintf('\nAbsolute Error\n%.7e\n\n', error);

% Evaluate over entier interval at once
a_0 = 0;
b_0 = pi/2;
Ans_full_int = GaussQuad(@pendulum, a_0, b_0, 5);
fprintf('[0,pi/2]\n%.10f\n\n',Ans_full_int )

% First Interval
a_1 = 0;
b_1 = pi/4;
Ans_first_int = GaussQuad(@pendulum, a_1, b_1, 5);

% Second Interval
a_2 = pi/4;
b_2 = pi/2;
Ans_second_int = GaussQuad(@pendulum, a_2, b_2, 5);

GQ_Ans_full = Ans_first_int + Ans_second_int;

% evaluate over two separate intervals then add
GQ_Ans_full = Ans_first_int + Ans_second_int;
fprintf('[0,pi/4] + [pi/4,pi/2]\n%.10f\n', GQ_Ans_full);

function [y] = pendulum(x)
    g = 9.81;
    Theta_0 = pi/8;
    L = 7.5;
    k = sin(0.5 * Theta_0);
    y = (4 * sqrt(L / g)) ./ (sqrt(1 - (k^2) * (sin(x)).^2));
end
```

```
function [val] = GaussQuad(f, a, b, num_points)
    if num_points == 2
        % 2 point Gauss
        fprintf('using 2 points Gauss Quad\n')
        w = ones(2,1);

        % gauss points (for 2-point Gauss-Legendre quadrature)
        xi = zeros(2,1);
        xi(1) = 1 / sqrt(3);
        xi(2) = -xi(1);

    elseif num_points == 5
        % 5 point Gauss
        fprintf('using 5 points Gauss Quad\n')

        % weights (based on the provided table in the question)
        w = zeros(5,1);
        w(1) = 0.236926885056189;
        w(2) = 0.478628670499366;
        w(3) = 0.568888888888889;
        w(4) = 0.478628670499366;
        w(5) = 0.236926885056189;

        % gauss points (based on the provided table in the question)
        xi = zeros(5,1);
        xi(1) = 0.906179845938664;
        xi(2) = 0.538469310105683;
        xi(3) = 0.000000000000000;
        xi(4) = -0.538469310105683;
        xi(5) = -0.906179845938664;

    else
        fprintf('Did not enter 2 or 5\n')
        return;
    end

    % Transformation of the interval [a,b] to [-1, 1]
    J = (b - a) / 2;
    x = J * xi + (b + a) / 2;

    % Evaluate the integral using the Gauss-Legendre quadrature
    val = J * sum(w .* f(x));
end
```

```
using 5 points Gauss Quad
5.7451825e+04

Absolute Error
2.9103830e-11

using 5 points Gauss Quad
[0,pi/2]
5.5472636613

using 5 points Gauss Quad
using 5 points Gauss Quad
```

```
[0,pi/4] + [pi/4,pi/2]
5.5472636729
```

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