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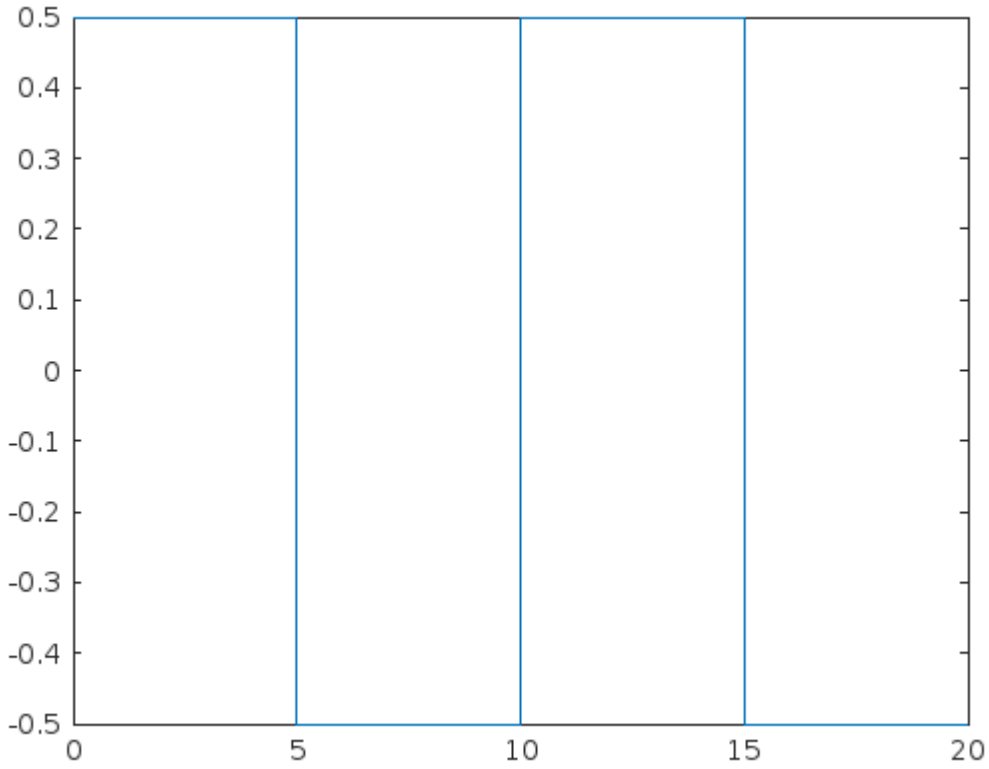
Question A)

```
[ time_pos , sq_wave , B_unnorm ] = generate_data;

% Plot
plot(time_pos, sq_wave)
```

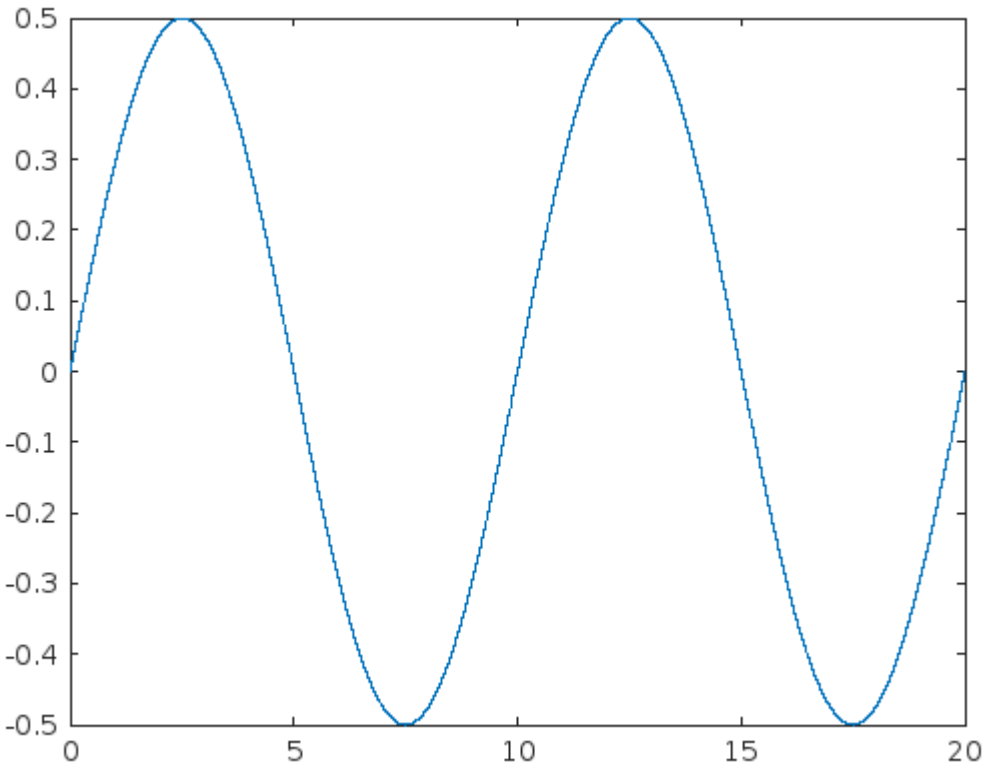


Question B)

To test the orthoganality of the basis vectors, I would multiply the two functions in a dot product. However since they are functions I would be taking the integral of the two functions multilpied. But since the functions are actually

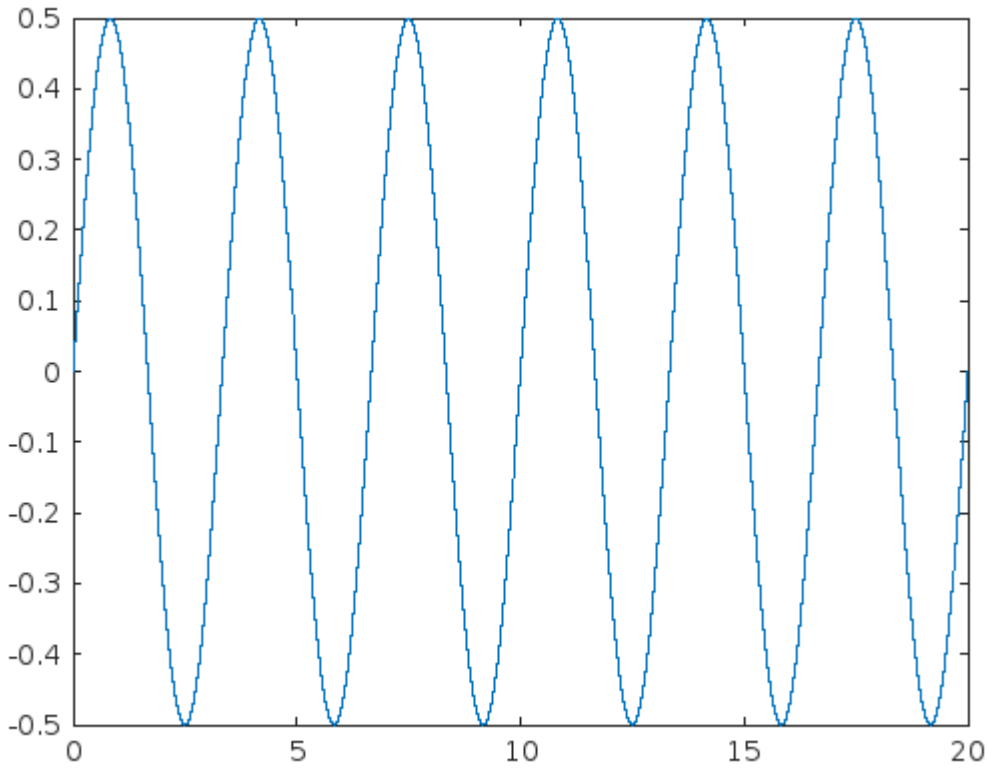
```
disp('B1')
plot(time_pos, B_unnorm(1,:))
```

B1



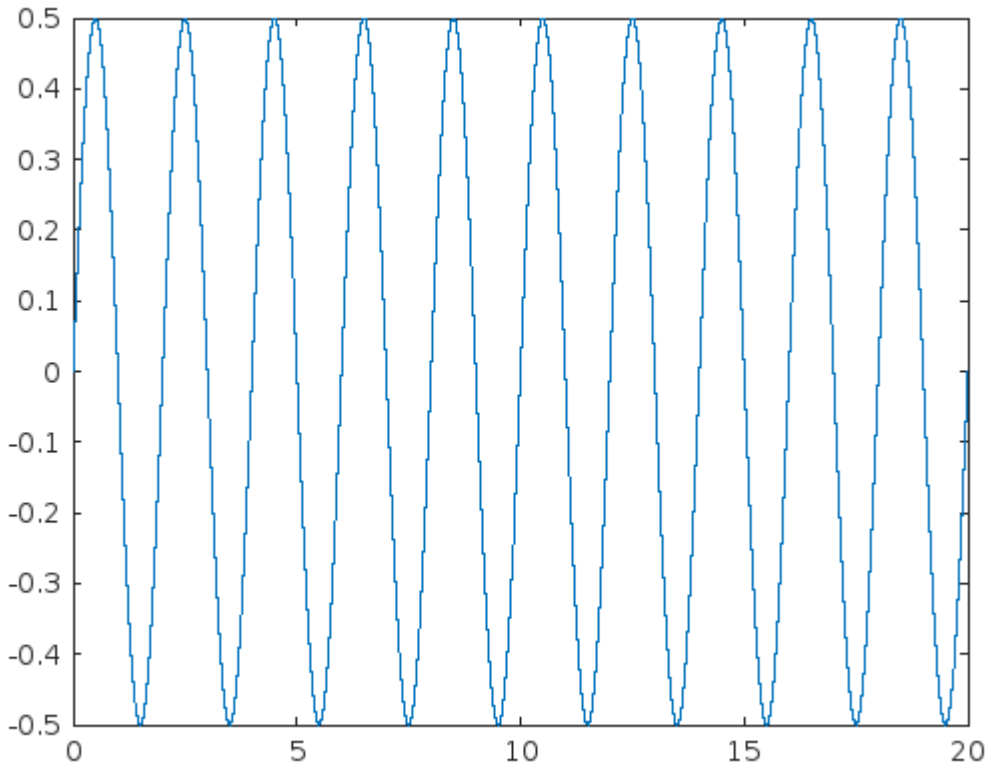

```
disp('B2')
plot(time_pos, B_unnorm(2,:))
```

B2



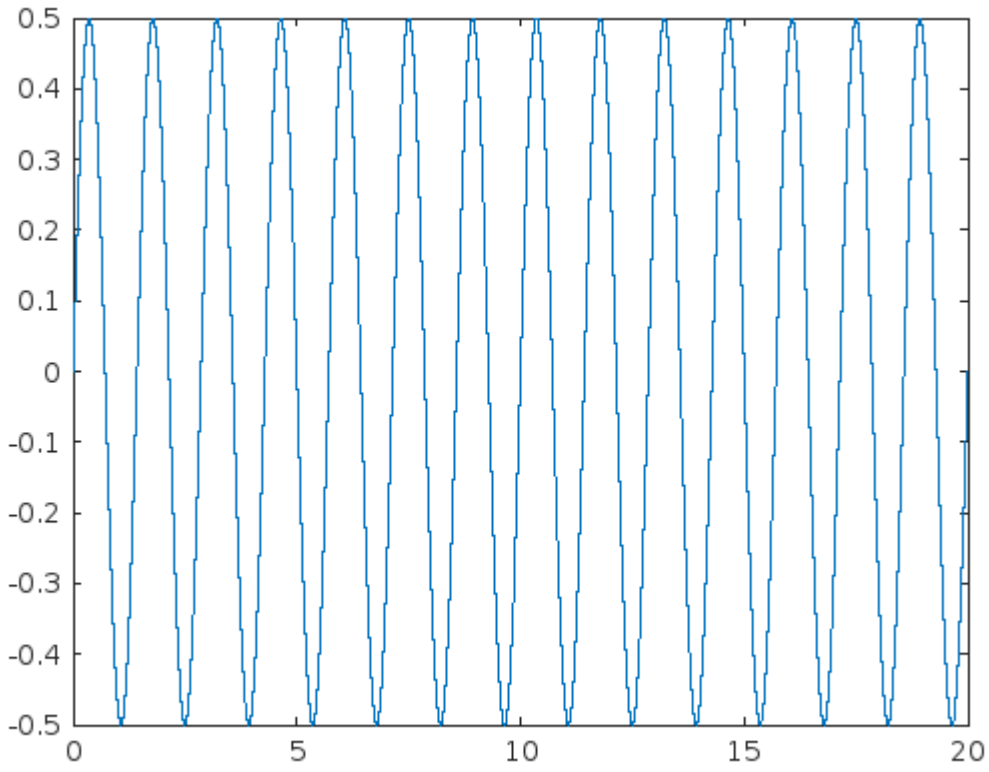

```
disp('B3')
plot(time_pos, B_unnorm(3,:))
```

B3



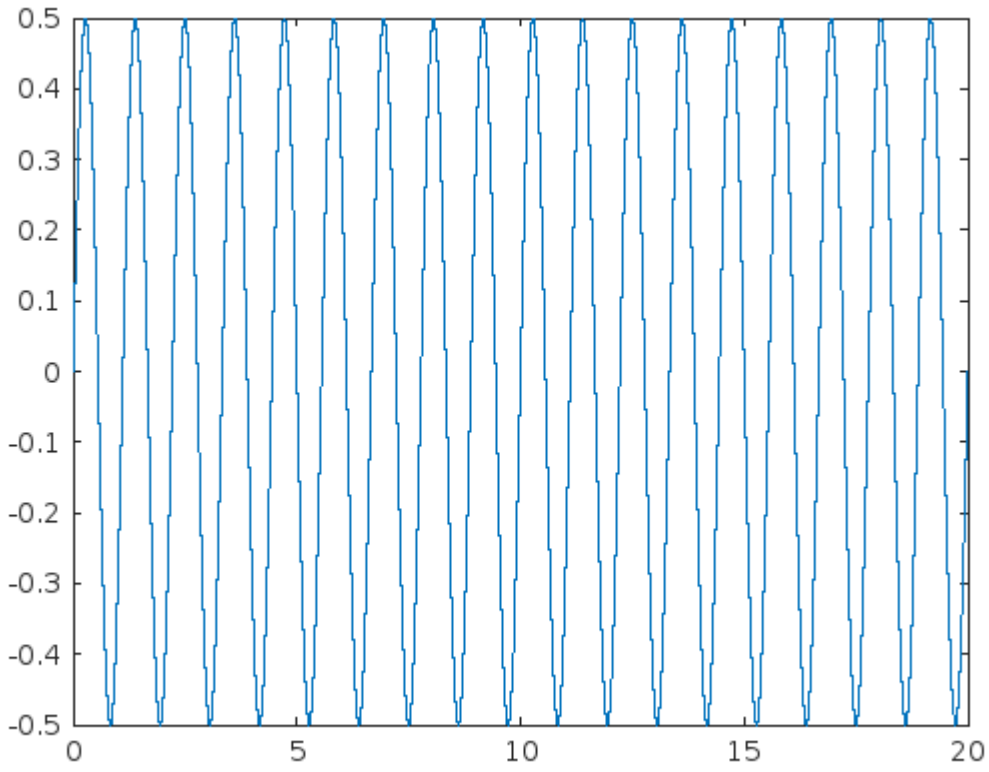

```
disp('B4')
plot(time_pos, B_unnorm(4,:))
```

B4



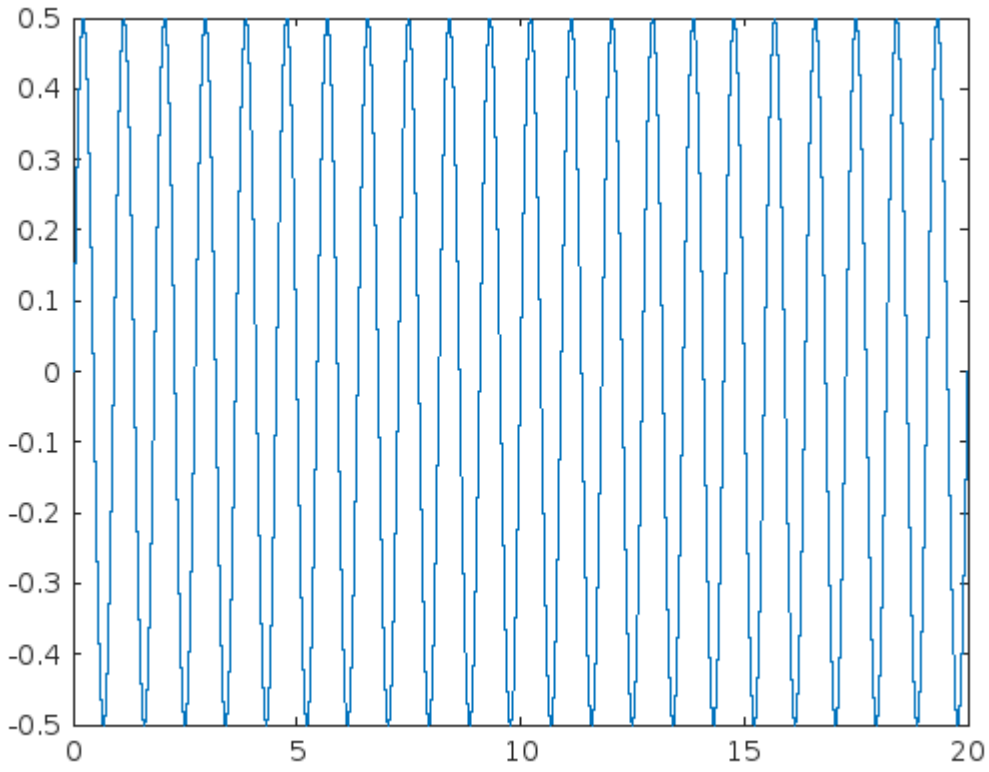

```
disp('B5')
plot(time_pos, B_unnorm(5,:))
```

B5




```
disp('B6')
plot(time_pos, B_unnorm(6,:))
```

B6



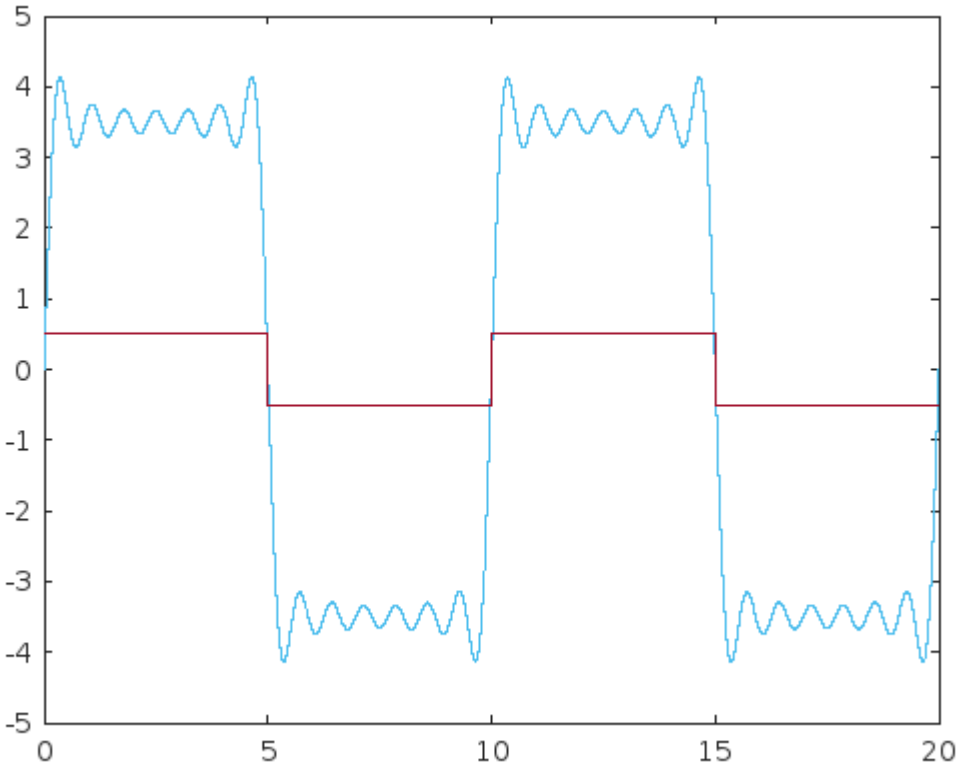
Question C)

Orthonormal Basis

```
B_norm = zeros(30,200001);
for i = 1:30
    B_norm(i,:) = B_unnorm(i,:)./(sqrt(sum(B_unnorm(i,:).^2)));
end

% l2 Projection
proj = zeros(30,200001);
for i = 1:30
    proj(i,:) = sum(sq_wave.*(B_norm(i,:))) .* B_norm(i,:);
end

plot(time_pos, proj(1,:));
plot(time_pos, proj(2,:));
plot(time_pos, proj(3,:));
plot(time_pos, proj(4,:));
plot(time_pos, proj(5,:));
plot(time_pos, proj(6,:));
plot(time_pos, proj(30,:));

for i = 1:7
    projection = projection + proj(i,:);
```

```
end

disp("With " + 7 + " Basis Vectors")
plot(time_pos, projection, time_pos,sq_wave)

function [ time_pos , sq_wave , B_unnorm ] = generate_data
    n_comps = 30; period = 10; fundFreq = 1/ period ;
    time_pos = 0:0.0001:2* period ; harmonics = 2*(1: n_comps ) -1;
    sq_wave = floor (0.9* sin (2* pi * fundFreq * time_pos ) ) +.5; % %
generate the signal
    B_unnorm = sin (2* pi * fundFreq *( harmonics .' * time_pos ) ) /2; % %
generate the basis
end
```

With 7 Basis Vectors



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