3.2.1 Write as many different ODEs, and their general solutions, as you can.

Question 3.2.1:
Consider the differential equation $\frac{dy}{dx} = -2x$. Use Euler's method to approximate the value of y at $x = 2$, given that $y(0) = 3$. Use a step size of 0.5.

Solution:
Code:

```
dydt = @(x, y) -2 * x;

x0 = 0;
y0 = 3;
h = 0.5;

x_euler = x0:h:2;
n = numel(x_euler);
y_euler = zeros(1, n);
y_euler(1) = y0;

fprintf('Question 3.2.1:\n');
fprintf('Step\tx\t\t\t\ty\n');

for i = 2:n
    y_euler(i) = y_euler(i-1) + h * dydt(x_euler(i-1),
        y_euler(i-1));
    fprintf('%d\t%.2f\t\t\t%.4f\n', i-1, x_euler(i-1),
        y_euler(i-1));
end

fprintf('%d\t%.2f\t\t\t%.4f\n\n', n, x_euler(n),
   y_euler(n));

figure;
plot(x_euler, y_euler, '-o');
xlabel('x');
ylabel('y');
title('Question 3.2.1');
grid on;
hold on;
```

1

The approximate values of y at different steps are as follows:

Step	x	y
0	0.00	3.0000
1	0.50	3.0000
2	1.00	2.5000
3	1.50	1.5000
4	2.00	0.0000

The plot of the approximation using Euler's method is shown below:

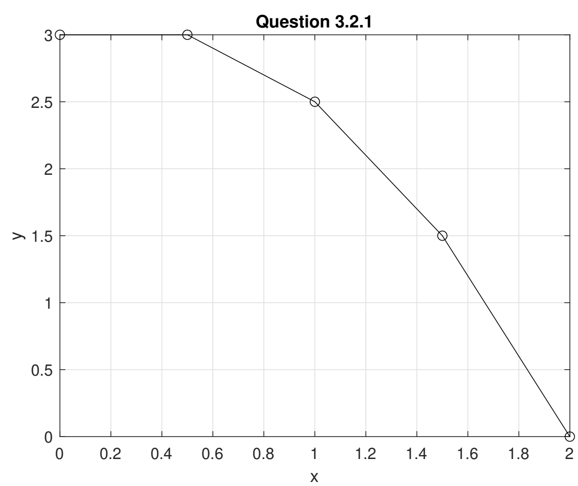

Figure 1: Graphical solution of 3.2.1