

(* Ryan White s44990392, MATH2100 Assignment 1, Semester 2 2020, Tutorial 7 *)

(* Problem 1 *)

(* Part 1 *)

$(23^2 - 3(117 - 42)^2) / ((7^4 - 5^2)^{1/2})$

$$\text{Out[*]} = -\frac{743 \sqrt{\frac{11}{6}}}{3}$$

In[*]:= NumberForm[N[%86], 4]

Out[*]/NumberForm=

-335.3

In[*]:= (* Part 2 *)

Cos[319 Pi / 12]

$$\text{Out[*]} = -\frac{-1 + \sqrt{3}}{2\sqrt{2}}$$

In[*]:= NumberForm[N[%87], 4]

Out[*]/NumberForm=

-0.2588

In[*]:=

(* Problem 2 *)

(* Part 1 *)

Simplify[Log[2 * E^5]]

$$\text{Out[*]} = 5 + \text{Log}[2]$$

In[*]:= (*Part2*)

Simplify[1 + Cos[2 x]]

$$\text{Out[*]} = 2 \cos^2[x]$$

In[*]:= (*Part 3*)

Simplify[(x^2 - 2 x - 8) / (x^3 - x^2 - 6 x)]

$$\text{Out[*]} = \frac{-4 + x}{(-3 + x)x}$$

(*Problem 3*)

(*Part 1*)

Factor[-680 - 714 x + 34 x^3]

$$\text{Out[*]} = 34(-5 + x)(1 + x)(4 + x)$$

In[*]:= (*Part 2*)

Factor[12 x^6 - 56 x^5 + 100 x^4 - 80 x^3 + 20 x^2 + 8 x - 4]

$$\text{Out[*]} = 4(-1 + x)^5(1 + 3x)$$

In[]:=

```
(*Problem 4*)
f[x_] := Cos[4 x] + 2 Tan[x]
g[x_] := 3 Sin[x] - Cos[2 x]
h[x_] := f[x] + g[x]
h[Pi]
```

Out[]= 0

```
(*Problem 5*)
ClearAll
```

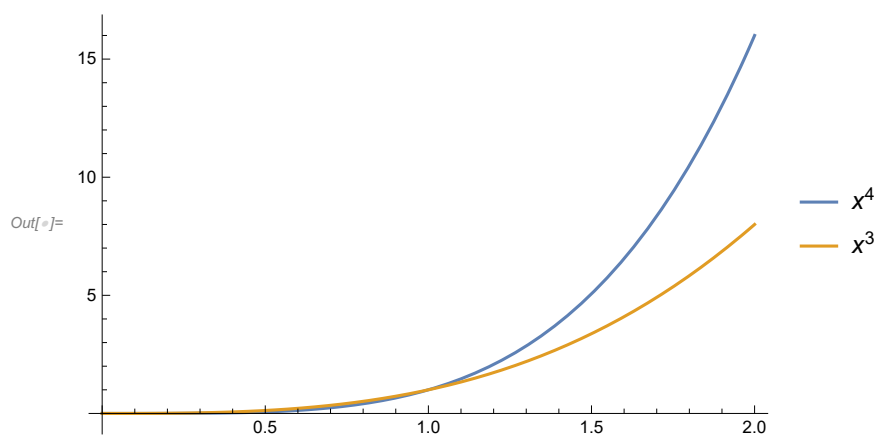
In[]:=

```
f[x_] := x - 3 + x^2
h[x_] := x^2 - 1
Simplify[h[f[h[x]]]]
```

Out[]= $-1 + (3 + x^2 - x^4)^2$

In[]:=

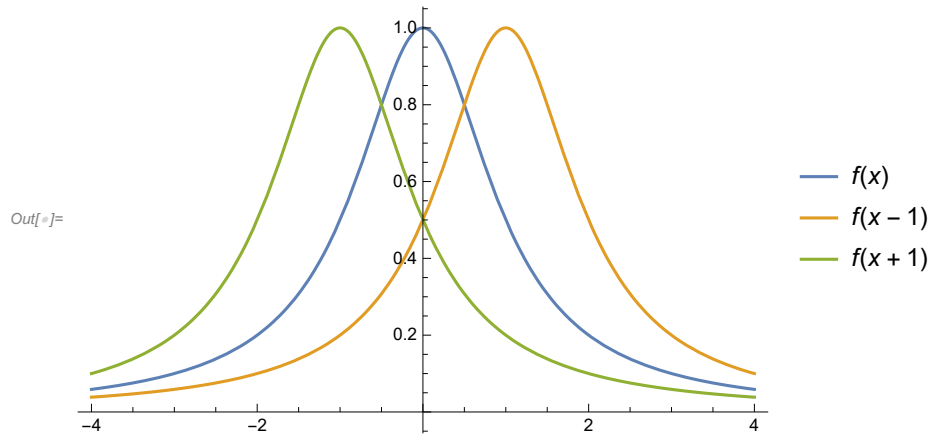
```
(*Problem 6*)
Plot[{x^4, x^3}, {x, 0, 2}, PlotLegends → "Expressions"]
```



In[]:=

```
(*Problem 7*)
ClearAll
f[x_] := 1 / (1 + x^2)
Show[Plot[{f[x], f[x - 1], f[x + 1]},
  {x, -4, 4}, PlotLegends -> "Expressions"], PlotRange -> All]
```

Out[]:= ClearAll



In[]:=

```
(*Problem8*)
ClearAll
Solve[x^3 == x + 1, x, Cubics -> True]
```

Out[]:= ClearAll

$$\text{Out[]} = \left\{ \left\{ x \rightarrow \frac{1}{3} \left(\frac{27}{2} - \frac{3\sqrt{69}}{2} \right)^{1/3} + \frac{\left(\frac{1}{2} (9 + \sqrt{69}) \right)^{1/3}}{3^{2/3}} \right\}, \right. \\ \left\{ x \rightarrow -\frac{1}{6} (1 + i\sqrt{3}) \left(\frac{27}{2} - \frac{3\sqrt{69}}{2} \right)^{1/3} - \frac{(1 - i\sqrt{3}) \left(\frac{1}{2} (9 + \sqrt{69}) \right)^{1/3}}{2 \times 3^{2/3}} \right\}, \\ \left. \left\{ x \rightarrow -\frac{1}{6} (1 - i\sqrt{3}) \left(\frac{27}{2} - \frac{3\sqrt{69}}{2} \right)^{1/3} - \frac{(1 + i\sqrt{3}) \left(\frac{1}{2} (9 + \sqrt{69}) \right)^{1/3}}{2 \times 3^{2/3}} \right\} \right\}$$

In[]:= NSolve[x^3 == x + 1, x, Reals]

Out[]:= {{x -> 1.32472}}

In[]:=

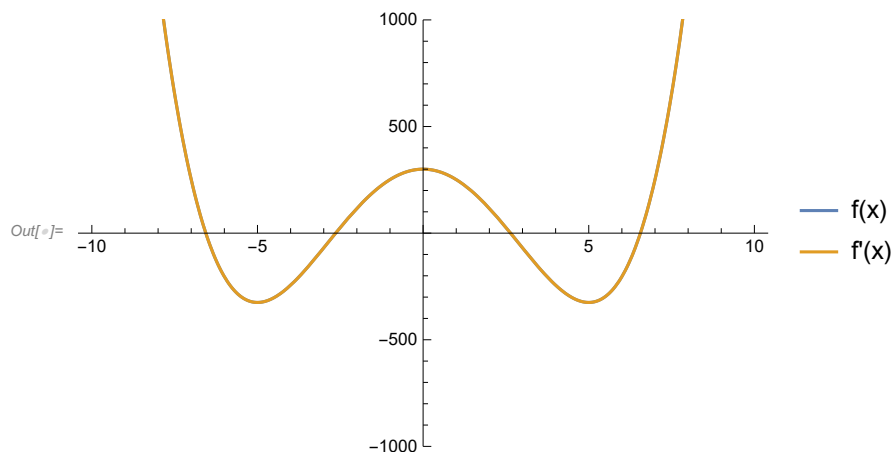
```
(*Problem 9*)
```

In[]:= Solve[{x + y + z == z, x - y + z == 1, x^2 + y^2 + z^2 == 2}]

$$\text{Out[]} = \left\{ \left\{ x \rightarrow \frac{1}{6} (2 - \sqrt{10}), y \rightarrow \frac{1}{6} (-2 + \sqrt{10}), z \rightarrow \frac{1}{3} (1 + \sqrt{10}) \right\}, \right. \\ \left. \left\{ x \rightarrow \frac{1}{6} (2 + \sqrt{10}), y \rightarrow \frac{1}{6} (-2 - \sqrt{10}), z \rightarrow \frac{1}{3} (1 - \sqrt{10}) \right\} \right\}$$

In[]:=

```
(*Problem 10*)
f[x_] := x^4 - 50 x^2 + 300
Plot[{f[x], D[f[x]]}, {x, -10, 10},
  PlotLegends -> {"f(x)", "f'(x)"}, PlotRange -> {-1000, 1000}]
```



In[]:=

```
(*Problem 11*)
ClearAll
f[x_] := 2 x^2
g[x_] := -x^2 + 10
sol = x /. NSolve[f[x] == g[x], x]
```

Out[]:= ClearAll

Out[]:= {-1.82574, 1.82574}

In[]:= Integrate[x^2 + 10, {x, -1.82574, 1.82574}]

Out[]:= 40.572

In[]:= (*Problem 12*)

(*Part 2*)

ClearAll

equ = f3'[x] == x * f3[x]

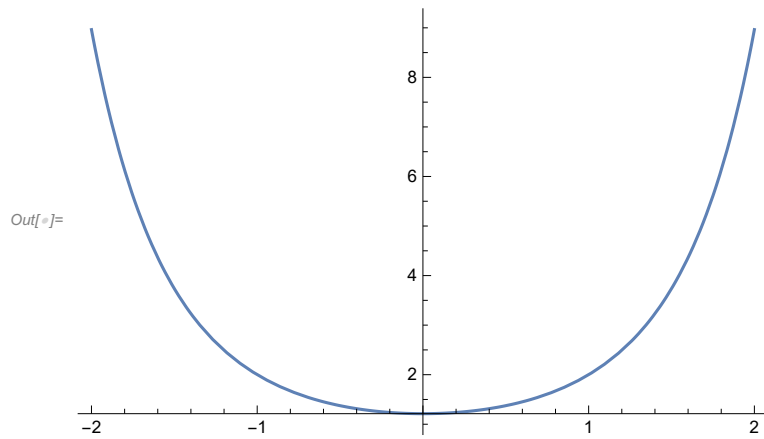
sol = DSolve[{equ, f3[1] == 2}, f3[x], x]

Out[]:= ClearAll

Out[]:= f3'[x] == x f3[x]

Out[]:= $\left\{ \left\{ f3[x] \rightarrow 2 e^{-\frac{1}{2} + \frac{x^2}{2}} \right\} \right\}$

In[]:= Plot[f3[x] /. sol[[1]], {x, -2, 2}]



In[*]:=

(*Problem 13*)

A = {{1, 0, 5}, {6, 2, 0}, {1, 0, 3}}

B = {{0, -2, 5}, {2, -7, 8}, {5, -8, 6}}

MatrixForm[A]

Out[*]= {{1, 0, 5}, {6, 2, 0}, {1, 0, 3}}

Out[*]= {{0, -2, 5}, {2, -7, 8}, {5, -8, 6}}

Out[*]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 5 \\ 6 & 2 & 0 \\ 1 & 0 & 3 \end{pmatrix}$$

In[*]:= **MatrixForm[B]**

Out[*]//MatrixForm=

$$\begin{pmatrix} 0 & -2 & 5 \\ 2 & -7 & 8 \\ 5 & -8 & 6 \end{pmatrix}$$

In[*]:= **Eigenvalues[A]**

Out[*]= $\{2 + \sqrt{6}, 2, 2 - \sqrt{6}\}$

In[*]:= **Eigenvectors[A]**

Out[*]= $\{\{-1 + \sqrt{6}, 6 - \sqrt{6}, 1\}, \{0, 1, 0\}, \{-1 - \sqrt{6}, 6 + \sqrt{6}, 1\}\}$

In[*]:= **Eigenvalues[B]**

Out[*]= $\{-2 + 3i, -2 - 3i, 3\}$

In[*]:= **Eigenvectors[B]**

Out[*]= $\{\{-i, 1 - i, 1\}, \{i, 1 + i, 1\}, \{1, 1, 1\}\}$

... DSolve: $2x^2$ cannot be used as a function.