Mathematica Practical Exercise Set 6

The Mathematica Practical Exercise Sets are optional but they will help you understand Multivariate Calculus and Linear Algebra better and sooner. This exercise set covers Chapter 6 of the course notes.

Plot the line y = (1/2) x+3 and give a parametric plot of the set of points (2 t-4, t+1), where 0 ≤ t ≤ 2.

```
Plot[(1/2) x + 3, {x, -9, 2}, PlotStyle → Black, AspectRatio → {1, 1}]
ParametricPlot[{-4, 1} + t {2, 1}, {t, 0, 2}]
```

Plot the unit circle together with points (1,0) and ((t^2-1)/(t^2+1),-2 t/(t^2+1)) and the line y = t(x-1).

```
Manipulate[A = ContourPlot[x^2 + y^2 == 1, {x, -1, 1}, {y, -1, 1}];
 B = ListPlot[{{1, 0}, {(t^2 - 1) / (t^2 + 1), -2 t / (t^2 + 1)}},
   PlotStyle → {Black, PointSize[0.02]}];
 G = ContourPlot[y == t (x - 1), {x, -1, 1}, {y, -1, 1}];
 Show[A, B, G], {t, -3, 3}]
```

Generate several Pythagorean triples (a,b,c) satisfying $a^2 + b^2 = c^2$ by choosing integer values of t.

```
Table[{t^2 - 1, 2 t, t^2 + 1}, {t, 2, 10}]
```

Plot the parametrization of y = (x - 2)^2.

```
a = -2;
b = 2;
P = {t + 2, t^2};
A = ParametricPlot[P, {t, a, b}, PlotStyle → Black];
B = Graphics[{Arrowheads[0.1],
    Arrow[{P /. {t → a}, P /. {t → a + 0.2}}], Arrow[{P /. {t → b - 0.2}, P /. {t → b}}]}];
Show[A, B]
f = Resultant[P[[1]] - x, P[[2]] - y, t]
```

Plot the parametrized surface (Cos[t] + u, t^2 u, t - u)

```
a = -2;
b = 2;
P = {Cos[t] + u, t^2 u, t - u};
A = ParametricPlot3D[P, {t, a, b}, {u, a, b}, PlotStyle → {Orange, Specularity[White, 10]}]
Show[A, B]
```

Plot the parametrized curve (sin(t), cos(t), t / 10)
in 3 D together with vectors r(t) and r'(t).

```
Manipulate[A = ParametricPlot3D[{Sin[u], Cos[u], u/10}, {u, 0, 20}];
 B = Graphics3D[
   {Red, Arrowheads[0.1], Arrow[Tube[{{0, 0, 0}, {Sin[t], Cos[t], t/10}}, 0.05]]}];
 G = Graphics3D[{Black, Arrowheads[0.05], Arrow[Tube[{{Sin[t], Cos[t], t/10},
       {Sin[t] + 0.2 Cos[t], Cos[t] - 0.2 Sin[t], t/10 - 0.2 * 1/10}}, 0.04]]}];
 Show[
  A,
  B,
  G],
 {t,
  0,
  20}]
```

Plot the parametrized curve $(t - \sin(t), 1 - \cos(t))$.

```
a = -2;
b = 8;
P = {t - Sin[t], 1 - Cos[t]};
A = ParametricPlot[P, {t, a, b}, PlotStyle → Black];
B = Graphics[{Arrowheads[0.1],
    Arrow[{P /. {t → a}, P /. {t → a + 0.2}}], Arrow[{P /. {t → b - 0.2}, P /. {t → b}}]}];
```

Plot the vector field

$F = (x + z, z, x + y)$

together with the parametrized curve

$r(t) = \left(t, t^2, t^3\right)$ in 3D.

In[14]:=
```
A = VectorPlot3D[{x + z, z, x + y}, {x, -1, 1}, {y, -1, 1}, {z, -1, 1}];
B = ParametricPlot3D[{t, t^2, t^3}, {t, 0, 1}, PlotStyle → Black];
Show[A, B]
```

Verify that an integral gives 0.

In[19]:=
```
Integrate[3 t^2 (t^3 - 3 t^2 + 2 t)^2 + 2 t^3 (t^3 - 3 t^2 + 2 t) (3 t^2 - 6 t + 2), {t, 0, 1}]
```