12 June 2013

1 o

i)

In[23]:=
```
<< VectorAnalysis‘;
SetCoordinates[Cartesian[x, y, z]];
Clear[x]; Clear[y]; Clear[z];
F[x_, y_, z_] := {1, 2 y z, y^2};
Print["Curf F =", Curl[F[x, y, z]]]
ϕ[x_, y_, z_] := x + y^2 z
Print["potential ϕ = ", ϕ[x, y, z]]
Print["Linear Integral: ", ϕ[1, 2, -3] - ϕ[-1, 1, 2]]
```

```
Curf F ={0, 0, 0}
potential ϕ = x + y^2 z
Linear Integral: -12
```

ii)

In[31]:=
```
Print["Polynomial y=ax+b"]
Fit[{{1, 0.5}, {1.5, 1.2},
  {1.8, 2} {2.2, -0.3}}, {1, x}, x]
```

```
Polynomial y=ax+b
```

Out[32]= $1.415086 - 0.4868819\,x$

2 o

i)

In[33]:=
```
Integrate[Sqrt[1 + x^2], {y, 0, x}]
Integrate[x Sqrt[1 + x^2], x]
Print["Double Integral: ",
 Integrate[Sqrt[1 + x^2], {x, 0, Sqrt[3]}, {y, 0, x}]]
```

Out[33]= $x\sqrt{1+x^2}$

Out[34]= $\frac{1}{3}\left(1+x^2\right)^{3/2}$

Double Integral: $\frac{7}{3}$

ii)

```
f[x_, y_] := Exp[-x^2 - y^2]
D[f[x, y], x]
D[f[x, y], y]
Solve[{D[f[x, y], x] == 0, D[f[x, y], y] == 0}, {x, y}]
```

$-2\, e^{-x^2-y^2}\, x$

$-2\, e^{-x^2-y^2}\, y$

$\{\{x \to 0, y \to 0\}\}$

```
A = D[D[f[x, y], x], x] /. {x → 0, y → 0}
B = D[D[f[x, y], x], y] /. {x → 0, y → 0}
C1 = D[D[f[x, y], y], y] /. {x → 0, y → 0}
z = A * C1 - B^2
```

-2

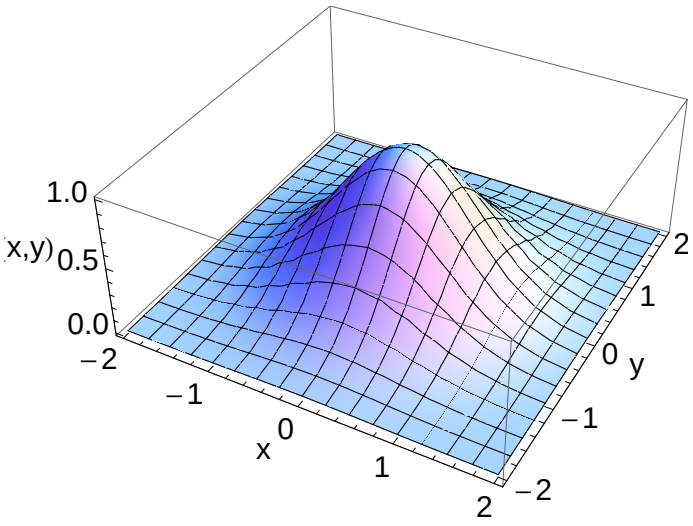
0

-2

4

D > 0 and A < 0 maximum

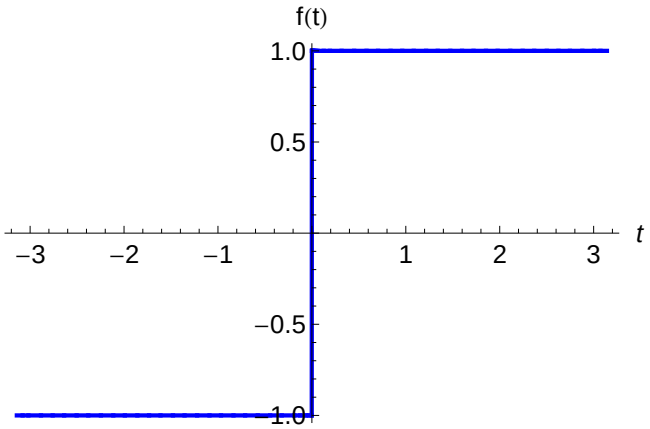
```
Plot3D[f[x, y], {x, -2, 2}, {y, -2, 2},
 AxesLabel → {"x", "y", "f(x,y)  "},
 BaseStyle → {FontFamily → "Arial", FontSize → 14}]
```



3 o

i)

```
fgr =
 Plot[Piecewise[{{ -1, -Pi < t < 0}, {1, 0 < t <  Pi}},
   False → 0], {t, -Pi,  Pi}, PlotStyle → Thick,
  ColorFunction -> Function[Blue],
  AxesLabel → {t, "f(t)"},
  BaseStyle → {FontFamily → "Arial", FontSize → 12}]
```



In[36]:=
```
T = 2 * Pi;
(4 / T) Integrate[Sin[(2 n Pi t) / T], t]
bn = (4 / T) Integrate[Sin[(2 n Pi t) / T], {t, 0, Pi}] /.
  Cos[n Pi] → (-1)^n
Print["b_n = ", bn]
```

Out[37]= $-\frac{2\,\text{Cos}[n\,t]}{n\,\pi}$

Out[38]= $\frac{2\,(1-(-1)^n)}{n\,\pi}$

$b_n = \frac{2\,(1-(-1)^n)}{n\,\pi}$

ii)

In[40]:=
```
LaplaceTransform[1, t, s]
Apart[1 / (s (s^2 + 4))]
Print["g(t) = ",
 InverseLaplaceTransform[1 / (s (s^2 + 4)), s, t]]
```

Out[40]= $\frac{1}{s}$

Out[41]= $\frac{1}{4\,s} - \frac{s}{4\left(4+s^2\right)}$

$g(t) = \frac{1}{4} - \frac{1}{4}\,\text{Cos}[2\,t]$