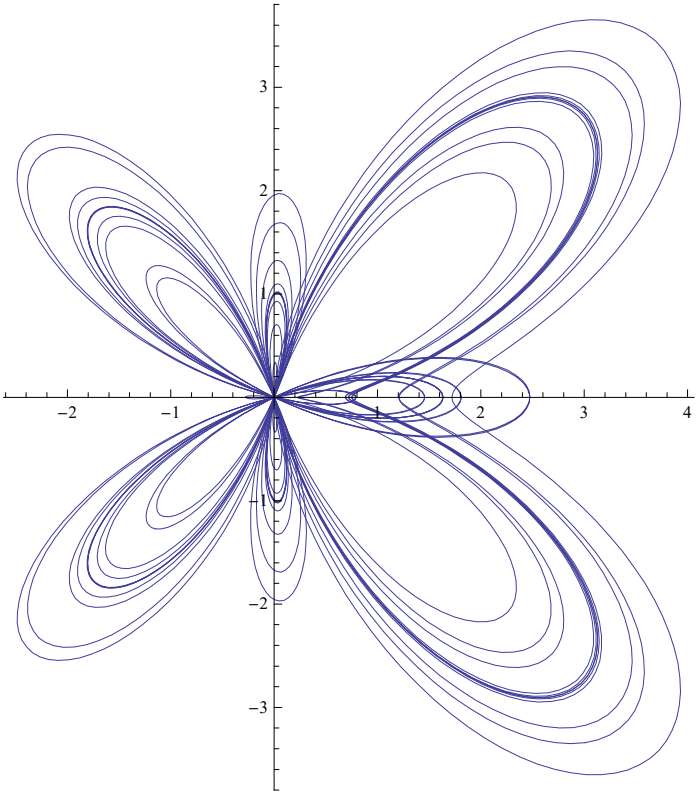
Question 01

```
r = e^Cos[t] - 2 * Cos[4 * t] + Sin[t / 12] ^ 5
```

$$e^{\text{Cos}[t]} - 2\,\text{Cos}[4\,t] + \text{Sin}\left[\frac{t}{12}\right]^5$$

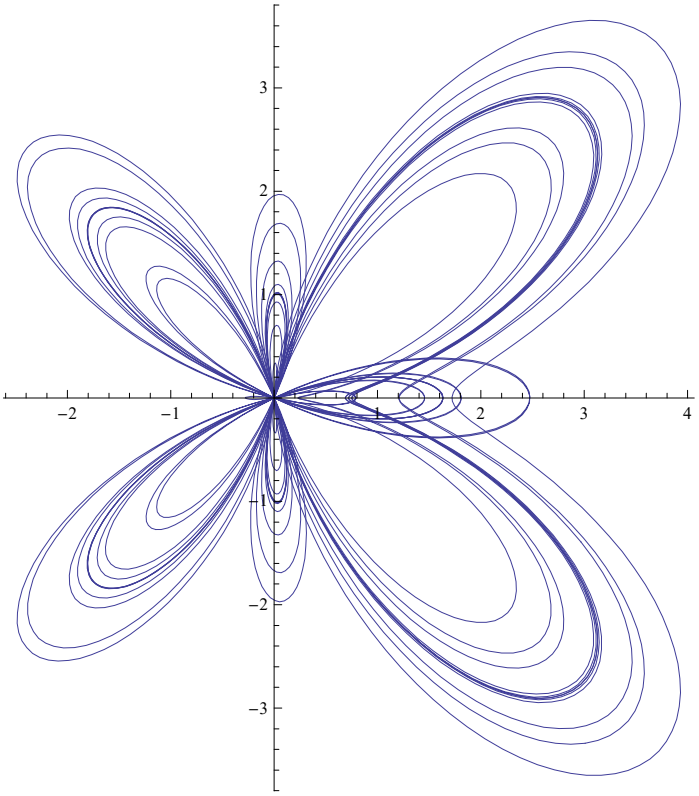
(a) Using polar plot

```
PolarPlot[r, {t, 0, 24 * Pi}]
```



(b) Using ParametricPlot

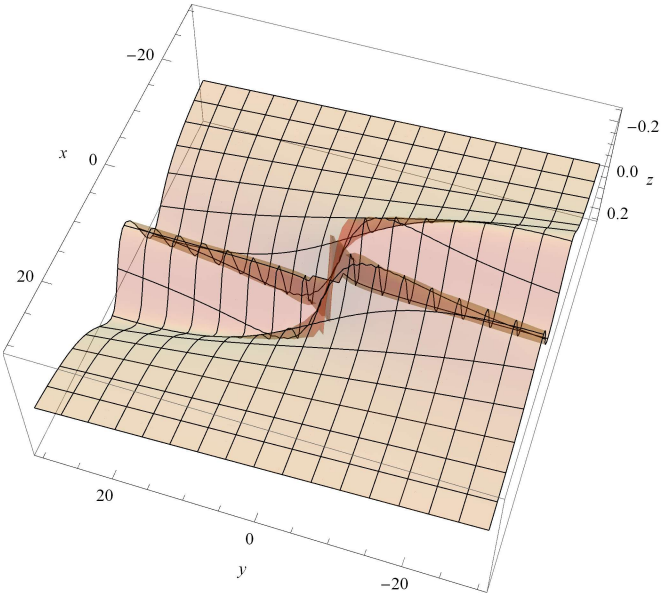
```
ParametricPlot[r {Cos[t], Sin[t]}, {t, 0, 24 * Pi}]
```



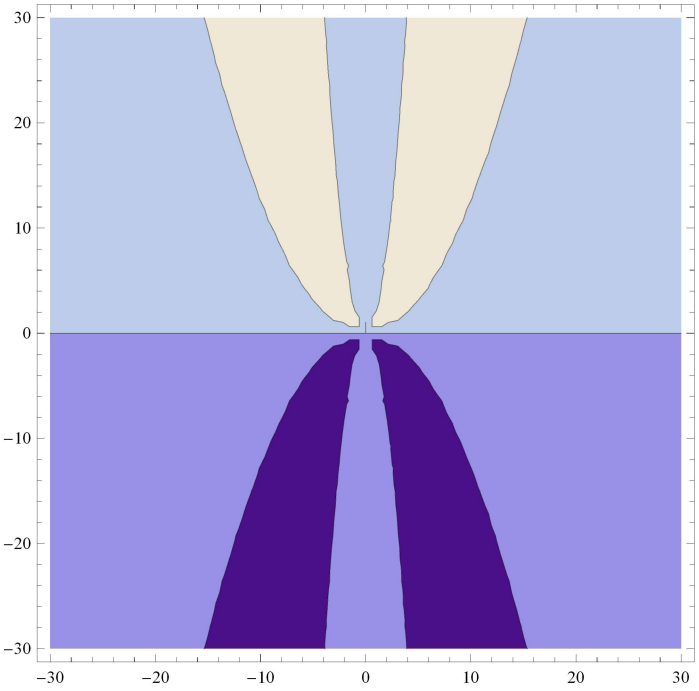
Question 02

$$f[x\_, y\_] := \frac{x^2 * y}{x^4 + 4 * y^2}$$

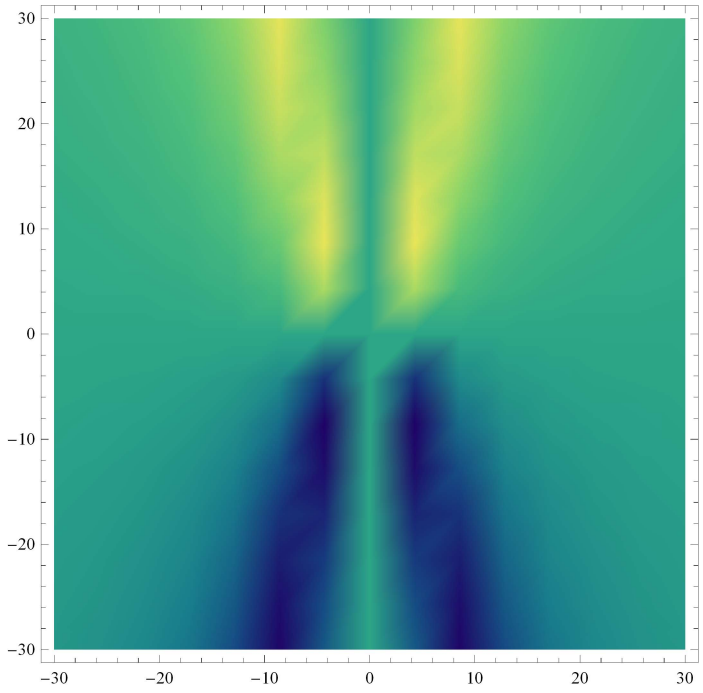
```
Plot3D[f[x, y], {x, -30, 30}, {y, -30, 30},
 Axes → {True, True, True}, AxesLabel → {x, y, z},
 PlotStyle → Directive[Opacity[.25], Orange],
 PlotPoints → 50]
```




```
ContourPlot[f[x, y], {x, -30, 30}, {y, -30, 30}, Contours → 3]
```



```
DensityPlot[f[x, y], {x, -30, 30}, {y, -30, 30}, ColorFunction → "BlueGreenYellow"]
```



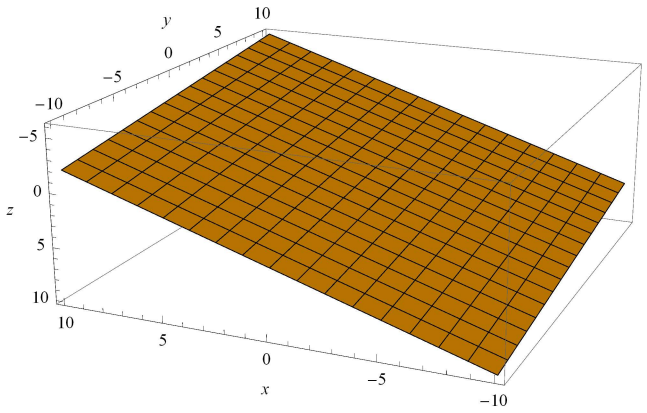
Question 03

```
p = {-2, 1, 3}; n = {3, 1, 5}; r = {x, y, z};
eq1 = (r - p).n == 0
eq = Solve[eq1, z]
res = eq[[1, 1, 2]]
Plot3D[res, {x, -10, 10}, {y, -10, 10},
 AxesLabel → {x, y, z}, PlotStyle → Orange, PlotPoints → 200]
```

$$-1 + 3\,(2 + x) + y + 5\,(-3 + z) == 0$$

$$\left\{\left\{z \to \frac{1}{5}\,(10 - 3\,x - y)\right\}\right\}$$

$$\frac{1}{5}\,(10 - 3\,x - y)$$



Question 04

ClearAll[“Global`*”]

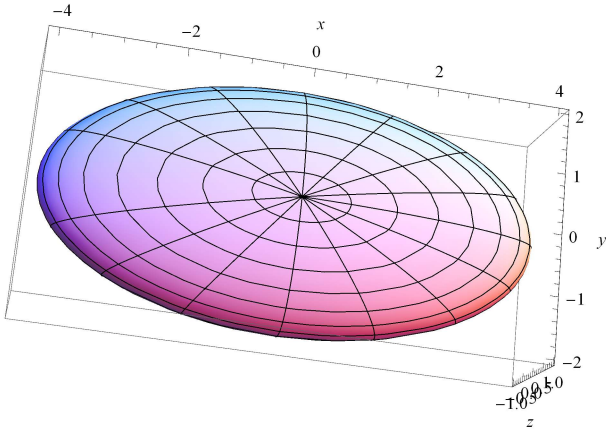
```
ClearAll
```

$$\mathbf{eq1 = \frac{x\hat{}2}{16} + \frac{y\hat{}2}{4} + z\hat{}2 == 1}$$

$$\frac{x^2}{16} + \frac{y^2}{4} + z^2 == 1$$

(i)ParametricPlot3D

```
ParametricPlot3D[{4 * Cos[t] * Cos[r], 2 * Cos[t] * Sin[r], Sin[t]},
 {t, -Pi / 2, Pi / 2}, {r, -Pi, Pi}, Axes → Automatic, AxesLabel → {x, y, z}]
```

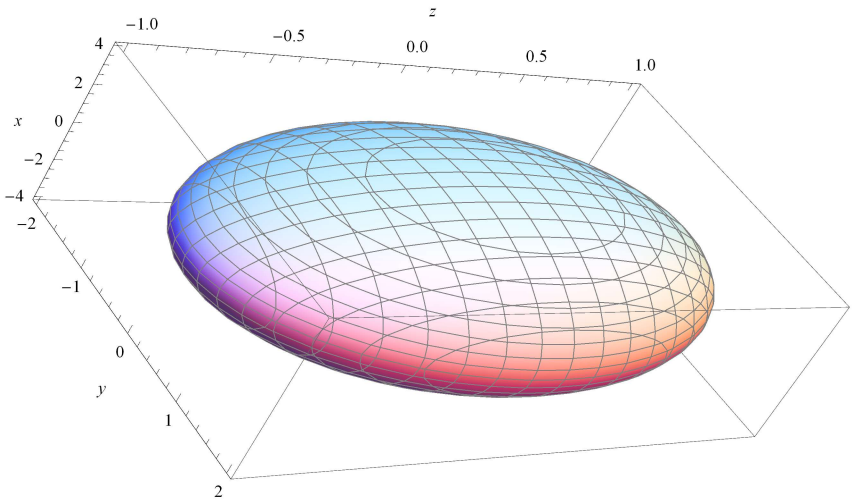


(ii) ContourPlot3D

```
eq1
```

$$\frac{x^2}{16} + \frac{y^2}{4} + z^2 == 1$$

```
ContourPlot3D[x^2/16 + y^2/4 + z^2 == 1,
 {x, -4, 4}, {y, -2, 2}, {z, -1, 1},
 BoxRatios → {1, 2, 4}, AxesLabel → {x, y, z}, MeshStyle → Gray
]
```

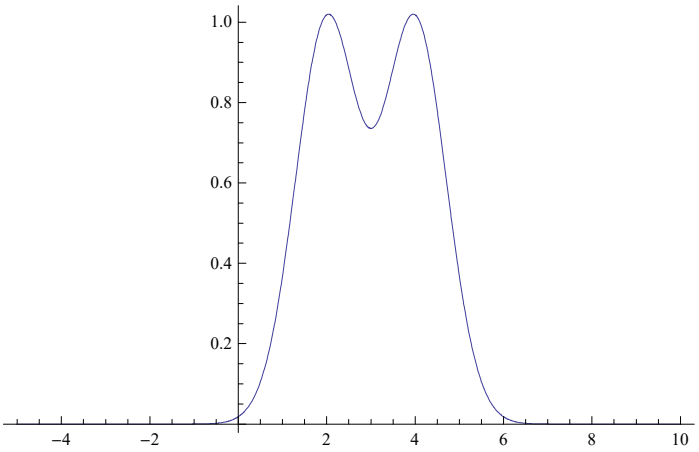


Question 05

```
f[x_] := e^-(x-2)^2 + e^-(x-4)^2
```

(i)Plot function

```
Plot[f[x], {x, -5, 10}]
```



(ii)Volume revolving disc and washer method

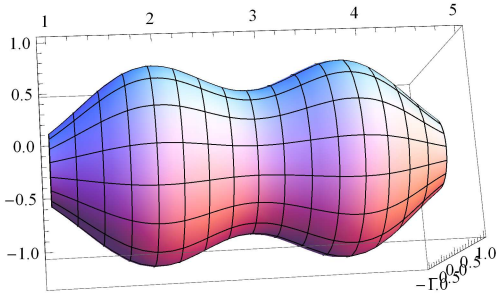
```
vol = Integrate[Pi * f[x]^2, {x, 1, 5}] // N
```

```
8.76132
```

(iii)X-axis

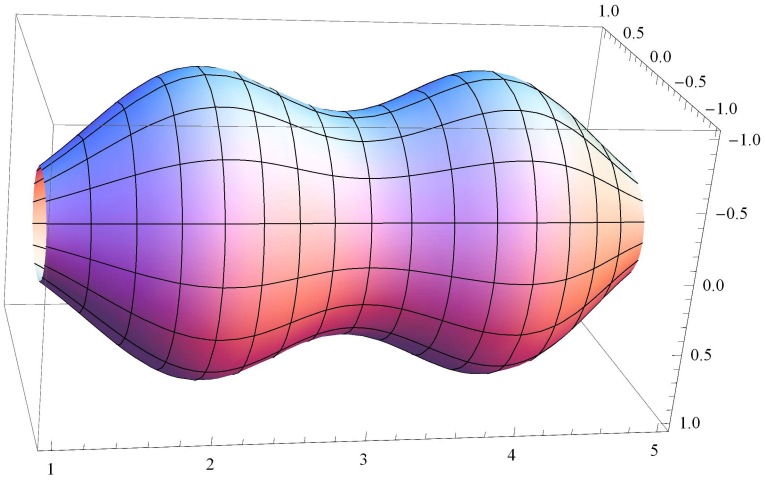
RevolutionPlot3D

```
RevolutionPlot3D[f[x], {x, 1, 5}, RevolutionAxis → {1, 0, 0}]
```



ParametricPlot3D

```
ParametricPlot3D[{f[x] * Cos[t], f[x] * Sin[t], x},
 {x, 1, 5}, {t, 0, 2 * Pi}, BoxRatios → Automatic]
```



(iv)Volume by cylindrical shell method

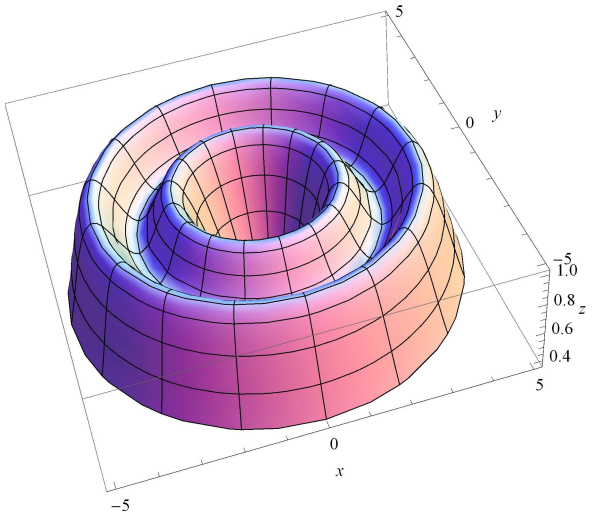
$$\text{vol2} = \int_1^5 f[x] * 2 * \text{Pi} * x \, dx \;//\; N$$

```
61.5638
```

(v)Y-Axis

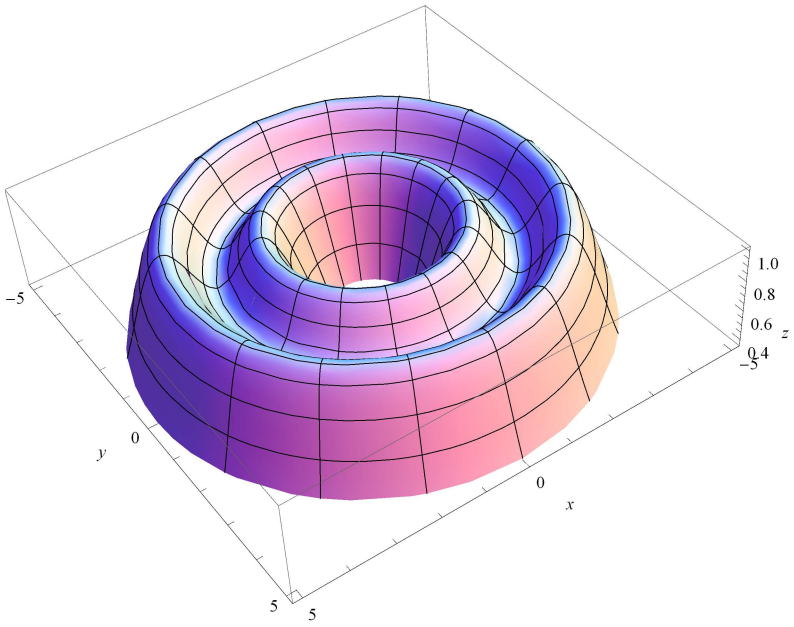
RevolutionPlot3D

```
RevolutionPlot3D[f[x], {x, 1, 5}, RevolutionAxis → {0, 0, 1}, AxesLabel → {x, y, z}]
```



ParametricPlot3D

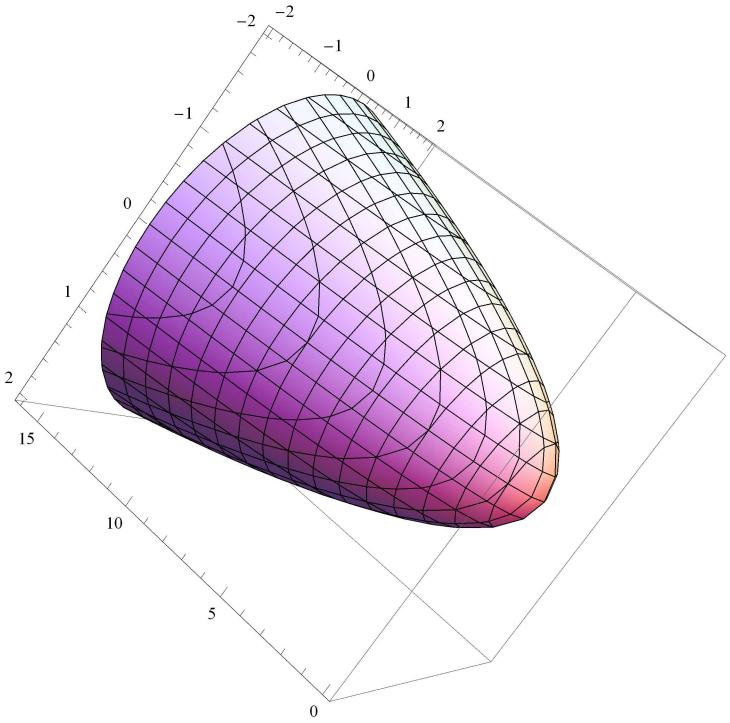
```
ParametricPlot3D[{x * Cos[t], x * Sin[t], f[x]}, {x, 1, 5
 }, {t, 0, 2 * Pi}, BoxRatios → {4, 4, 1}, AxesLabel → {x, y, z}]
```

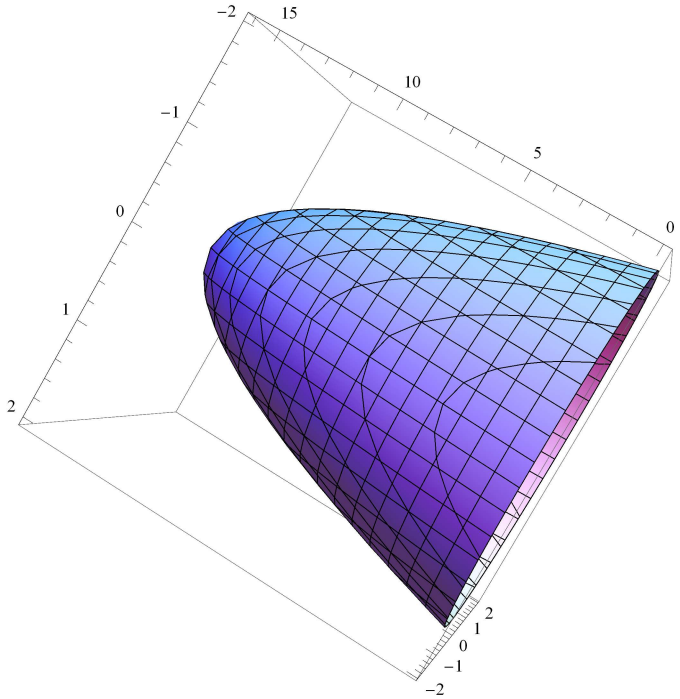


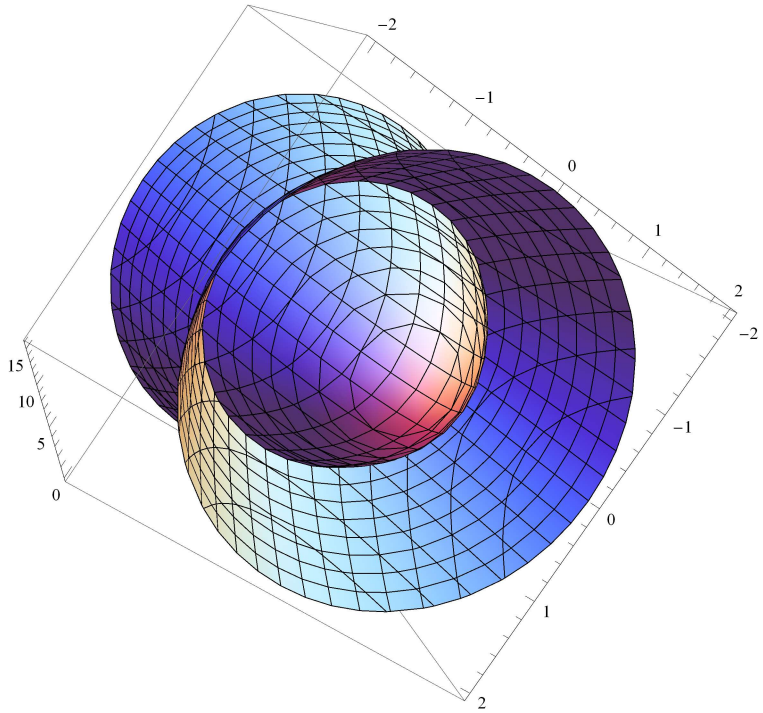
Question 06

```
z1 = 4 * x^2 + 4 * y^2;
z2 = 16 - 4 * x^2 - 4 * y^2;

g1 = ContourPlot3D[z == 4 * x^2 + 4 * y^2, {x, -2, 2}, {y, -2, 2}, {z, 0, 16}]
g2 = ContourPlot3D[z == 16 - (4 * x^2 + 4 * y^2), {x, -2, 2}, {y, -2, 2}, {z, 0, 16}]
Show[g1, g2]
```







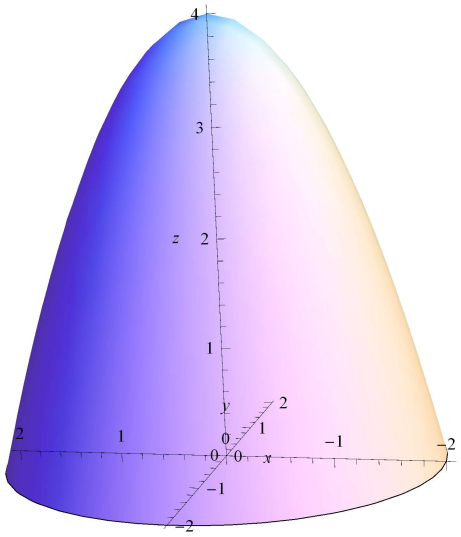

```
vol = Integrate[z2 - z1, {x, -1, 1}, {y, -1, 1}]
```

$$\frac{128}{3}$$

Question 07

```
Remove[x, y, z]
```

```
z == 4 - x^2 - y^2;
ContourPlot3D[z == 4 - x^2 - y^2, {x, -2, 2}, {y, -2, 2}, {z, 0, 4},
 AxesOrigin → {0, 0, 0}, AxesLabel → {x, y, z}, Mesh → None, Boxed → False]
```

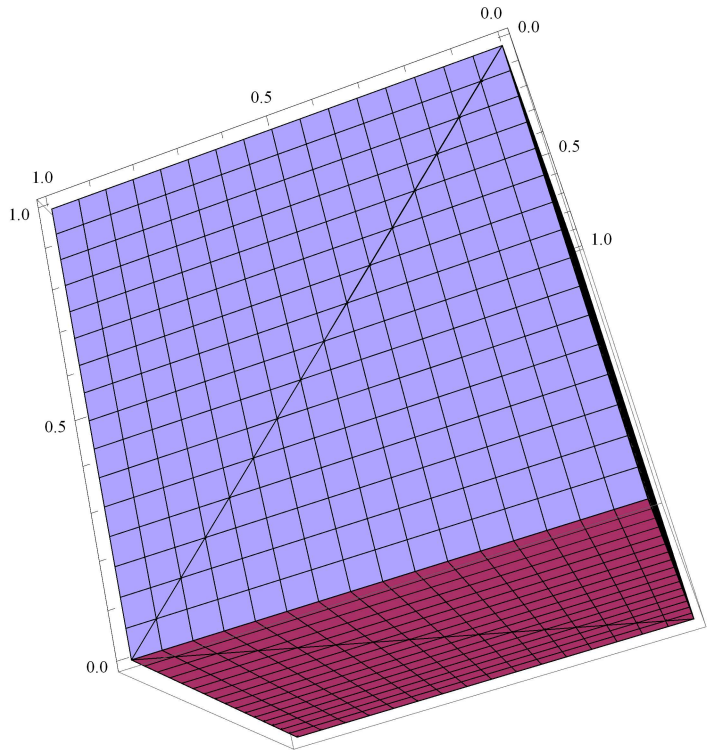



```
vol = Integrate[r * (4 - r^2), {t, 0, 2 * Pi}, {r, 0, 2}]
```

8π

Question 08

```
g1 = ContourPlot3D[z == 1 - x - y, {x, 0, 1}, {y, 0, 1}, {z, 0, 1}];
g2 = ContourPlot3D[z == 1 + x + y, {x, 0, 1}, {y, 0, 1}, {z, 0, 1}];
g3 = ContourPlot3D[y == 1 - x, {x, 0, 1}, {y, 0, 1}, {z, 0, 1}];
g4 = ContourPlot3D[y == 0, {x, 0, 1}, {y, 0, 1}, {z, 0, 1}];
g5 = ContourPlot3D[x == 0, {x, 0, 1}, {y, 0, 1}, {z, 0, 1}];
g6 = ContourPlot3D[z == 1, {x, 0, 1}, {y, 0, 1}, {z, 0, 1}];
g7 = ContourPlot3D[z == 0, {x, 0, 1}, {y, 0, 1}, {z, 0, 1}];
Show[g1, g2, g3, g4, g5, g6, g7]
```




```
rho = (1 + x^2 + y^2);
dV = Abs[1 + x + y - (1 - x - y)];
mass = Integrate[rho * dV, {x, 0, 1}, {y, 0, 1 - x}]
```

$$\frac{14}{15}$$

Question 09

$$f[x\_, y\_] := \frac{4}{x^2 + y^2 + 1}$$

```
x0 = 1 / 2; y0 = 1;
```

```
s1 = D[f[x, y], x] /. {x → x0, y → y0};
s2 = D[f[x, y], y] /. {x → x0, y → y0};
s3 = -1;
r = {s1, s2, s3};
X = {x, y, z};
X0 = {x0, y0, f[x0, y0]};
```

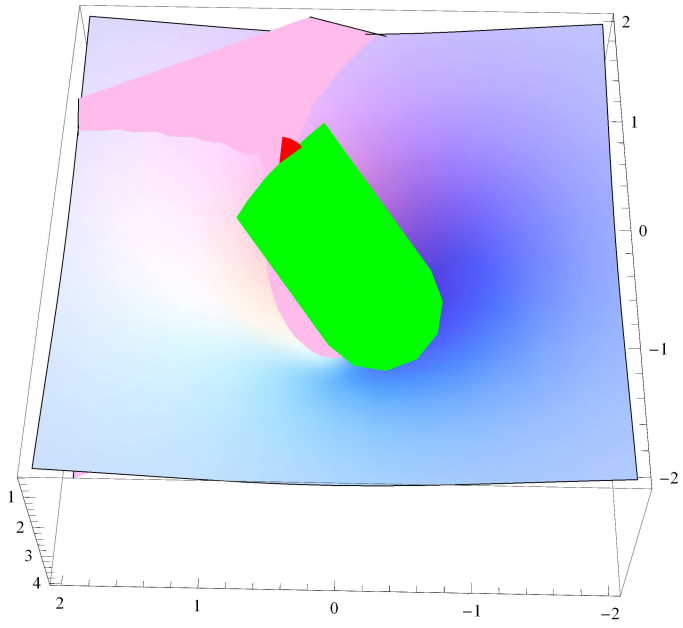
```
tangent = Solve[r.(X - X0) == 0, z][[1, 1, 2]]
```

$$-\frac{16}{81}\,(-19 + 4\,x + 8\,y)$$

```
normal = Solve[(X - X0)/t == r, {x, y, z}] // Flatten
```

$$\left\{x \to \frac{1}{162}\,(81 - 128\,t),\ y \to \frac{1}{81}\,(81 - 128\,t),\ z \to \frac{1}{9}\,(16 - 9\,t)\right\}$$

```
g1 = Plot3D[f[x, y], {x, -2, 2}, {y, -2, 2}, Mesh → None];
g2 = Plot3D[tangent, {x, -2, 2}, {y, -2, 2}, Mesh → None];
g3 = ParametricPlot3D[Table[normal[[i, 2]], {i, 1, 3}],
    {t, -1, 1}, PlotStyle → {RGBColor[0, 1, 0], Thickness[.2]}];
(*g4=PlotPoints[Point[X0]]*)
Show[g1, g2, g3, Graphics3D[{Red, PointSize[.1], Point[X0]}]]
```



Question 10

```
LessPrimes[n_] := Module[
  {a = n, p = {}},
  For[i = 1, i ≤ a, i++,
   If[PrimeQ[i], p = Append[p, i]]
  ]
  ; p
 ]
LessP = LessPrimes[50]
```

```
{2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47}
```