

```

In[ ]:= m = 0.44;
g = 9.8;
k1 = 0.0123;
k2 = 0.0144;
ω0 = 15;
ω = {0, 0, ω0 - t};
r[t_] := {x[t], y[t], z[t]};
v = r'[t];
G = {0, 0, -m g};
fg = -k1 Norm[v] v;
      | 模
fM = k2 ω × v;
eqns := m ∂{t,2} r[t] == G + fg + fM;
sol = NDSolveValue[
      | 数值解的值
{eqns, r[0] == {0, 0, 0}, r'[0] == {24, 16, 8.5}}, {x[t], y[t], z[t]}, {t, 0, 30}]
ParametricPlot3D[sol, {t, 0, 20}, PlotRange → 300]
      | 绘制三维参数图                                | 绘制范围

```

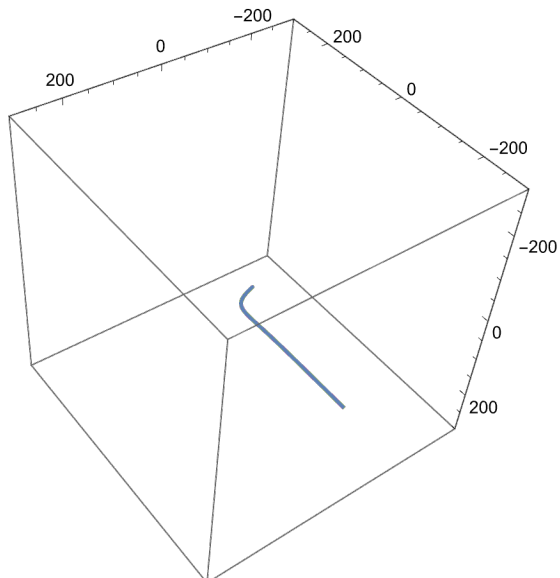
Out[]:=

```

{InterpolatingFunction[
      | + |  | Domain: {{0., 30.}}
      |   |  | Output: scalar
      |   |  | ] [t],
InterpolatingFunction[
      | + |  | Domain: {{0., 30.}}
      |   |  | Output: scalar
      |   |  | ] [t],
InterpolatingFunction[
      | + |  | Domain: {{0., 30.}}
      |   |  | Output: scalar
      |   |  | ] [t]}

```

Out[]:=



```

In[ ]:= StreamPlot[ {NIntegrate[
|流线图      |数值积分

$$\frac{1 - r \cos[\theta]}{\left(1 + r^2 + \left(-\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{-3/2}} + \frac{1 - r \cos[\theta]}{\left(1 + r^2 + \left(\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{-3/2}}, \{\theta, 0, 2 \pi\}],$$

NIntegrate[
|数值积分

$$\frac{\left(-\frac{1}{2} + z\right) \cos[\theta]}{\left(1 + r^2 + \left(-\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{-3/2}} + \frac{\left(\frac{1}{2} + z\right) \cos[\theta]}{\left(1 + r^2 + \left(\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{-3/2}},$$


$$\{\theta, 0, 2 \pi\} \}], \{z, -2, 2\}, \{r, -2, 2\}]$$


```

... NIntegrate: 在以 $\{0, 6.28319\}$ 为界的区域内, 对于所有采样点, 计算被积函数

$$\left(1 + r^2 + \left(-\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{3/2} (1 - r \cos[\theta]) + \left(1 + r^2 + \left(\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{3/2} (1 - r \cos[\theta]) \text{ 得到非数值.}$$

... NIntegrate: 在以 $\{0, 6.28319\}$ 为界的区域内, 对于所有采样点, 计算被积函数

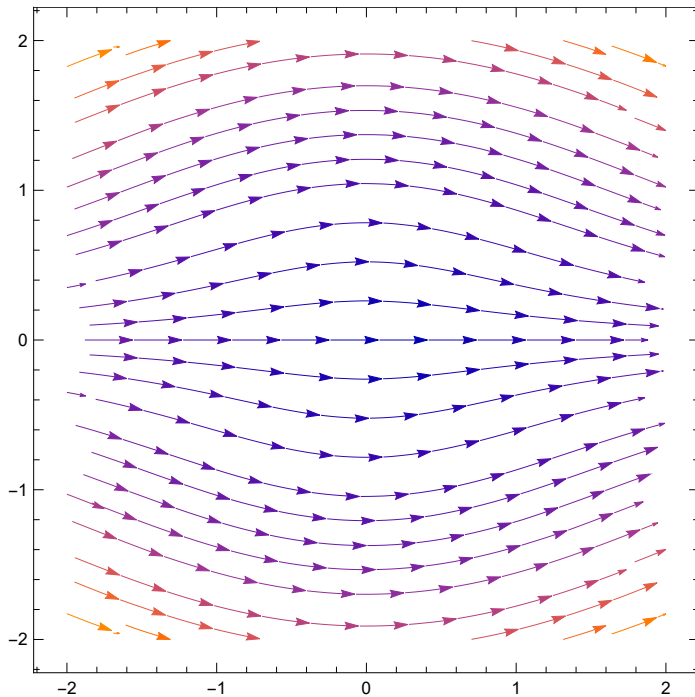
$$\left(1 + r^2 + \left(-\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{3/2} (1 - r \cos[\theta]) + \left(1 + r^2 + \left(\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{3/2} (1 - r \cos[\theta]) \text{ 得到非数值.}$$

... NIntegrate: 在以 $\{0, 6.28319\}$ 为界的区域内, 对于所有采样点, 计算被积函数

$$\left(-\frac{1}{2} + z\right) \cos[\theta] \left(1 + r^2 + \left(-\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{3/2} + \left(\frac{1}{2} + z\right) \cos[\theta] \left(1 + r^2 + \left(\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{3/2} \text{ 得到非数值.}$$

... General: 在本次计算中, NIntegrate::inumr 的进一步输出将被抑制.

Out[]:=



```

In[ ]:= Plot3D[ {NIntegrate[
|绘制... |数值积分

$$\frac{1 - r \cos[\theta]}{\left(1 + r^2 + \left(-\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{-3/2}} + \frac{1 - r \cos[\theta]}{\left(1 + r^2 + \left(\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{-3/2}}, \{\theta, 0, 2 \pi\}],$$

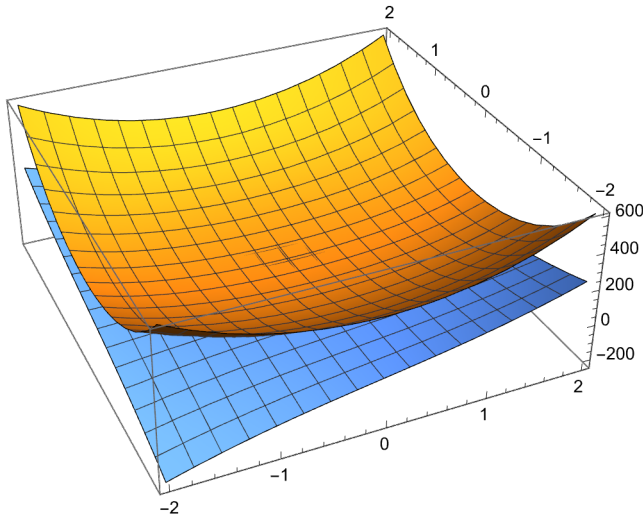
NIntegrate[
|数值积分

$$\frac{\left(-\frac{1}{2} + z\right) \cos[\theta]}{\left(1 + r^2 + \left(-\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{-3/2}} + \frac{\left(\frac{1}{2} + z\right) \cos[\theta]}{\left(1 + r^2 + \left(\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{-3/2}},$$


$$\{\theta, 0, 2 \pi\}], \{z, -2, 2\}, \{r, -2, 2\}]$$


```

Out[]:=



```

In[ ]:= StreamPlot[
|流线图
Evaluate@{NIntegrate[
|计算 |数值积分

$$\frac{1 - r \cos[\theta]}{\left(1 + r^2 + \left(-\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{3/2}} + \frac{1 - r \cos[\theta]}{\left(1 + r^2 + \left(\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{3/2}},$$


$$\{\theta, 0, 2 \pi\}], NIntegrate[$$


$$\frac{\left(-\frac{1}{2} + z\right) \cos[\theta]}{\left(1 + r^2 + \left(-\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{3/2}} +$$


$$\frac{\left(\frac{1}{2} + z\right) \cos[\theta]}{\left(1 + r^2 + \left(\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{3/2}}, \{\theta, 0, 2 \pi\}], \{z, -2, 2\}, \{r, -2, 2\}]$$


```

⋯ NIntegrate: 在以 $\{0, 6.28319\}$ 为界的区域内, 对于所有采样点, 计算被积函数

$$\frac{1 - r \cos[\theta]}{\left(1 + r^2 + \left(-\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{3/2}} + \frac{1 - r \cos[\theta]}{\left(1 + r^2 + \left(\frac{1}{2} + z\right)^2 - 2 r \cos[\theta]\right)^{3/2}} \text{ 得到非数值.}$$

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... **General**: 在本次计算中, NIntegrate::inumr 的进一步输出将被抑制.

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