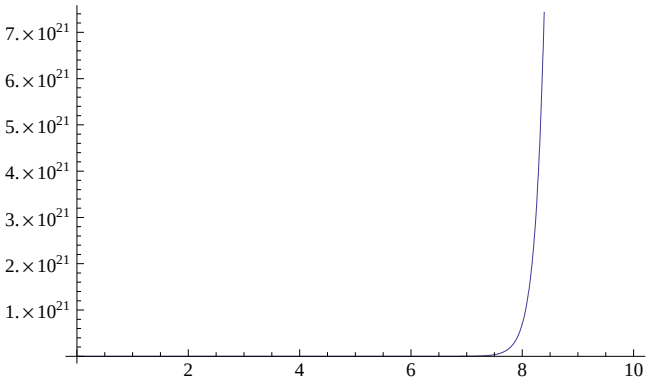
TEHT2

- **a)**

```
a = DSolve[f'[x] == 6 * f[x], f[x], x]
```

$$\{\{f[x] \to e^{6x} C[1]\}\}$$

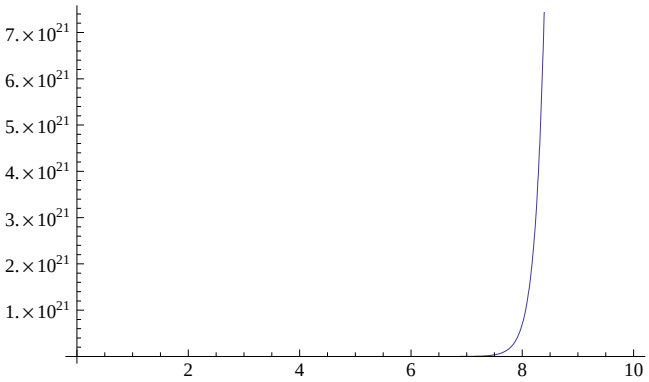
```
Plot[f[x] /. a[[1]] /. C[1] → 1, {x, 0, 10}]
```




```
s = NDSolve[{y'[x] == 6 * y[x], y[0] == 1}, y, {x, 0, 10}]
```

```
{{y → InterpolatingFunction[{{0., 10.}}, <>]}}
```

```
Plot[y[x] /. s, {x, 0, 10}]
```



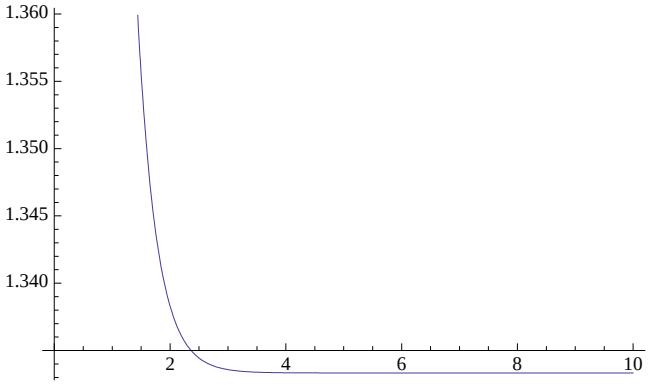
- **b)**

```
f[x] =.; x =.
```

```
b = DSolve[f'[x] + 3 * f[x] == 4, f[x], x]
```

$$\left\{\left\{f[x] \to \frac{4}{3} + e^{-3x} C[1]\right\}\right\}$$

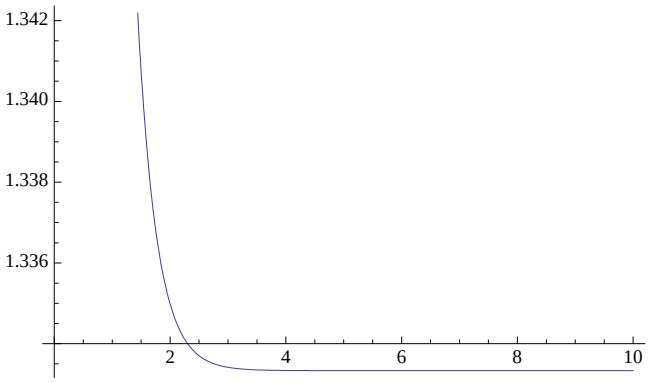
```
Plot[f[x] /. b /. C[1] → 2, {x, 0, 10}]
```




```
b2 = NDSolve[{f'[x] + 3 * f[x] == 4, f[0] == 2}, f, {x, 0, 10}]
```

```
{{f → InterpolatingFunction[{{0., 10.}}, <>]}}
```

```
Plot[f[x] /. b2, {x, 0, 10}]
```



■ c)

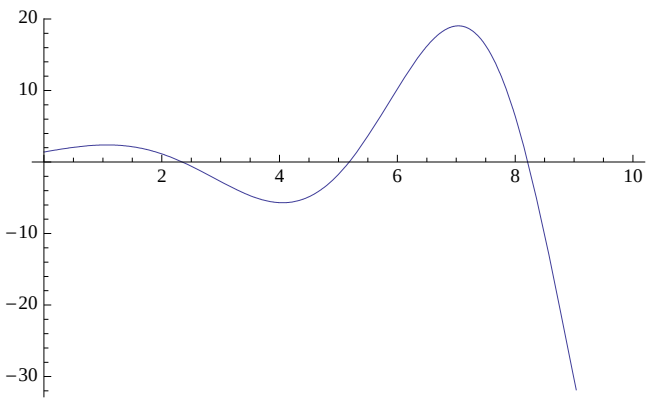
```
c = DSolve[4 * f''[x] - 3*f'[x] + 5 * f[x] == 2, f[x], x]
```

$$\left\{\left\{f[x] \to \frac{2}{5} + e^{3x/8} C[2] \text{Cos}\left[\frac{\sqrt{71}\, x}{8}\right] + e^{3x/8} C[1] \text{Sin}\left[\frac{\sqrt{71}\, x}{8}\right]\right\}\right\}$$

```
Re[f[x] /. c /. {C[1] → 1, C[2] → 1}]
```

$$\left\{\frac{2}{5} + \text{Re}\left[e^{3x/8} \text{Cos}\left[\frac{\sqrt{71}\, x}{8}\right] + e^{3x/8} \text{Sin}\left[\frac{\sqrt{71}\, x}{8}\right]\right]\right\}$$

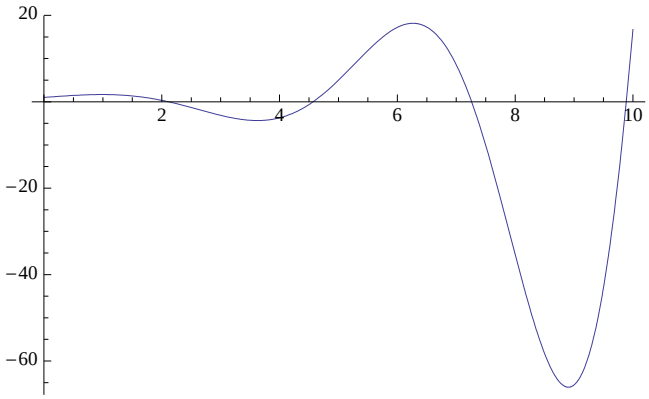
```
Plot[Re[f[x] /. c /. {C[1] → 1, C[2] → 1}], {x, 0, 10}]
```



```
c2 = NDSolve[{3 * f''[x] - 3 * f'[x] + 5 * f[x] == 2, f[0] == 1, f'[0] == 1}, f, {x, 0, 10}]
```

```
{{f → InterpolatingFunction[{{0., 10.}}, <>]}}
```

```
Plot[f[x] /. c2, {x, 0, 10}]
```



ТЕНТ3

```
u =.
a = DSolve[u''[t] == -9.81, u[t], t]
```

```
{{u[t] → -4.905 t^2 + C[1] + t C[2]}}
```

```
y[t_] := u[t] /. a[[1]] /. C[1] → y0 /. C[2] → vy0
```

```
b = DSolve[r'[t] == vx0, r[t], t]
```

```
{{r[t] → t vx0 + C[1]}}
```

```
x[t_] := r[t] /. b[[1]] /. C[1] → x0
```

```
vx0 = 10
vy0 = 20
x0 = 0
y0 = 0
```

```
10
```

```
20
```

```
0
```

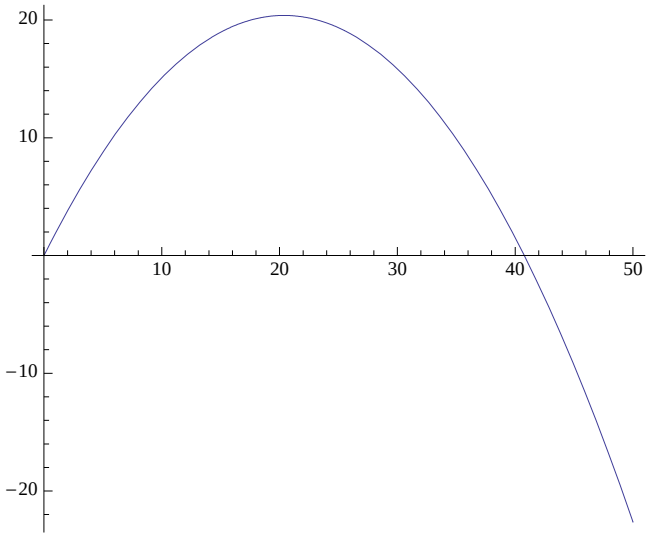
```
0
```

```
x[t]
y[t]
```

```
10 t
```

```
20 t - 4.905 t^2
```

```
ParametricPlot[{x[t], y[t]}, {t, 0, 5}]
```



Etäisyys :

```
Solve[y[t] == 0, t]
```

```
{{t → 0.}, {t → 4.07747}}
```

```
x[t] /. %[[2]]
```

```
40.7747
```

Lakikorkeus :

```
D[y[t],t]
```

```
20 - 9.81 t
```

```
y[t] /. Solve[D[y[t], t] == 0, t]
```

```
{20.3874}
```

TEHT 4

```
m = 1
g = -9.81
k = 0.1
```

```
1
```

```
-9.81
```

```
0.1
```

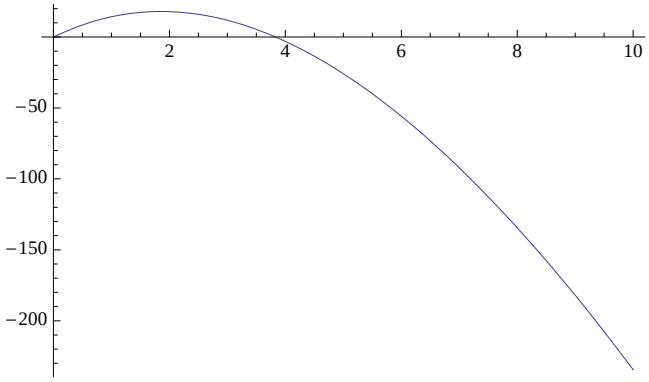
```
a2 = DSolve[{d''[t] == g - k / m * d'[t], d[0] == 0, d'[0] == 20}, d[t], t]
```

```
{{d[t] → e^(-0.1 t) (-1181. + 1181. e^(0.1 t) - 98.1 e^(0.1 t) t)}}
```

```
l[t_] = d[t] /. a2[[1]] /. m → 10 /. g → 9.81
```

```
e^(-0.1 t) (-1181. + 1181. e^(0.1 t) - 98.1 e^(0.1 t) t)
```

```
Plot[l[t], {t, 0, 10}]
```




```
y2[t_] = u[t] /. a2[[1]] /. C[1] → 20 /. C[2] → 0
```

$-200.\, e^{-0.1\,t} - 98.1\,t$

```
Plot[y2[t], {t, 0, 10}]
```

```
b2 = DSolve[{m * p''[t] == -k * p'[t], p'[0] == 10, p[0] == 0}, p[t], t]
```

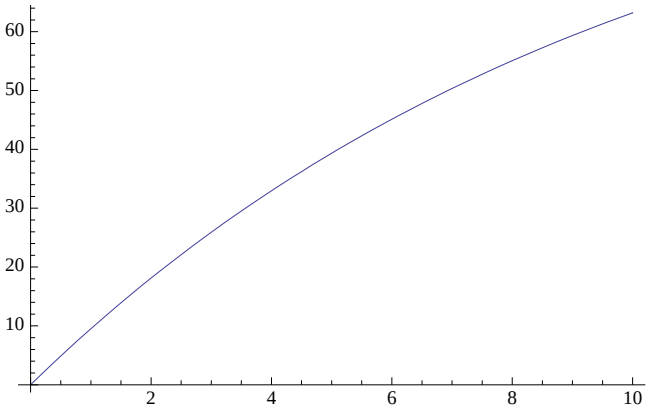
$\left\{\left\{p[t] \to e^{-0.1\,t}\left(-100. + 100.\, e^{0.1\,t}\right)\right\}\right\}$

```
Plot[]
```

```
x2[t_] = p[t] /. b2[[1]]
```

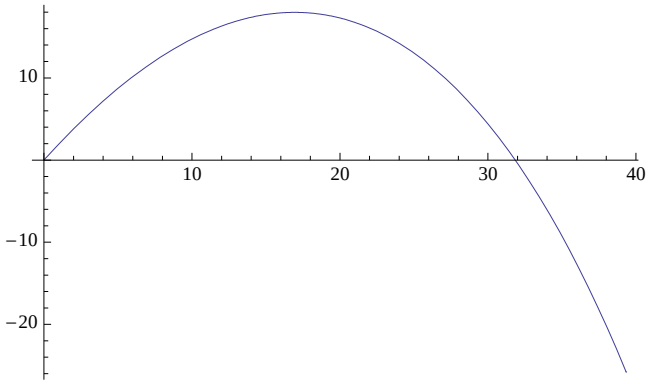
$e^{-0.1\,t}\left(-100. + 100.\, e^{0.1\,t}\right)$

```
Plot[x2[t], {t, 0, 10}]
```



-9.81

```
ParametricPlot[{x2[t], l[t]}, {t, 0, 5}, AspectRatio → 1 / GoldenRatio]
```



lakipiste :

```
l[t] /. FindRoot[D[l[t], t] == 0, {t, 1}]
```

```
17.981
```

Heiton pituus :

```
x2[t] /. FindRoot[l[t] == 0, {t, 5}]
```

```
31.8404
```

```
l[t]
```

$$e^{-0.1\,t}\left(-1181.+1181.\,e^{0.1\,t}-98.1\,e^{0.1\,t}\,t\right)$$

```
D[l[t], t]
```

$$-0.1\,e^{-0.1\,t}\left(-1181.+1181.\,e^{0.1\,t}-98.1\,e^{0.1\,t}\,t\right)+e^{-0.1\,t}\left(20.\,e^{0.1\,t}-9.81\,e^{0.1\,t}\,t\right)$$

Y : n suuntainen rajanopeus :

```
Limit[%291, t → 1 000 000]
```

```
-98.1
```

```
Plot[%, {t, 0, 100}]
```