3.2)

```
# 3.2

import matplotlib.pyplot as plt
import numpy as np

array100 = np.arange(1, 101)

sum100 = np.sum(array100)

print("Sum av tallene til 100: ", sum100)
```

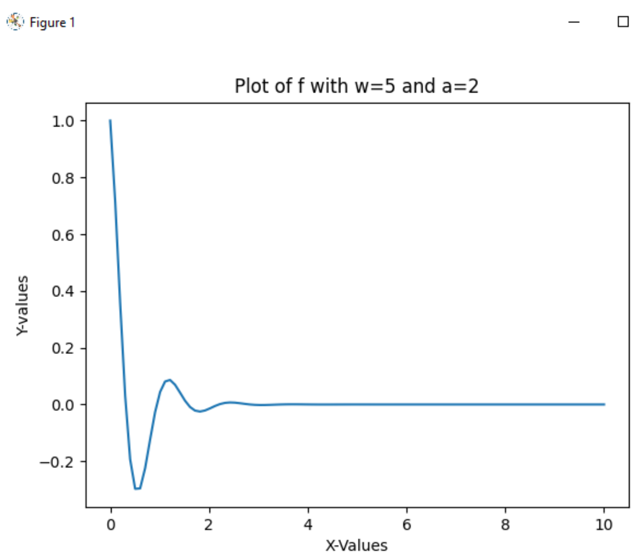
```
Sum av tallene til 100:  5050
```

3.3)

```
# 3.3


w = 5
a = 2
time = np.linspace(0, 10, 100)
values = np.cos(w*time)*np.exp(-a*time)


plt.plot(time, values)
plt.title("Plot of f with w=5 and a=2")
plt.ylabel("Y-values")
plt.xlabel("X-Values")
plt.show()
```



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OPPGAVE 4

4i)

$$|A| = \sqrt{4m^2 + 3m^2} = 5m$$

$$|B| = \sqrt{2m^2 + (-3m)^2} = \sqrt{13}\,m$$

Ø ll

ii)

$$A+B = 4m\hat{i} + 3m\hat{j} + 2m\hat{i} - 3m\hat{j} = 6m\hat{i}$$

$$A-2B = 4m\hat{i} + 3m\hat{j} - 2(2m\hat{i} - 3m\hat{j}) = 9m\hat{j}$$

iii)

$$A \cdot B = 4m\hat{i} \cdot 2m\hat{i} + 3m\hat{j} \cdot -3m\hat{j} = 8m^2\hat{i}^2 - 9m^2\hat{j}^2$$

$$A \cdot B = 8m^2 - 9m^2 = -1m^2$$

iv)

$$F \times B = (8N\hat{i} - 15N\hat{j}) \times (2m\hat{i} - 3m\hat{j})$$

$$F \times B = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 8N & -15N & 0 \\ 2m & -3m & 0 \end{vmatrix} = \hat{i}(0 \cdot -15N - 0 \cdot -3m) - \hat{j}(0 \cdot 8N - 0 \cdot 2m) + \hat{k}(8N \cdot -3m - -15N \cdot 2m)$$

$$F \times B = \hat{k}(-24Nm + 30Nm) = \cancel{\hat{k}\,54Nm} = \hat{k}\,6Nm$$

v)

$$A-F = (4m - 8N)\hat{i} + (3m + 15N)\hat{j}$$

← m - N gir ikke mening.

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4b)

$\vec{A} = A\hat{a}$

$4m\hat{i} + 3m\hat{j} = \sqrt{4m^2+3m^2}\;\hat{a}$

$4m\hat{i} + 3m\hat{j} = 5m\,\hat{a}$

$\Rightarrow \hat{a} = \frac{4}{5}m\hat{i} + \frac{3}{5}m\hat{j}$

4c)

$\cancel{K} = \frac{1}{2}mv^2, \quad m = 9\,kg$

$K = \frac{1}{2} \cdot 9\,kg \left(2\frac{m}{s}\hat{i} \cdot 2\frac{m}{s}\hat{i} + -3\frac{m}{s}\hat{j} \cdot -3\frac{m}{s}\hat{j}\right)$

$K = 58{,}5\,kg\,\frac{m^2}{s^2} = 58{,}5\,J = 58{,}5\,Nm$

Hvis $v \to -v$ så hadde svaret vært det samme siden $v^2 = (-v)^2$

5i)

$v(t)$: $\quad v' = a$

$\int_0^t v'(\tau)\,d\tau = \int_0^t a(\tau)\,d\tau$

$v(t) - v(0) = \int_0^t a(\tau)\,d\tau$

$x(t)$: $\int_0^t x'(t)\,d\tau = \int_0^t v(\tau)\,d\tau$

$x(t) - x(0) = \int_0^t v(\tau)\,d\tau$

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5ii) Si enhet

Hastighet: m/s

Akselerasjon: $m/s^2 = m \cdot s^{-2}$

5iii) Hvis a er konstant

$$v(t) - v(0) = \int_0^t a(\tau)\,d\tau$$

$$v(t=0) = v(0) = v_0$$

$$\Rightarrow v(t) = v_0 + \int_0^t a(\tau)\,d\tau$$

Siden a er konstant

$$\Rightarrow v(t) = v_0 + a\int_0^t 1\,d\tau$$

$$v(t) = v_0 + at \quad \square$$

$$x(t) - x(0) = \int_0^t v(\tau)\,d\tau$$

a er konstant, $x_0 = x(0) = x(t=0)$

$$\Rightarrow x(t) = x_0 + \int_0^t (v_0 + a\tau)\,d\tau$$

$$\Rightarrow x(t) = x_0 + v_0 t + a\int_0^t \tau\,d\tau$$

$$\Rightarrow x(t) = x_0 + v_0 t + a\frac{t^2}{2}$$

$$\Rightarrow x(t) = x_0 + v_0 t + \frac{1}{2}at^2 \quad \square$$

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6i)

$a = c_1 t - c_2 t^3 \quad c_1 = 3{,}0 m/s^3 \quad c_2 = 0{,}8 m/s^5$

$v_0 = 0$

$$v(t) = v_0 + \int_0^t (c_1 \tau - c_2 \tau^3)\, d\tau$$

$$v(t) = 0 + \frac{1}{2} c_1 t^2 - \frac{1}{4} c_2 t^4$$

$$x(t) = x(0) + \int_0^t \left(\frac{1}{2} c_1 \tau^2 - \frac{1}{4} c_2 \tau^4\right) d\tau$$

$$x(t) = 0 + \frac{1}{6} c_1 t^3 - \frac{1}{20} c_2 t^5$$

$$x(2s) = \frac{1}{6} \cdot 3 \frac{m}{s^3} \cdot 2^3 s^3 - \frac{1}{20} \cdot 0.8 \frac{m}{s^5} \cdot 2^5 s^5$$

$$x(2s) = 2{,}72 m = \underline{\underline{2{,}7 m}}$$

6ii)

Gjennomsnittshastighet:

$$\frac{2{,}7m - 0m}{2s - 0s} = 1{,}35 m/s$$

6iii)

Analytiske Areal av $v = x \Rightarrow \underline{\underline{2{,}72 m}}$

Numerisk analyse i Python med trapesintegrasjon og $N = 100$ gir $2{,}7199 m \approx \underline{\underline{2{,}72 m}}$

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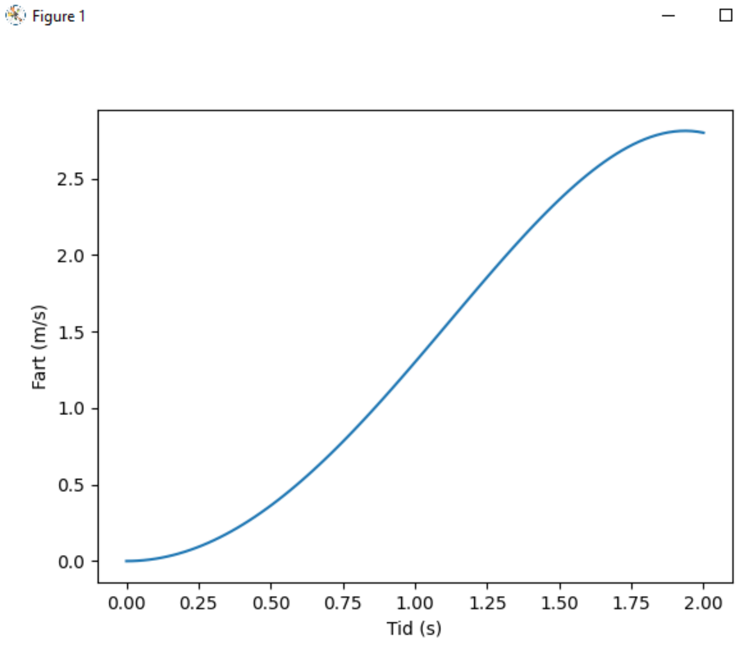
4.6iii)

```
# Task 6

# 6.3
t0 = 0
tf = 2
N = 100  # Antall punkter
c1 = 3
c2 = 0.8
t = np.linspace(t0, tf, N)
v = 0.5*c1*t**2-0.25*c2*t**4
plt.plot(t, v)
plt.ylabel("Fart (m/s)")
plt.xlabel("Tid (s)")
plt.show()


def trapezoidal(f, a, b, n):
    h = float(b - a) / n
    s = 0.0
    s += f(a)/2.0
    for i in range(1, n):
        s += f(a + i*h)
    s += f(b)/2.0
    return s * h


print("Areal: ", trapezoidal(lambda t: 0.5*c1*t**2-0.25*c2*t**4, 0, 2, N))
```




```
Areal:  2.7199866688000003
```

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7)

$$\frac{36.2\,m}{1.7\,s} = \frac{362}{17}\,m/s \approx \underline{\underline{21\,m/s}}$$

Oppgave 5

8)

$a_t = 4.0\,m/s^2 \qquad v_t(0) = 0 \qquad x_t(0) = 0$

$v_t(t) = 0\,m/s + 4.0\,m/s^2 \cdot t = 4.0\,\frac{m}{s^2} \cdot t$

$x_t(t) = 0\,m + 0\,m/s\,t + \frac{1}{2} \cdot 4.0\,m/s^2 \cdot t^2 = 2.0\,m/s^2 \cdot t^2$

$a_p = 0.0\,m/s^2$

$x_p(t) = 0 + (xt - x) + 0$

$x_t(t) = x_p(t)$

$2t^2 = xt - x \Rightarrow 2t^2 = x(t-1)$

$\Rightarrow \frac{2t^2}{t-1} = x$

Må finne nullpunktet til den deriverte av $\frac{2t^2}{t-1}$ for å finne minste konstante hastighet

$$\frac{2t^2}{t-1}\frac{d}{dt} = \frac{4t}{t-1} - \frac{2t^2}{(t-1)^2}$$

$$\Rightarrow \frac{4t}{t-1} - \frac{2t^2}{(t-1)^2} = 0 \Rightarrow t = 2$$

Putter $t=2$ inn i $\frac{2t^2}{t-1} \Rightarrow \frac{2 \cdot 2^2}{2-1} = x = \underline{\underline{8\,m/s}}$

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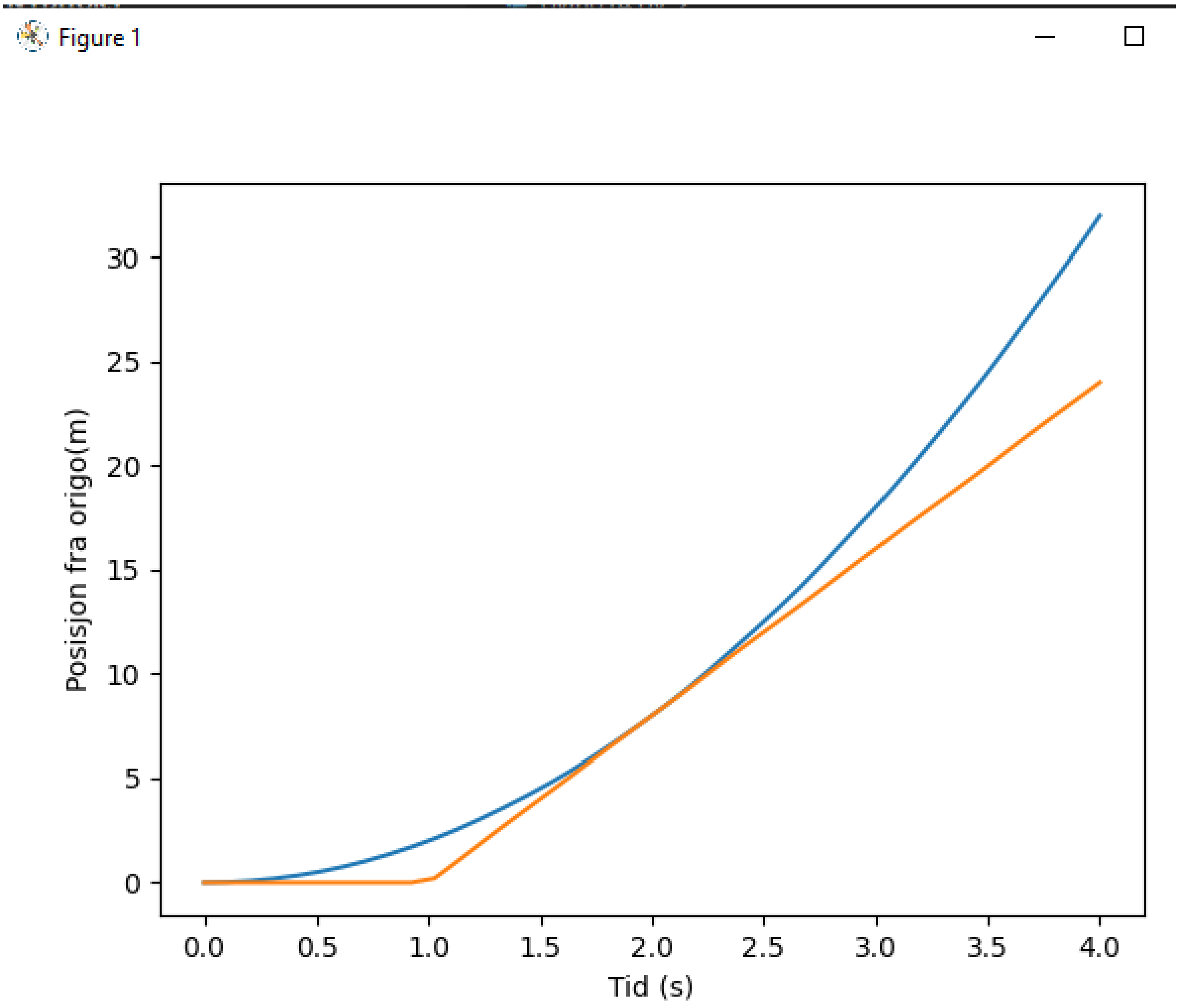
5.8)

```
# Task 8
t = np.linspace(start=0, stop=4, num=40)
pt = 2*t**2
pp = 8*t-8
pp = np.hstack((np.zeros(10), pp[10:]))

plt.plot(t, pt, t, pp)

plt.ylabel("Posisjon fra origo(m)")
plt.xlabel("Tid (s)")
plt.show()
```



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a) i)

$t = 4\,\text{min} = 240\,s$

$$v(240) = 30{,}0\,m/s \cdot \frac{(120)^2 s^2}{(240)^2 s^2} = \underline{\underline{7{,}50\,m/s}}$$

Når $t \to \infty$ vil $v(t) = 0$ fordi $\frac{1}{t^2} = 0$ når $t \to \infty$.

a) ii)

$$a(t) = v'(t) = \frac{v_0 t_1^2}{t^2} \frac{d}{dt} = \frac{-2 \cdot v_0 \cdot t_1^2}{t^3}$$

Graf i python for $t \geq 120\,s$

$$a(t) = \begin{cases} 0, & t < t_1 \\ \frac{-2 \cdot v_0 \cdot t_1^2}{t^3}, & t \geq t_1 \end{cases}$$

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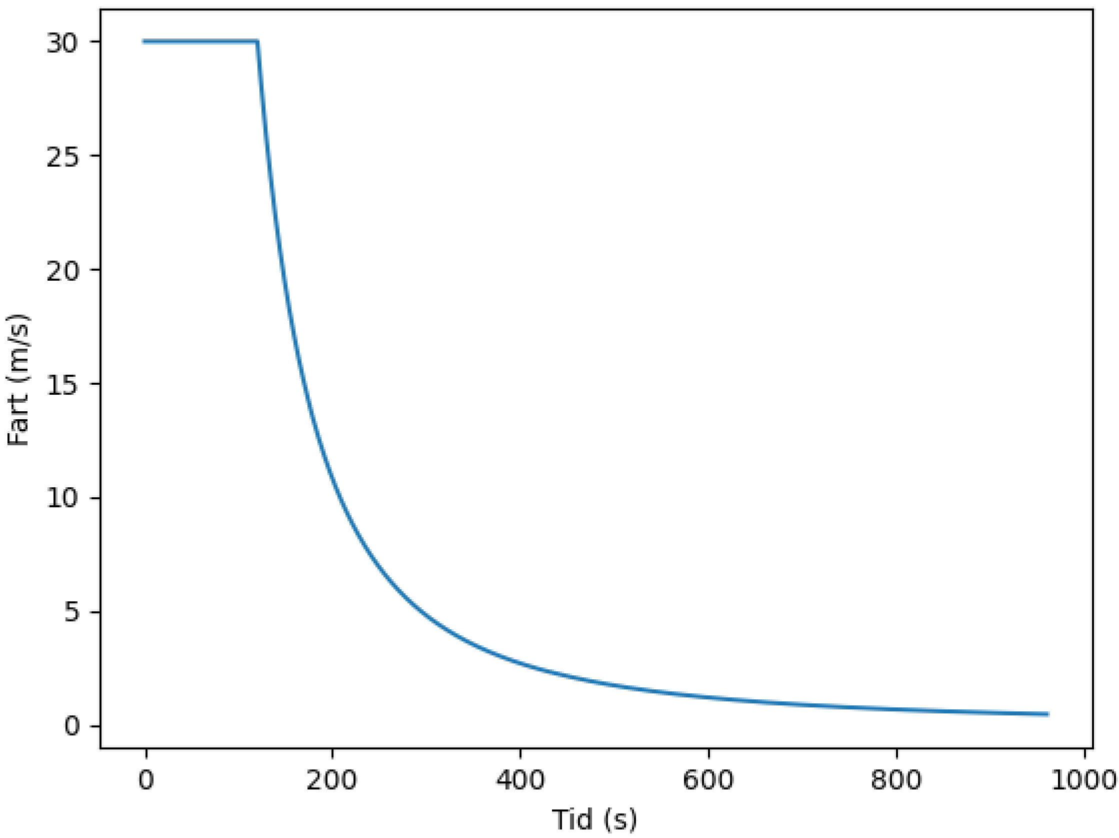
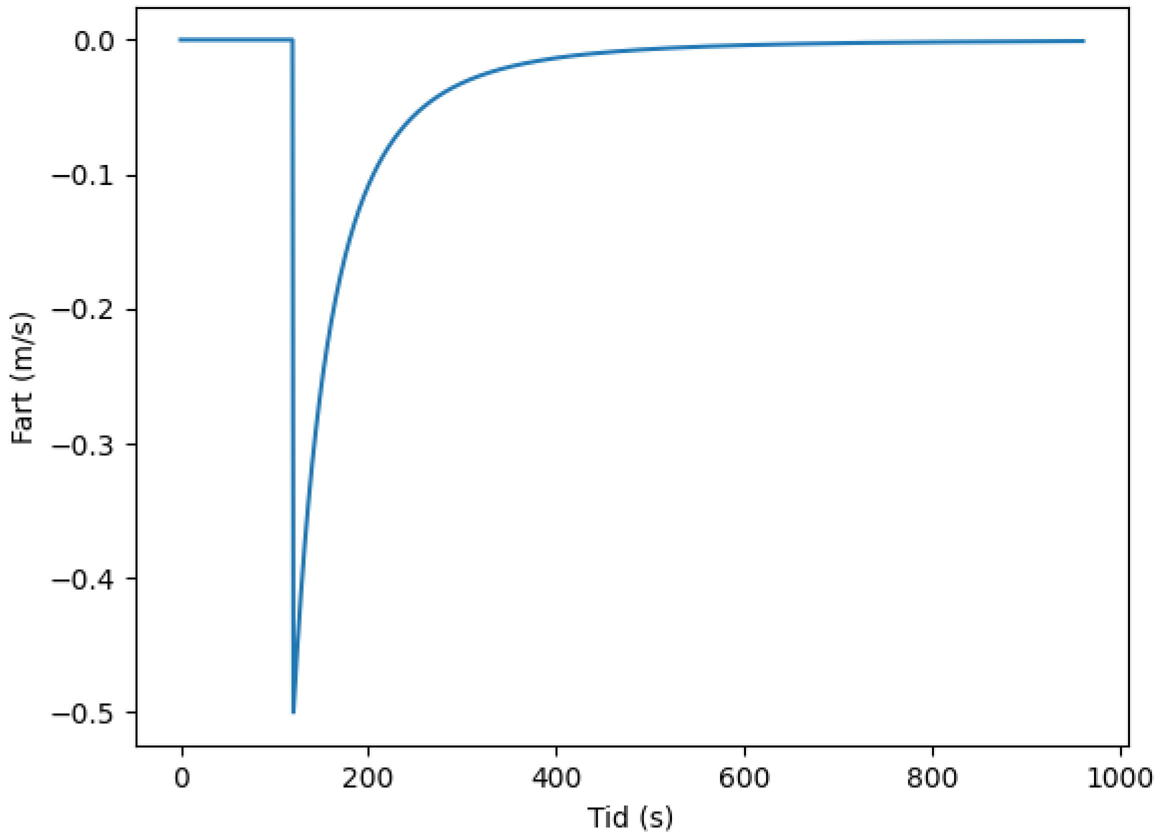
5.9i)

```
# Task 9

# 9.1
t0 = 0
t120 = 120
v0 = 30

t = np.linspace(t120, 960, 840)
b = v0*t120**2/t**2

a = np.ones(120)*30

t = np.linspace(0, 960, 960)
c = np.hstack((a, b))

plt.plot(t, c)
plt.ylabel("Fart (m/s)")
plt.xlabel("Tid (s)")
plt.show()
```



5.9ii)

```
# 9.2

a = np.ones(t120)*0
t = np.linspace(t120, 960, 840)
b = -2*v0*t120**2/t**3

t = np.linspace(0, 960, 960)
c = np.hstack((a, b))

plt.plot(t, c)
plt.ylabel("Fart (m/s)")
plt.xlabel("Tid (s)")
plt.show()
```



9iii)

$$S(t) = S(0) + \int_0^t v \, dt = \int_0^{120} V_0 + \int_{120}^{t} \frac{v_0 t_1^2}{t^2} dt$$

$$s(t) = \left[V_0 t\right]_0^{120} + \left[\frac{-v_0 t_1^2}{t}\right]_{120}^{t}$$

$$S(t) = \begin{cases} V_0 t, & t \leq 120 \\ V_0 \cdot 120 + \left(\frac{-V_0 t_1^2}{t} + \frac{V_0 t_1^2}{120}\right), & t > 120 \end{cases}$$

$$S(240) = 30 \cdot 120 + \left(\frac{-30 \cdot 120^2}{240} + \frac{30 \cdot 120^2}{120}\right) = \underline{\underline{5400 m}}$$

$$= \underline{\underline{5{,}4 km}}$$

$$S(t \to \infty) = 30 \cdot 120 + \left(0 + \frac{30 \cdot 120^2}{120}\right) = \underline{\underline{7{,}2 km}}$$

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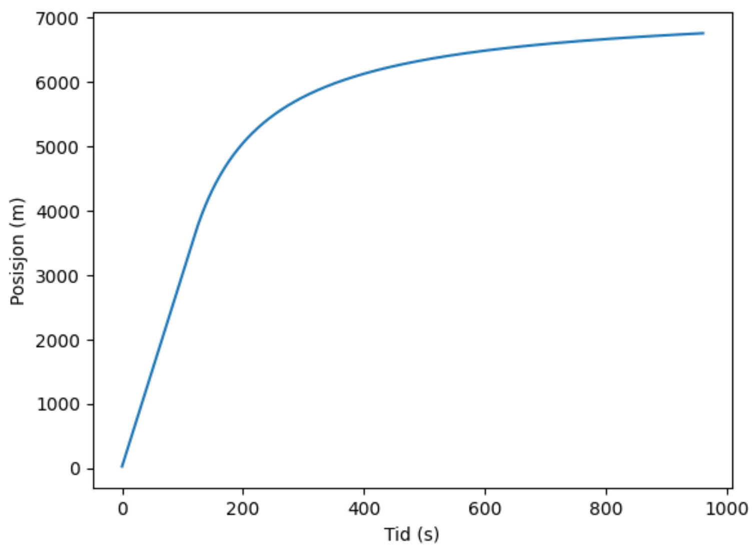
5.9iii)

```
# 9.3

t0 = 0
t120 = 120
v0 = 30

t = np.linspace(t120, 960, 840)
b = v0*t120**2/t**2

a = np.ones(120)*30

t = np.linspace(0, 960, 960)
c = np.hstack((a, b))


def integration(arrayC):
    temp = 0
    integration = []
    for i in range(len(arrayC)):
        integration.append(temp+arrayC[i])
        temp += arrayC[i]
    return integration


plt.plot(t, integration(c))
plt.ylabel("Posisjon (m)")
plt.xlabel("Tid (s)")
plt.show()
```



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10)

$V_{0y} = 150 m/s \cdot \sin(30^\circ)$

$X_y(t) = 0_m + 150_{m/s} \sin(30^\circ) t + \frac{1}{2} \cdot -9{,}8 \cdot t^2$

$0 = 150 \cdot \sin(30^\circ) t + \frac{1}{2} \cdot -9{,}8 t^2$

$\Rightarrow t_1 = 0 \quad t_2 = \underline{\underline{15{,}3 s}}$

Det tar ~~[illegible]~~ $\underline{\underline{15 s}}$ før kulen treffer bakken.

Lengde i Horisontal retning

$X_x(t) = 150 m/s \cdot \cos(30^\circ) \cdot t$

$X_x(15 s) = 150 m/s \cdot \cos(30^\circ) \cdot 15 s = \underline{\underline{2.0 km}}$

11)

Her behøves kun å regne akselerasjonsleddet for $X_x(t) = X_0 + V_0 t + \frac{1}{2} a t^2$

$\frac{1}{2} \cdot 0.03 m/s^2 \cdot 15^2 s^2 = \underline{\underline{3{,}4 m}}$

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12)

$$x(t) = 10\,m/s \cdot t + \frac{1}{2} \cdot -9{,}8\,m/s^2 \, t^2$$

$$x(t) = 5$$

$$\Rightarrow \frac{1}{2} \cdot -9{,}8_{m/s^2} t^2 + 10\,m/s \cdot t - 5 = 0$$

$$\Rightarrow t_1 = 0.876100\,s$$

$$t_2 = 1{,}164715\,s$$

$$t_2 - t_1 = \underline{\underline{0{,}29\,s}}$$

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