

Computation sheet for examples 1–2 section 2.3

```
> restart :
  Digits := 5 :
```

Example 1:

```
> a1 := -9.8;
  v1 := t → -9.8 · t + 49;
  y1 := t → -4.9 · t2 + 49 · t;

                                a1 := -9.8
                                v1 := t → (-1) · 9.8 t + 49
                                y1 := t → (-1) · 4.9 t2 + 49 t
```

(1)

Example 2: First, check our hand work:

```
> deqtn := diff(v(t), t) = -rho · (v(t) + g/rho);
  ics := v(0) = v0; # if I'd used a subscript "0" there would be issues for v(t) later.

                                deqtn := d/dt v(t) = -ρ (v(t) + g/ρ)
                                ics := v(0) = v0
```

(2)

```
> with(DEtools) :
  dsolve({deqtn, ics});

                                v(t) = -g/ρ + e-ρt (v0 + g/ρ)
```

(3)

```
> v := t → vτ + e-ρt (v0 - vτ); # vτ = -g/ρ

  deqtn2 := diff(y(t), t) = v(t);
  ics2 := y(0) = y0;
  dsolve({deqtn2, ics2});

                                v := t → vτ + e-ρt (v0 - vτ)
                                deqtn2 := d/dt y(t) = vτ + e-ρt (v0 - vτ)
                                ics2 := y(0) = y0

                                y(t) = -e-ρt (v0 - vτ)/ρ + vτ t + y0 + (v0 - vτ)/ρ
```

(4)

```
> y := t → -e-ρt (v0 - vτ)/ρ + vτ t + y0 + (v0 - vτ)/ρ;

                                y := t → -e-ρt (v0 - vτ)/ρ + vτ t + y0 + (v0 - vτ)/ρ
```

(5)

Now plug in our values:

```
> v0 := 49.;
  g := 9.8;
  y0 := 0;
  ρ := .04;
  vτ := - $\frac{g}{\rho}$ ;
  v(t);
  y(t);
```

$v0 := 49.$

$g := 9.8$

$y0 := 0$

$\rho := 0.04$

$v\tau := -245.00$

$-245.00 + 294.00 e^{-0.04t}$

$-7350.0 e^{-0.04t} - 245.00 t + 7350.0$

(6)

```
> solve(v(t) = 0.0, t);
```

4.5580

(7)

```
> y(4.5580); # maximum height
```

108.3

(8)

```
> solve(y(t) = 0.0, t); # should give landing time
```

9.4110, 0.

(9)

```
> 9.4110 - 4.5580; # falling time
```

4.8530

(10)

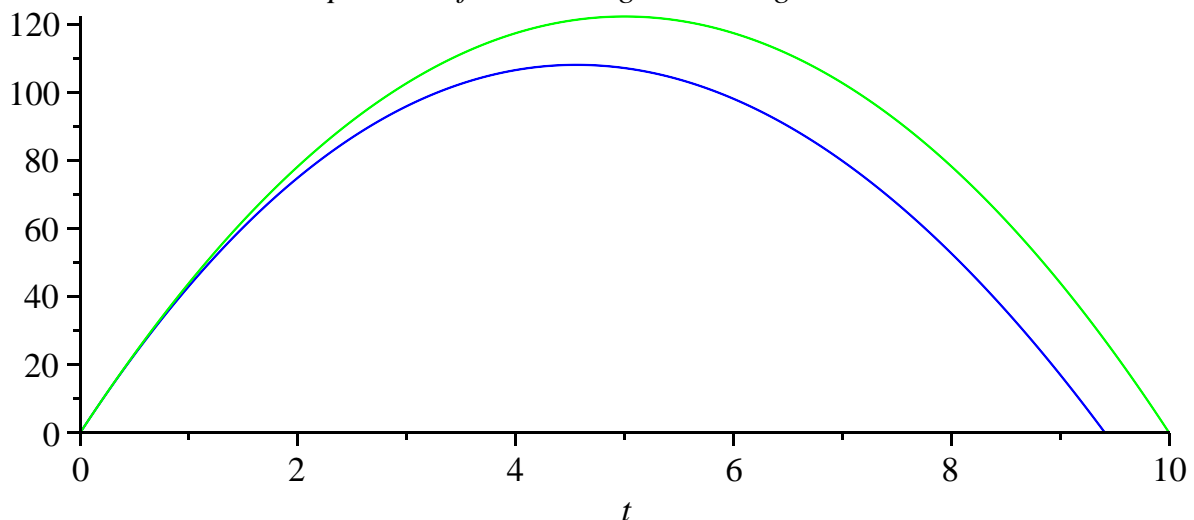
```
> with(plots) :
```

```
  plot1 := plot(y1(t), t=0..10, color = green) :
```

```
  plot2 := plot(y(t), t=0..9.4110, color = blue) :
```

```
  display( {plot1, plot2}, title = 'comparison of linear drag vs no drag models');
```

comparison of linear drag vs no drag models



L>