PRACTICAL -1 (a)
EXPONENTIAL GROWTH MODEL

Example 1:- Suppose that the population of a certain country grows at an annual rate of 2%.If the current population is 3 million, what will the population be in 10 years? Also plot the graph of the solution.

Solution :- Here $x_0 = 3$, $k = 2\% = 0.02$, t = 10 years, x[t]= ?

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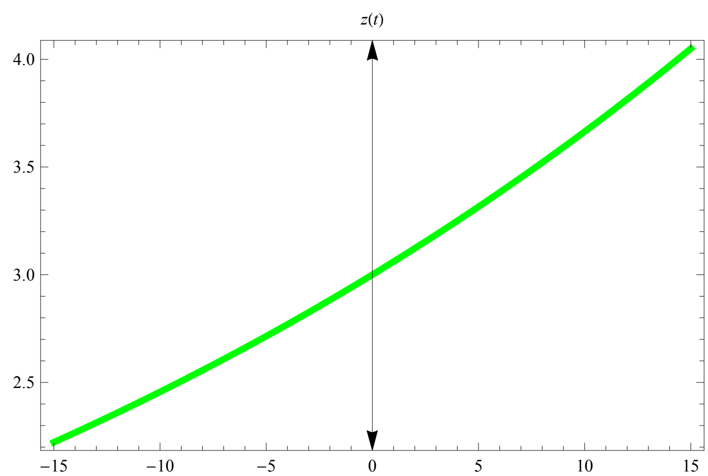
In[11]:= sol = DSolve[z'[t] == k z[t], z[t], t]
sol1 = Evaluate[z[t] /. sol[[1]] /. {k → 0.02, C[1] → 3}]
Plot[sol1, {t, -15, 15}, PlotStyle → {Green, Thickness[0.01]},
 AxesLabel → {t, z[t]}, AxesStyle → Arrowheads[{-.03, .03}], Frame → True]
z[10] = sol1 /. {t → 10};
```

Out[11]= $\{\{z[t] \to e^{k\,t}\, C[1]\}\}$

Out[12]= $3\, e^{0.02\, t}$

Out[13]=



Example 2 :- In the same country as in Example 1, how long will it take the population to reach 5 million ?

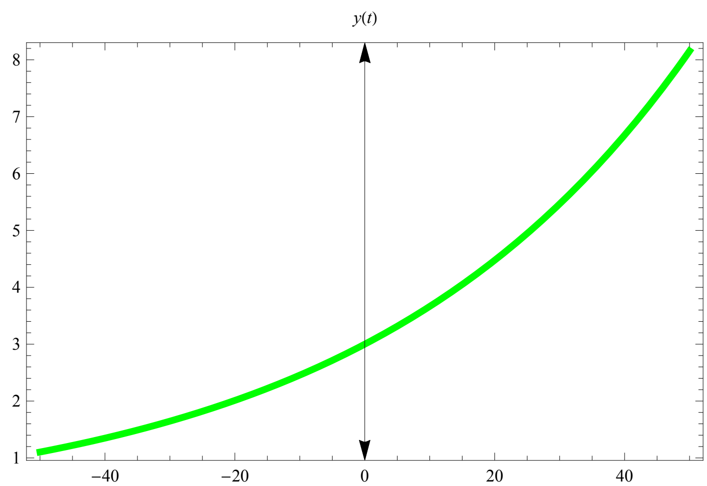
Solution :- Here $x_0 = 3$, $k = 2\% = 0.02$ and x[t] = 5 for some time t.

In[15]:=
```
sol = DSolve[y'[t] == k y[t], y[t], t]
sol1 = Evaluate[y[t] /. sol[[1]] /. {k → 0.02, C[1] → 3}]
Plot[sol1, {t, -50, 50}, PlotStyle → {Green, Thickness[0.01]},
 AxesLabel → {t, y[t]}, AxesStyle → Arrowheads[{-.03, .03}], Frame → True]
Solve[sol1 == 5, t]
```

Out[15]= $\{\{y[t] \to e^{k t} C[1]\}\}$

Out[16]= $3 e^{0.02 t}$

Out[17]=



Solve::ifun :

Inverse functions are being used by Solve, so some solutions may not be found; use Reduce for complete solution information. ≫

Out[18]= $\{\{t \to 25.5413\}\}$

Conclusion:- Hence population will reach to % million in 25.5413 years approximately.

Example 3 :- Soppose that the size of a bacterial culture is given by the function P(t) = 100 $e^{0.15\,t}$ where the size P(t) is measured in ghrams and time t is measured in hours. How long will it take for the culture to double in size?

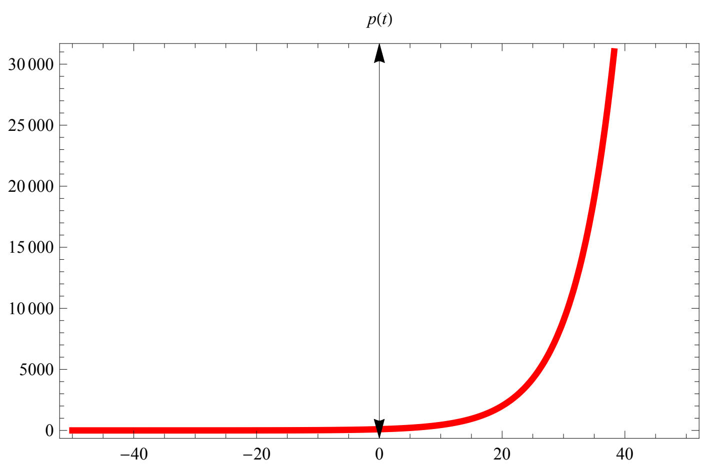
Solution :- Here P_0=100, k=15%=0.15 and t =?

In[19]:=
```
Clear[t, k];
sol = DSolve[p'[t] == k p[t], p[t], t]
sol1 = Evaluate[p[t] /. sol[[1]] /. {k → 0.15, C[1] → 100}]
Plot[sol1, {t, -50, 50}, PlotStyle → {Red, Thickness[0.01]},
 AxesLabel → {t, p[t]}, AxesStyle → Arrowheads[{-.03, .03}], Frame → True]
Solve[sol1 == 200, t]
```

Out[20]= {{p[t] → $e^{k\,t}$ C[1]}}

Out[21]= 100 $e^{0.15\,t}$

Out[22]=



Solve::ifun :

Inverse functions are being used by Solve, so some solutions may not be found; use Reduce for complete solution information. ≫

Out[23]= {{t → 4.62098}}

DECAY MODEL

Example 1 :- Suppose that a certain radioactive element has an annual decay rate of 10% starting with a 200 gram sample of the element, how many grams will be left in 3 years ?

Solution :- Here k =10%=0.1, x(0) = 200, t=3, x(t) = ?

In[24]:=
```
Sol = DSolve[y'[t] == -k y[t], y[t], t]
Sol /. {k → 0.1, y[t] → 200, t → 3}
c[1] = 200 / 0.740818 // N
Sol1 = Evaluate[y[t] /. Sol[[1]] /. {k → 1.0, C[1] → 269.972}]
Plot[Sol1, {t, -50, 50}, PlotStyle → {Red, Thickness[0.01]},
 AxesLabel → {t, y[t]}, AxesStyle → Arrowheads[{-.03, .03}], Frame → True]
y[3] = Evaluate[Sol1 /. {t → 3}]
```

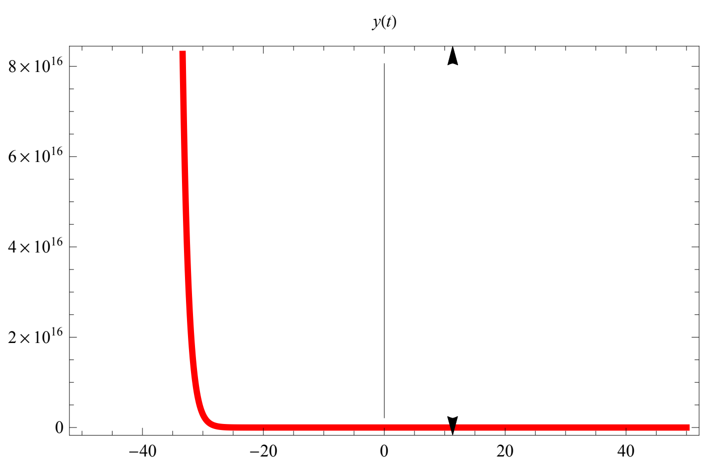
Out[24]= $\{\{y[t] \to e^{-k\,t}\, C[1]\}\}$

Out[25]= $\{\{200 \to 0.740818\, C[1]\}\}$

Out[26]= 269.972

Out[27]= $269.972\, e^{-1.\,t}$

Out[28]=



Out[29]= 13.4411