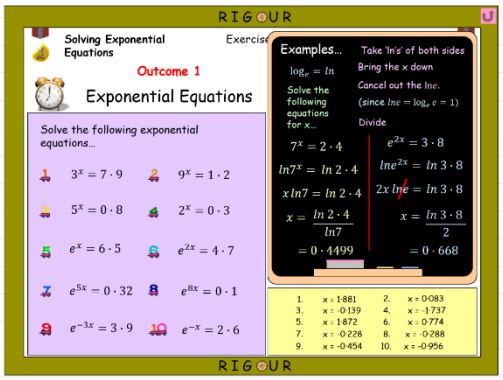
Bronze Outcome 1 – Exponential equations



① $3^x = 7 \cdot 9$
$\ln 3^x = \ln 7 \cdot 9$
$x \ln 3 = \ln 7 \cdot 9$
$x = \frac{\ln 7 \cdot 9}{\ln 3}$
$= 1 \cdot 881$

② $9^x = 1 \cdot 2$
$\ln 9^x = \ln 1 \cdot 2$
$x \ln 9 = \ln 1 \cdot 2$
$x = \frac{\ln 1 \cdot 2}{\ln 9}$
$= 0 \cdot 083$

③ $5^x = 0 \cdot 8$
$\ln 5^x = \ln 0 \cdot 8$
$x \ln 5 = \ln 0 \cdot 8$
$x = \frac{\ln 0 \cdot 8}{\ln 5} = -0 \cdot 139$

④ $2^x = 0 \cdot 3$
$\ln 2^x = \ln 0 \cdot 3$
$x \ln 2 = \ln 0 \cdot 3$
$x = \frac{\ln 0 \cdot 3}{\ln 2}$
$= -1 \cdot 737$

⑤ $e^x = 6 \cdot 5$
$\ln e^x = \ln 6 \cdot 5$
$x \ln e = \ln 6 \cdot 5$
$x = \ln 6 \cdot 5$
$= 1 \cdot 872$

⑥ $e^{2x} = 4 \cdot 7$
$\ln e^{2x} = \ln 4 \cdot 7$
$2x \ln e = \ln 4 \cdot 7$
$x = \frac{\ln 4 \cdot 7}{2}$
$= 0 \cdot 774$

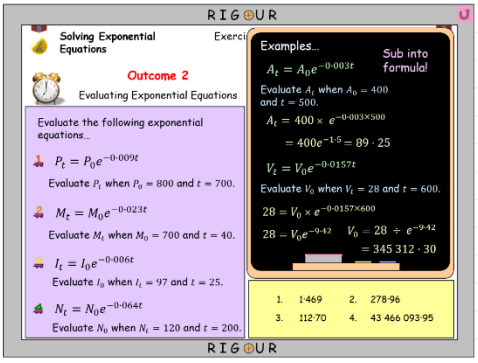
⑦ $e^{5x} = 0 \cdot 32$
$\ln e^{5x} = \ln 0 \cdot 32$
$5x \ln e = \ln 0 \cdot 32$
$x = \frac{\ln 0 \cdot 32}{5}$
$= -0 \cdot 288$

⑧ $e^{8x} = 0 \cdot 1$
$\ln e^{8x} = \ln 0 \cdot 1$
$8x \ln e = \ln 0 \cdot 1$
$x = \frac{\ln 0 \cdot 1}{8}$
$= -0 \cdot 288$

⑨ $e^{-3x} = 3 \cdot 9$
$\ln e^{-3x} = \ln 3 \cdot 9$
$-3x \ln e = \ln 3 \cdot 9$
$x = \frac{\ln 3 \cdot 9}{-3} = -0 \cdot 454$

⑩ $e^{-x} = 2 \cdot 6$
$\ln e^{-x} = \ln 2 \cdot 6$
$-x \ln e = \ln 2 \cdot 6$
$x = \frac{\ln 2 \cdot 6}{-1} = -0 \cdot 956$

Silver Outcome 2 – Evaluating exponential equations



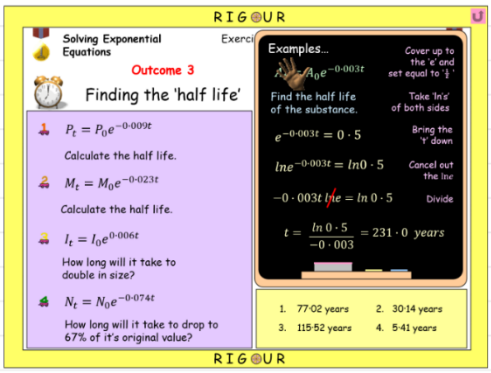
① $P_t = 800 \times e^{-0 \cdot 009 \times 700}$
$= 800 \times e^{-6 \cdot 3} = 1 \cdot 469$

② $M_t = 700 \times e^{-0 \cdot 023 \times 40}$
$= 700 \times e^{-0 \cdot 92} = 278 \cdot 96$

③ $97 = I_0 e^{-0 \cdot 006 \times 25}$
$97 = I_0 e^{-0 \cdot 15}$
$I_0 = 97 \div e^{-0 \cdot 15} = 112 \cdot 70$

④ $120 = N_0 e^{-0 \cdot 064 \times 200}$
$120 = N_0 e^{-12 \cdot 8}$
$N_0 = 120 \div e^{-12 \cdot 8}$
$= 43\,466\,093 \cdot 95$

Gold Outcome 3 – Finding the "half life"



① $e^{-0.009t} = 0.5$ (for half life set = 0.5)

$\ln e^{-0.009t} = \ln 0.5$

$-0.009t \ln e = \ln 0.5$

$t = \frac{\ln 0.5}{-0.009} = 77.02$ years

② $e^{-0.023t} = 0.5$

$\ln e^{-0.023t} = \ln 0.5$

$-0.023t \ln e = \ln 0.5$

$t = \frac{\ln 0.5}{-0.023} = 30.14$ years

③ $e^{0.006t} = 2$ (to double set = 2)

$\ln e^{0.006t} = \ln 2$

$0.006t \ln e = \ln 2$

$t = \frac{\ln 2}{0.006} = 115.52$ years

④ $e^{-0.074t} = 0.67$ $\left(67\% = \frac{67}{100} = 0.67\right)$

$\ln e^{-0.074t} = \ln 0.67$

$-0.074t \ln e = \ln 0.67$

$t = \frac{\ln 0.67}{-0.074} = 5.41$ years