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# 14·3 Exponential Modelling

1) a) $P = 20000e^{0.01t}$

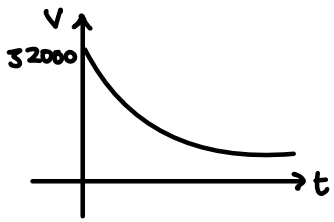
$\frac{dP}{dt} = 200e^{0.01t}$

b) $t = 10$

$200e^{0.01 \times 10} = 221.03$

↳ 221·0

2) a) $V = 32000e^{-0.08t}$




b) $\frac{dV}{dt} = -2560e^{-0.08t}$

c) $t = 10$

$-2560e^{-0.08 \times 10}$

$= -516.85$

↳ −516·9

d) The slope is negative so the value of the car is decreasing.

3) a) $D = 1300e^{\frac{1}{8}t}$

i) $t = 0$

$1300e^{\frac{1}{8} \times 0} = 1300$

ii) $t = 2$

$1300e^{\frac{1}{8} \times 2} = 1669.23$

↳ 1669

iii) 30 months → $\frac{1}{12} \times 30$

$t = \frac{5}{2}$ $= \frac{5}{2}$ years

$1300e^{\frac{1}{8} \times \frac{5}{2}} = 1776.88$

↳ 1777

b) The initial deer population

c) $\frac{dD}{dt} = 162.5e^{\frac{1}{8}t}$

d) sub $t = 8$ into $\frac{dD}{dt}$

$162.5e^{\frac{1}{8} \times 8} = 441.72 \approx 440$

e) $t = 80$

$162.5e^{\frac{1}{8} \times 80} = 357980$

This is not a reasonable value

4) a) $V = 29000e^{-0.12t}$

$t = 6$

$29000e^{-0.12 \times 6} = 14115.815$

↳ £14115·82

b) i) $\frac{dV}{dt} = -3480e^{-0.12t}$

$t = 2$

$-3480e^{-0.12 \times 2} = -2737.46$

ii) $t = 6$

$-3480e^{-0.12 \times 6} = -1693.897$

↳ −1693·90

c) The value decreases over the first 6 years of ownership. Initially it decreases more quickly then more slowly.

5) a) $P_0 = 18000$

b) $P = 18000e^{0.02t}$

$\frac{dP}{dt} = 360e^{0.02t}$

$t = 25$ $\quad 2005 - 1980 = 25$ years

$360e^{0.02 \times 25} = 593.53$

$\hookrightarrow 594$

c) The population would be increasing at an increasingly rapid rate, making it very unlikely the model is valid.

6) a) $P = 250e^{-0.15t}$

$t = 6$

$250e^{-0.15 \times 6} = 101.642$

$\hookrightarrow 101.6$ mg

b) $\frac{dP}{dt} = -37.5e^{-0.15t}$

$= -0.15P$

$k = -0.15$

c) $k$ is negative, so the amount of paracetamol in the body is decreasing.

7) a) $V = 150000e^{0.06t}$

$t = 0$

$150000e^{0.06 \times 0} = £150000$

b) $t = 7$

$150000e^{0.06 \times 7} = £228294$

c) $\frac{dV}{dt} = 9000e^{0.06t}$

d) Sub $t = 8$ into $\frac{dV}{dt}$

$9000e^{0.06 \times 8} = £14644.67$

Sub $t = 9$ into $\frac{dV}{dt}$

$9000e^{0.06 \times 9} = £15444.06$

During 8–9 years, property prices increases by £15000 per year so the conditions are right for the crash.