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1.1: Exponential models

① $Y = \log y \quad X = x \quad ; \quad Y = 0.7 + 1.2X$

a) $y = kb^x$ b) $\log y = 0.7 + 1.2x \Rightarrow 10^{\log y} = 10^{0.7+1.2x} \Rightarrow y = 10^{0.7} \times 10^{1.2x}$

$\Rightarrow k = 5.01 \quad b = 15.8 \ (3sf)$

② $Y = \log y \quad X = \log x \quad ; \quad Y = 1.5 + 0.8X$

a) $y = ax^n$ b) $\log y = 1.5 + 0.8 \log x \Rightarrow \log y = 1.5 + \log x^{0.8}$

$\Rightarrow y = 10^{1.5} \times 10^{\log(x)^{0.8}} \Rightarrow y = 10^{1.5} \times x^{0.8} \Rightarrow a = 31.6 \ (3sf)$

$n = 0.8$

③ $X = x \quad Y = \log y \quad ; \quad (11, 7.6)(18, 11.1) \quad ; \quad y = kb^n$

$Y = mx + c \quad m = \frac{11.1 - 7.6}{18 - 11} = 0.5 \Rightarrow 7.6 = 0.5(11) + c$

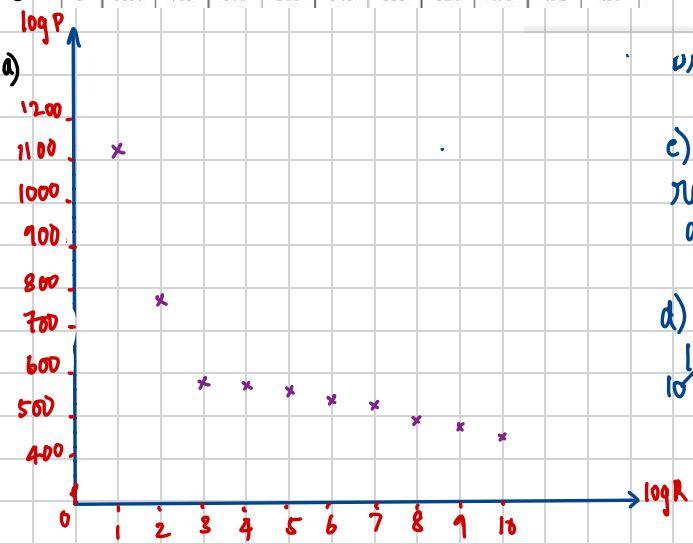
$\Rightarrow c = 2.1$

$\Rightarrow \log y = 0.5x + 2.1 \Rightarrow y = 10^{0.5x} \times 10^{2.1} \Rightarrow k = 126 \quad b = 3.16 \ (3sf)$

④

R	1	2	3	4	5	6	7	8	9	10
P	1137	785	578	561	546	535	524	496	492	459

a)



b) strong negative correlation

c) Yes; the variable shows a linear relationship when $\log P$ is plotted against to $\log R$

d) $X = \log R \quad Y = \log P \quad ; \quad y = 3.00 - 0.355x$

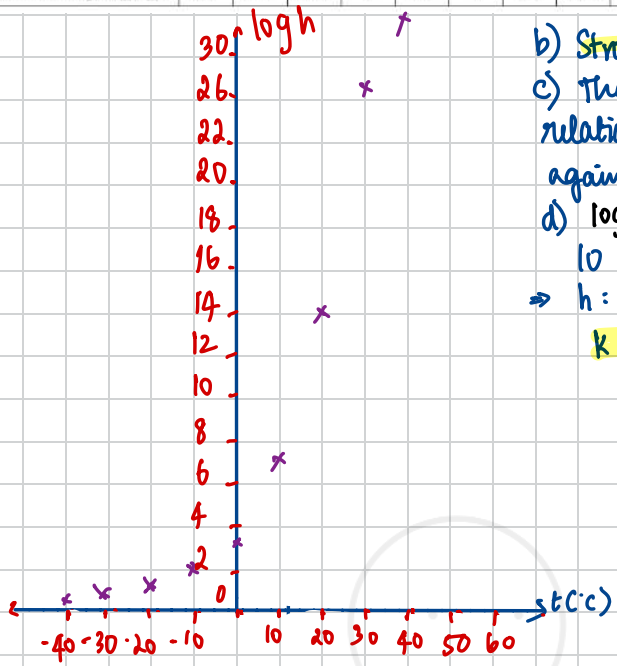
$\log P = 3 - 0.355 \log R$

$\Rightarrow P = 10^3 \times R^{-0.355} \Rightarrow P = 1000R^{-0.355}$

(5)

Temperature, t (°C)	−40	−30	−20	−10	0	10	20	30	40
Specific humidity, h (g/kg)	0.1	0.3	0.75	2	3.5	7	14	26.5	47

a)



b) Strong positive correlation

c) The variables shows a linear relationship when log h is plotted against t.

d) $\log h = 0.476 + 0.0327t$

$\Rightarrow h = 10^{0.476} \times 10^{0.0327t}$ $[h = kb^t]$

$k = 2.99$ $b = 1.08$ (3sf)

(6) $x = \log W$ $y = \log E$; $y = 1.02x - 1.22$

$\Rightarrow \log E = 1.02(\log w) - 1.22 \Rightarrow \log E = \log w^{1.02} - 1.22$

$\Rightarrow 10^{\log E} = 10^{\log w^{1.02}} \times 10^{-1.22} \Rightarrow E = 0.0603 w^{1.02}$, $a = 0.0603$, $n = 1.02$ (3SF)

(7) $x = l$ $y = \log m$; $y = 3.27x + 1.50$

$\Rightarrow 10^{\log m} = 10^{3.27l} \times 10^{1.50} \Rightarrow m = 1860^{l} \times 31.6$; $k = 31.6$ $b = 1860$ (3sf)

(8) $x = \log N$ $y = \log H$; $y = 2.6 + 0.67x$

a) $\log H = 2.6 + 0.67(\log N) \Rightarrow 10^{\log H} = 10^{2.6} \times 10^{\log N^{0.67}} \Rightarrow H = 398 N^{0.67}$; $a = 398$, $n = 0.67$ (3SF)

b) 900 kg/ha is outside the range of the data (extrapolation)