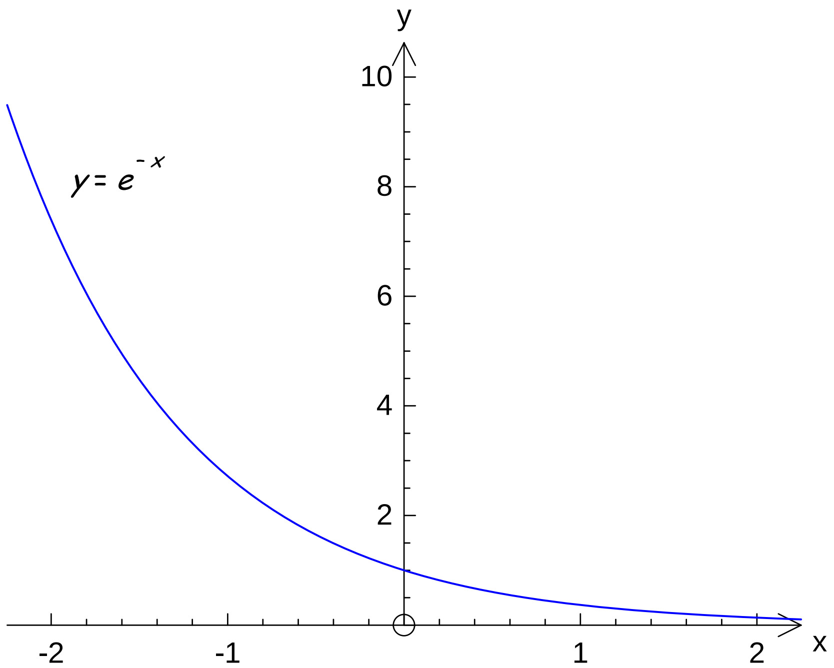
Complete solutions to Exercise 5(b)

1. Substituting $T_1 = 1000$, $\mu = 0.2$ and $\theta = 2\pi/3$ into $T_2 = T_1 e^{\mu\theta}$ gives

$$T_2 = 1000\, e^{0.2 \times 2\pi/3} = 1520.26 \text{ N} \quad \text{(by calculator)}$$

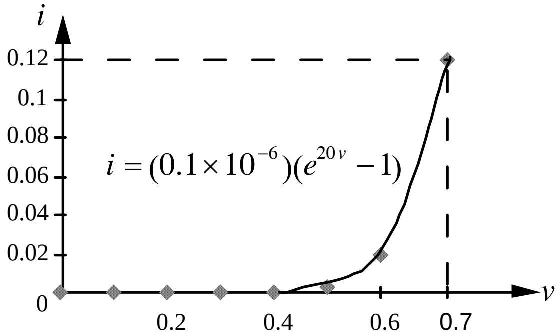
2.

x	-2	-1	0	1	2
$y = e^{-x}$	$e^2 = 7.39$	$e^1 = 2.72$	$e^0 = 1.00$	$e^{-1} = 0.37$	$e^{-2} = 0.14$



3.

v	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
i	0	6.39×10^{-7}	5.36×10^{-6}	4.02×10^{-5}	2.93×10^{-4}	2.2×10^{-3}	16.27×10^{-3}	0.12



4. (a) $p = \left(20\times10^3\right)e^{-\left(1.25\times10^{-4}\right)\times\left(5\times10^3\right)} = 10705$ Pa

(b) $p = \left(20\times10^3\right)e^{-\left(1.25\times10^{-4}\right)\times\left(7\times10^3\right)} = 8337$ Pa

(c) $p = \left(20\times10^3\right)e^{-\left(1.25\times10^{-4}\right)\times\left(10\times10^3\right)} = 5730$ Pa

5. Substituting $t = 0$ gives $\theta = 300 + 100e^{0} = 400°C$

Substituting $t = 1$ gives $\theta = 300 + 100e^{-0.1} = 390°C$

Substituting $t = 2$ gives $\theta = 300 + 100e^{-0.2} = 382°C$

Substituting $t = 5$ gives $\theta = 300 + 100e^{-0.5} = 361°C$

6. We have $C = 1\times 10^{-6}$ because $\mu = 10^{-6}$:

$$W = \frac{1}{2}\times\left(1\times10^{-6}\right)\times\left[e^{-\left(1\times10^{3}\right)t}\right]^2 = \left(0.5\times10^{-6}\right)\underbrace{e^{-\left(2\times10^{3}\right)t}}_{\text{by (5.3)}}$$

7. (a)

$$p = \left(1-e^{-t/2\times10^{-6}}\right)\left(0.4e^{-t/2\times10^{-6}}\right)$$
$$= 0.4\left(e^{-t/2\times10^{-6}} - e^{-2t/2\times10^{-6}}\right)$$
$$= 0.4\left(e^{-t/2\times10^{-6}} - e^{-t/1\times10^{-6}}\right) \text{ (cancelling the 2's on the index)}$$

(b) We have

$$p = e^{-\left(5\times10^{3}\right)(t-1)}.(-0.05)e^{-\left(5\times10^{3}\right)(t-1)} \underbrace{=}_{\text{by (5.1)}} -0.05e^{-\left(5\times10^{3}\right)(t-1)-\left(5\times10^{3}\right)(t-1)}$$

$$p = -0.05e^{-\left(10\times10^{3}\right)(t-1)}$$

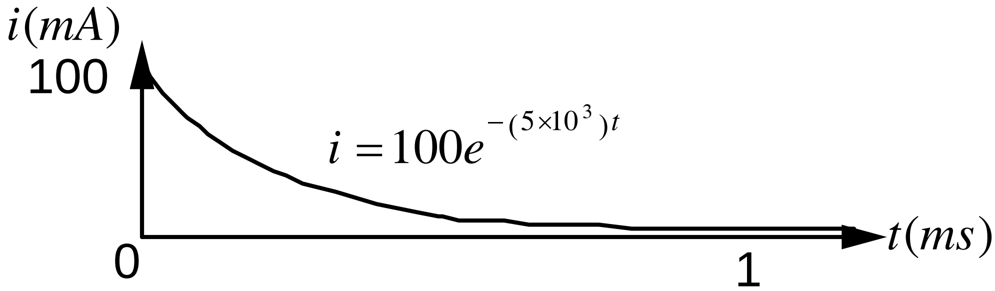
The idea of negative power might seem strange but negative current refers to a capacitor discharging, and so the negative value of p refers to the power delivered to the load.

8.

$$p = 5\left(e^{-200t}-e^{-800t}\right)\left(e^{-200t}+400e^{-800t}\right)$$
$$= 5\left[\left(e^{-200t}.e^{-200t}\right)+400\left(e^{-800t}.e^{-200t}\right)-\left(e^{-800t}.e^{-200t}\right)-400\left(e^{-800t}.e^{-800t}\right)\right]$$
$$\underbrace{=}_{\text{by (5.1)}} 5\left[\left(e^{-200t-200t}\right)+400\left(e^{-800t-200t}\right)-\left(e^{-800t-200t}\right)-400\left(e^{-800t-800t}\right)\right]$$
$$= 5\left(e^{-400t}+\underbrace{400e^{-1000t}-e^{-1000t}}_{=399e^{-1000t}}-400e^{-1600t}\right)$$
$$= 5\left(e^{-400t}+399e^{-1000t}-400e^{-1600t}\right)$$
$$p = 5e^{-400t}\left(1+399e^{-600t}-400e^{-1200t}\right)$$

9. Since there is a negative sign in front of the exponential index, it is a decaying graph. Moreover since the index is a large negative number, -5×10^{3}, the graph decays within milliseconds, (ms).

At $t = 0$ the current i is $100mA$:



10. When $t = 0,\ e^{0} = 1,$ so $v = 0.$

As $t \to \infty,\ e^{-t} \to 0.$ Hence $v \to 20(1-0) = 20$

(5.1) $$a^m a^n = a^{m+n}$$

(5.3) $\left(a^m\right)^n = a^{m\times n}$