All members were present for all of the work

1. (a) $L'$ denotes the number of filters/kernels adding layers of depth to the output in the form of feature maps.

   (b)
   $$w' = \frac{w - k + 2p}{s} + 1 \tag{1}$$

   (c) Firstly, we're given that we are doing same convolution, i.e., $w' = w$. Thus, in order to solve for $p$ with the equation above, we can just set $w' = w$ and solve the equation using algebra, which gives us
   $$\begin{aligned} w &= \frac{w - k + 2p}{s} + 1 \\ w - 1 &= \frac{w - k + 2p}{s} \\ s(w-1) &= w - k + 2p \\ p &= \frac{s(w-1) - w + k}{2} \end{aligned}$$

2. (a) For $w'$, we get
   $$\begin{aligned} w' &= \frac{w - k + 2p}{s} + 1 \\ &= \frac{100 - 10 + 2(0)}{2} + 1 \\ &= 46. \end{aligned}$$
   Thus, with 20 filters, we get $w' \times w' \times L' = 46 \times 46 \times 20$

   (b) $k \times k$ kernel with 5 input channels with 1 bias per multiplied by 20 filters results in: $((10 \times 10 \times 5) + 1) \times 20 = 10020$

   (c) $((10 \times 10 \times 5) + 1) \times (46 \times 46) \times 20 = 21,202,320$

3. The stride of 2 will split the input in half after the dimension reduction from the kernel.
   $$\begin{aligned} w' &= \frac{w - 2 + 2P}{S} + 1 \\ w' &= \frac{100 - 2 + 2(0)}{2} + 1 \\ w' &= 50. \end{aligned}$$

   Since the pooling does not affect the number of feature maps, we know that $L' = 32$. Thus, $w' \times w' \times L' = 50 \times 50 \times 32$

4. (a) $w$ for $A_{(1)}$: $w = \frac{w-k+2p}{s} + 1 = \frac{101-6+2\times 0}{2} + 1 = 46.$

$w$ for $A_{(2)}$: $w = \frac{46-6+2\times 0}{2}$

$A_{(2)} w' = 20$

$A_{(2)} L' = 4$

(b) $12 \times 12 = 144$
$(k * 2)^2$

5. $A = \begin{bmatrix} \alpha & \beta \\ \gamma & \delta \end{bmatrix}$

Flipped $A = \begin{bmatrix} \delta & \gamma \\ \beta & \alpha \end{bmatrix}$

$K = \begin{bmatrix} A & B & C \\ D & E & F \\ G & H & I \end{bmatrix}$

$$\begin{bmatrix} \delta A & \delta B & \delta C + \gamma A & \gamma B & \gamma C \\ \delta D & \delta E & \delta F + \gamma D & \gamma E & \gamma F \\ \delta G + \beta A & \delta H + \beta B & \delta I + \gamma G + \beta C + \alpha A & \gamma H + \alpha B & \gamma I + \alpha C \\ \beta D & \beta E & \beta F + \alpha D & \alpha E & \alpha F \\ \beta G & \beta H & \beta I + \alpha G & \alpha H & \alpha I \end{bmatrix}$$