1. Since there is a 20% down payment, the loan amount is $80\% \times 5m = 4m$ peso.
   (a) The yearly payment is

$$A = 4m(A/P, 40\%, 15) = 4m \times \frac{0.4}{1 - \frac{1}{1.4}^{15}} = 1,610,351$$

   (b) Since the nominal interest rate is 40%, the effective monthly rate is $40\%/12 = 3.33\%$. The monthly payment is

$$A = 4m(A/P, 3.33\%, 15 \times 12) = 4m \times \frac{0.033}{1 - \frac{1}{1.033}^{180}} = 134,196$$

2. (a) True. The equivalent annual effective rate is $e^r - 1 = 0.105 > 0.1 = r$.
   (b) True. The effectively monthly rate is $e^{r/12} - 1 = 1.005\%$. The principal is is then

$$P = \$185(P/A, 1.005\%, 24) = \$3927.68.$$

   The balance after the tenth monthly payment is made is

$$\$185(P/A, 1.005\%, 14) = \$2404.81 > \$1963.84 = \$3927.68/2$$

   (c) False. The present value of \$1791 ten years from now is

$$\$1791(P/F, 4\%, 20) = \$817 \neq \$900$$

   (d) False. For example, when $n = 2$, we have

$$(P/A, i\%, n) = \frac{1}{1+i} + \frac{1}{(1+i)^2} \neq 2\frac{1}{1+i} = (P/F, i\%, 1)$$

   which is not true in general. In particular, this is not true unless $i = 0$.
   (e) (P/F, i%, n)

3. (a) Since the withdrawals are annual, we need the effective annual rate We have

$$i_{eff} = (1 + 12\%/12)^{12} - 1 = 12.68\%.$$

   The annual withdrawals are

$$\$10,000(A/P, 12.68\%, 4) = \$3339.79.$$

   (b) The effective semiannual rate is

$$(1 + 12\%/12)^6 - 1 = 6.15\%.$$

   And so the level of the equal withdrawals are

$$\$3339.79(A/F, 6.15\%, 2) = \$1620$$

(c) The effective rate per four months is

$$(1 + 12\%/12)^4 - 1 = 4.06\%.$$

And so the level of the equal withdrawals are

$$\$3339.79(A/F, 4.06\%, 3) = \$1069$$

4. (a) The NPV at an interest rate of 5% is

$$-3020 + \frac{5000}{1+5\%} - \frac{5000}{(1+5\%)^2} + \frac{5000}{(1+5\%)^3} - \frac{5000}{(1+5\%)^4} = \$3.95$$

(b) The IRR is the value of i that solves

$$-3020 + \frac{5000}{1+i} - \frac{5000}{(1+i)^2} + \frac{5000}{(1+i)^3} - \frac{5000}{(1+i)^4} = 0.$$

Denote the left-hand-side of above by $NPV(i)$. From part (a) we know that $NPV(0.05) = 3.95 > 0$. Moreover, $NPV(0) = -20$ and $NPV(0.1) = -11.33$. Thus we know that there are at least two IRRs.

To find these two IRRs, we can carry out bisection iterations.

For the IRR between 0% and 5%:

$i = (i_{lo} + i_{hi})/2$	$NPV(i)$	range of IRR (i_{lo}, i_{hi})
0.025	$-1.98 < 0$	$(0.025, 0.05)$
0.0375	$2.33 > 0$	$(0.025, 0.0375)$
0.03125	$0.53 > 0$	$(0.025, 0.03125)$
0.028125	$-0.63 > 0$	$(0.028125, 0.03125)$
0.029688	$-0.028 < 0$	$(0.029688, 0.03125)$
0.030469	$0.257 > 0$	$(0.029688, 0.030469)$
0.030078	$0.116 > 0$	$(0.029688, 0.030078)$
0.029883	$0.044 > 0$	$(0.029688, 0.029883)$
0.029736	$-0.009967 < 0$	$(0.029736, 0.029785)$
0.029761	$-0.000896 < 0$	$(0.029761, 0.029785)$

At this point we note that both upper and lower bound for the IRR now rounds to 2.98% in three decimal places. Therefore we can say to there decimal places of accuracy that the IRR is 2.98%.

A similar calculation can be carried out for the IRR between 5% and 10% to obtain an IRR of 7.56%.

An alternative method to find the IRR is to narrow down the range to a small interval and do interpolation iterations. This is shown as follows:

By trying different interest rates we note that:

$NPV(3\%) = 0.087422 > 0$ and $NPV(2\%) = -4.531576$. We can use interpolation to estimate

$$\frac{4.531576}{IRR - 2\%} = \frac{0.087422 + 4.531576}{3\% - 2\%}$$

which gives an estimate of $i = 0.0298$.

We then check that $NPV(2.98\%) = 0.013668 > 0$. Say, we target at an accuracy of two decimal places. Then to make sure we have two decimal places of accuracy, we check the value of $NPV(2.975\%) = -0.004886$. This means that the IRR is within 2.975% to 2.98%, both of which rounds to 2.98%. At this point we can therefore conclude that the IRR is 2.98% to 2 decimal places of accuracy.

Note that we have initially narrowed down the interval to a length of 1% before doing interpolation. If you do interpolation with a larger interval, the error will be large and you generally need more than one interpolation iterations.

In this case, the cash flows have two IRRs. This is suggested by the multiple sign changes in the cash flows. In fact, the four sign changes suggest that there will be 4, 2, or 0 positive IRRs.