Solutions to the Math Exercises on pages 77/78 in your textbook

① Since the lunisolar calendar is 10 days shorter than a solar year, after 3 lunisolar calendars,

a $3 \cdot 10 = 30$ - day month must be inserted in the calendar to compensate for the difference.

$\Longrightarrow$ once every 3 years a 30-day month should be inserted in the calendar.

② if there were 12.8 lunations in a solar year,

then there would be 13 months in the lunisolar calendar,

since 13 is the closest possible whole number to 12.8.

(Please, refer to "Stepping Back from Calendars" on page 78)

③ Since the lunisolar calendar is 10 days longer than a solar year,
after 3 lunisolar calendars,

a $3 \cdot 10 = 30$-day month must be deleted

from the calendar to compensate for the difference.

(Please, compare with exercise ①)

$\Rightarrow$ once every 3 years a 30-day month should be deleted from the calendar

④ a moon completes its orbit around a planet once every 90 days,
and
the planet completes its orbit around its sun once every 600 days;
let x be the number of cycles (revolutions) for the moon to complete its orbit around the planet until the cycles of the moon and the planet coincide for the first time.

let y be the number of cycles (revolutions) for the planet to complete its orbit around its sun until the cycles of the moon and the planet coincide for the first time.

Since x and y denote number of cycles, both x and y must be positive integers (whole numbers), i.e., $x, y = 1, 2, 3, \ldots$.

Next, the equation, expressing the fact that the cycles of the moon and the planet coincide, is the following:

$$\boxed{90x = 600y} \quad ☺$$

Note: the left-hand side of ☺ is the number of days until the cycles coincide, so is the right-hand side.

Since dividing both sides of ☺ by a nonzero number doesn't change the solution, let's divide by 30 both sides and obtain an equivalent form for ☺, namely:

$$\boxed{3x = 20y}$$

We want to find the smallest possible positive integers that satisfy the relationship $3x = 20y$

Obviously, $x = 20$ and $y = 3$ are the numbers we are looking for.

Finally, in $90x = 90 \cdot 20 = \underline{1800}$ days the cycles will coincide.

(the same answer is $600y = 600 \cdot 3 = 1800$)