



## Problem of the Week Problem A and Solution Cleaning Calculation

### Problem

A housekeeper is responsible for cleaning all the rooms on one floor of a hotel. The floor has 16 regular rooms and 5 suites. Regular rooms take 20 minutes each to clean. Suites take 30 minutes each to clean.

- (a) How long does it take to clean all the rooms on the floor of the hotel?
- (b) If the housekeeper starts cleaning at 10:00 a.m. and does not take a break, at what time is the job finished?

### Solution

- (a) We can calculate the time it takes to clean the regular rooms by skip counting by 20:

20, 40, 60, 80, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300, 320

We see that it takes a total of 320 minutes to clean the regular rooms.

We can calculate the time it takes to clean the suites by skip counting by 30:

30, 60, 90, 120, 150

We see that it takes a total of 150 minutes to clean the suites. We add these two numbers together to see that it takes a total of  $320 + 150 = 470$  minutes to clean the entire floor.

From this total number of minutes, we could calculate the result in hours and minutes.

However, we could also recognize that when skip counting by 20, we get to 60 minutes after three 20-minute intervals. This means it takes an hour to clean three regular rooms.

We could count a bit differently:

20 min, 40 min, 1 hour, 80 min, 100 min, 2 hours, 140 min, 160 min, 3 hours, 200 min,  
220 min, 4 hours, 260 min, 280 mins, 5 hours, 320 mins

We can see that 320 minutes is equal to 5 hours and 20 minutes.

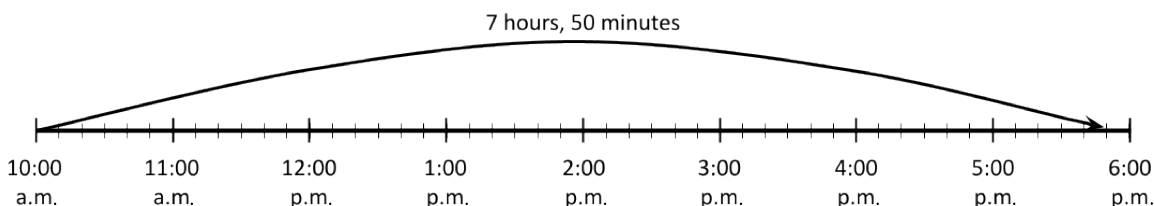
Similarly, we get to 60 minutes after two 30-minute intervals. With similar counting we see that 150 minutes is equal to 2 hours and 30 minutes.

Now we can find the total time taken as:

$$5 \text{ hours} + 2 \text{ hours} + 20 \text{ minutes} + 30 \text{ minutes}$$

which is equal to 7 hours and 50 minutes.

- (b) We can use a timeline to determine the time that is 7 hours and 50 minutes after 10:00 a.m.



Therefore, the housekeeper will finish the job at 5:50 p.m.



## Teacher's Notes

Although we often think of *rates* as being related to distance and time, we can describe this problem in terms of rates. The units we use when describing rates is:

$$(\text{some quantity})/(\text{some unit of time})$$

For example, a car's speed may be measured in *km/hr* or a computer's download speed may be measured in *MBits/sec*.

When working with rates involving distance and time, we can consider this formula that shows the relationship between *rate*, *distance*, and *time*:

$$\text{rate} = \frac{\text{distance}}{\text{time}}$$

Given any two of the values, we can use the formula to calculate the third. For example, if we know the *rate* and *time*, we can calculate the distance. Often we rearrange the formula to make it easier to calculate the missing value, where the missing value is isolated on one side of the equals sign.

$$\text{rate} \times \text{time} = \text{distance} \quad \text{and} \quad \text{time} = \frac{\text{distance}}{\text{rate}}$$

For this problem, we can consider the following formula for the rate of cleaning:

$$\text{rate} = \frac{\text{rooms}}{\text{time}}$$

For regular rooms, we know the rate is  $\frac{1 \text{ room}}{20 \text{ min}}$  and the number of rooms is 16.

We can rearrange the formula to isolate the time:

$$\text{time} = \frac{\text{rooms}}{\text{rate}}$$

Now we can substitute the actual numbers into this formula:

$$\text{time} = \frac{16 \text{ rooms}}{\frac{1 \text{ room}}{20 \text{ mins}}}$$

To calculate this result we must divide by a fraction, which we can do by inverting the fraction and multiplying like this:

$$\begin{aligned} \text{time} &= 16 \cancel{\text{rooms}} \times \frac{20 \text{ mins}}{1 \cancel{\text{room}}} \\ \text{time} &= 320 \text{ mins} \end{aligned}$$