Math Fundamentals PoW Packet

All Aboard!

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Welcome!

This packet contains a copy of the problem, our answer check, our solutions, and teaching suggestions. **The problem-specific scoring rubric is a separate stand-alone document available from a link on the problem page.** The problem is new, so we have no student work to share.

The Problem

In ***All Aboard!***, students apply basic operations skills along with concepts of time and elapsed time. There are two Extras, each one dealing with the concept of half. Extra 1 addresses the distances displayed on the schedule; Extra 2 extends the concept of elapsed time.

The text of the problem is included below. A print-friendly version is available using the *Print this Problem* link on the problem page.

All Aboard!

Read Down	Mile		
			Washington, DC (ET)
4 05P	0	Dp	Charlottesville—see back
4 29P	16		Rockville, MD
5 16P	55		Harpers Ferry, WV (Frederick, MD)
5 45P	74		Martinsburg, WV(Hagerstown, MD)
7 14P	146	Ar	Cumberland, MD
7 24P		Dp	
9 47P	239	Dp	Connellsville, PA
11 48P	299	Ar	Pittsburgh, PA
11 59P		Dp	
1 39A	383	Dp	Alliance, OH (Canton)
2 53A	439	Ar	Cleveland, OH
2 59A		Dp	
3 29A	464		Elyria, OH (Lorain)
4 02A	499		Sandusky, OH
5 08A	546	Ar	Toledo, OH
5 22A		Dp	Detroit, E. Lansing—see back
6 36A	624		Waterloo, IN (Ft. Wayne)
7 29A	679		Elkhart, IN
7 51A	696		South Bend, IN (ET)
			Chicago, IL–Union Station (CT)
8 45A	780	Ar	Madison—see back

Sasha wants to take the train to visit her friends over the holidays. Amtrak's Train 29, the Capitol Limited, leaves Union Station in Washington, D.C., at 4:05 p.m. Eastern Time.

It arrives at Chicago's Union Station at 8:45 a.m. Central Time the next morning.

How long will her trip take? Explain how you found the answer.

Extra 1: Use the schedule to find out which station is closest to half of the distance from Washington to Chicago.

Extra 2: Where will the train be when half of the time has passed?

Be sure to explain how you know.

Times in the Central Time Zone are one hour earlier than in the Eastern Time Zone. When it is 2 p.m. in Washington, it is 1 p.m. in Chicago. To see current times in cities around the world, visit http://www.timeanddate.com/worldclock/.

Answer Check

After students submit their solution, we encourage them to check their answer by looking at the answer that we provide. Below is what they will see.

Sasha's trip will take 17 hours and 40 minutes.

If your answer does not match ours,

- did you remember that Washington and Chicago are in different time zones?
- did you remember how many minutes are in an hour?
- did you understand that Sasha's trip was overnight?
- did you check your arithmetic?

If your answer does match ours,

- is your explanation clear and complete?
- did you try the Extras?
- did you verify your answer with another method?
- did you have any "Aha!" moments? Describe them.

Our Solutions

Here are two ways I imagine children might solve the problem. They are not meant to be prescriptive or comprehensive. We often receive solutions from students who have used approaches we've not anticipated. These are to be celebrated! I hope you will share such approaches on the *funpow-teachers* discussion board, along with any teaching strategies you found to be successful.

Strategy 1: Adjust to a friendly number; chunk the time before and after midnight

I pretended that the train left Washington 5 minutes earlier, at 4:00 p.m. instead of 4:05 p.m., and arrived 5 minutes earlier, at 8:40 a.m. This made the calculation easier but kept the total time the same. From 4 p.m. to 12:00 midnight is 8 hours. From midnight to 8:40 a.m. is 8 hours and 40 minutes. Then I added 8 hr + 8 hr + 40 min = 16 hr 40 min. I added an hour because 8:40 Central Time is 9:40 Eastern Time. Sasha's trip will take 17 hr 40 min.

Strategy 2: Count one hour at a time

I knew that the time Sasha arrived in Chicago was really 9:45 a.m. in Washington. I counted how many whole hours it would be from 4:05 p.m. until 9:05 a.m. the next morning. It was 17 hr. Then I knew it was another 40 min. to get to 9:45, so the trip took 17 hr and 40 min.

Extra 1: I looked at the timetable and saw that the total distance from Washington to Chicago was 780 miles. Half of 780 is 390. The station on the schedule that is closest to 390 miles from Washington is Alliance, OH, which is at the 383 mile mark, only 7 miles from halfway. The next station, Cleveland, is at 439 miles, 49 miles past halfway.

Extra 2: I needed to find half of the total time of 17 hr. 40 min. Half of 17 hr. is 8 hr. 30 min. Half of 40 min. is 20 min. 8 hr. 30 min. + 20 min. = 8 hr. 50 min. which is half the time of the trip. I added that onto the starting time. 8 hours past 4:05 p.m. is 12:05 a.m., or 5 minutes past midnight. I add the other 50 min. to find that the train would complete half of the time of its trip at 12:55 a.m. According to the schedule it would be somewhere between Pittsburgh and Alliance, and probably closer to Alliance.

Teaching Suggestions

All Aboard offers students an opportunity to learn how to find elapsed time. The problem could be integrated into a geography lesson. Timetables for all Amtrak trains can be downloaded from their web site, linked on the Online Resources Page. Learning to read such timetables is a useful life skill.

Students will need to understand how our time zones work, how hours and minutes are related, time notation, and the meaning of a.m. and p.m. There are a number of applets on the Online Resources Page that help illustrate these. When using an analog clock, it is important for students to understand how the hands of the clock move in relation to each other. Geared clocks, such as the Judy Clock, are more useful than ones in which the hands can be manipulated independently.

Adjusting numbers to make them "friendlier," as illustrated in Strategy 1 is a powerful technique for facilitating mental arithmetic in many problem contexts. It involves the concept that changing both numbers in a subtraction by the same amount results in the same difference. By the same token increasing one addend to a friendlier number and decreasing the other addend by the same amount maintains their sum. *Everyday Math* calls these the Same-Change Rule (subtraction) and the Opposite-Change Rule (addition.)

Scoring Rubric

The problem-specific scoring rubric we use to assess student solutions is a separate stand-alone document available from a link on the problem page. We consider each category separately when evaluating the students' work, thereby providing more focused information regarding the strengths and weaknesses in the work. A **generic student-friendly rubric** can be downloaded from the *Teaching with PoWs* link in the left menu (when you are logged in). We encourage you to share it with your students to help them understand our criteria for good problem solving and communication.

We hope these packets are useful in helping you make the most of Math Fundamentals Problems of the Week. Please let me know if you have ideas for making them more useful.

https://www.nctm.org/contact-us/