Math 7 Unit 1 worksheet: Temperatures below zero and temperature change (answer key)

ANSWERS AT A GLANCE

1. (a) 13, a rise (b) −16, a fall (c) 11, a rise (d) −14, a fall (e) −12, a fall (f) 19, a rise
2. Row 1: later 5. Row 2: change −14. Row 3: earlier −11. Row 4: change 18. Row 5: earlier −21.
3. (a) Monday, Wednesday and Friday. (b) Tuesday too cold by 2 degrees; Thursday too warm by 4 degrees; Saturday too cold by 1 degree.
4. (a) She added −3 instead of its opposite: subtracting −3 is adding 3. (b) −8, a fall of 8 degrees.
5. (a) −61 degrees, a fall of 61 degrees. (b) 38 degrees, a rise of 38 degrees.
6. (a) −10°F (b) 4°F
7. (a) 24 degrees (b) inside 13°C, outside −16°C (c) farther apart, by 5 degrees

WORKED SOLUTIONS

1. Find the change in temperature from the first reading to the second, and say whether it is a rise or a fall.

(a) −8°C to 5°C (b) 6°C to −10°C (c) −15°F to −4°F

(d) −7°F to −21°F (e) 0°C to −12°C (f) −19°C to 0°C

ANSWER

(a) 13, a rise (b) −16, a fall (c) 11, a rise (d) −14, a fall (e) −12, a fall (f) 19, a rise

SOLUTION

Every change is later minus earlier.

(a) 5 − (−8) = 5 + 8 = 13, a rise of 13 degrees.

(b) −10 − 6 = −16, a fall of 16 degrees.

(c) −4 − (−15) = −4 + 15 = 11, a rise of 11 degrees.

(d) −21 − (−7) = −21 + 7 = −14, a fall of 14 degrees.

(e) −12 − 0 = −12, a fall of 12 degrees.

(f) 0 − (−19) = 0 + 19 = 19, a rise of 19 degrees.

2. Each row of the table is one temperature change, in degrees Celsius, so that earlier + change = later. Fill in each blank.

Earlier	Change	Later
−9	14	_____
3	_____	−11
_____	−6	−17
−20	_____	−2
_____	8	−13

ANSWER

Row 1: later 5. Row 2: change −14. Row 3: earlier −11. Row 4: change 18. Row 5: earlier −21.

SOLUTION

Row 1: later = −9 + 14 = 5.

Row 2: change = later − earlier = −11 − 3 = −14.

Row 3: earlier = later − change = −17 − (−6) = −17 + 6 = −11. Check: −11 + (−6) = −17.

Row 4: change = −2 − (−20) = −2 + 20 = 18.

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Row 5: earlier = −13 − 8 = −21. Check: −21 + 8 = −13.

3. A clinic keeps a vaccine in a storage unit that must stay from −25°C to −15°C, including both of those readings. The log for one week shows:

Day	Mon	Tue	Wed	Thu	Fri	Sat
Reading (°C)	−18	−27	−15	−11	−24	−26

(a) On which days was the reading inside the safe range?

(b) For each day outside the range, say whether the unit was too warm or too cold, and by how many degrees the reading missed the range.

ANSWER

(a) Monday, Wednesday and Friday. (b) Tuesday too cold by 2 degrees; Thursday too warm by 4 degrees; Saturday too cold by 1 degree.

SOLUTION

(a) A safe reading lies on the scale between −25 and −15: $-25 \le t \le -15$. Monday's −18 and Friday's −24 are between them, and Wednesday's −15 is the top of the range itself, which counts.

(b) Tuesday: −27 < −25, below the range, so too cold, by −25 − (−27) = 2 degrees.

Thursday: −11 > −15, above the range, so too warm, by −11 − (−15) = 4 degrees.

Saturday: −26 < −25, too cold, by −25 − (−26) = 1 degree.

Notice that the reading with the largest size, −27, is the coldest, and the one with the smallest size, −11, is the warmest.

4. Sofia found the change in temperature from −3°C at dawn to −11°C at midnight like this:

$$-11 - (-3) = -14$$

She wrote: "The temperature fell 14 degrees."

(a) What mistake did Sofia make?

(b) Find the correct change, and check it by adding it to the dawn reading.

ANSWER

(a) She added −3 instead of its opposite: subtracting −3 is adding 3. (b) −8, a fall of 8 degrees.

SOLUTION

(a) Subtracting a number is adding its opposite, so −11 − (−3) means −11 + 3. Sofia worked it out as −11 + (−3).

(b) −11 − (−3) = −11 + 3 = −8. The change is negative, so the temperature fell 8 degrees. Check: −3 + (−8) = −11, the midnight reading. A fall of 14 from −3 would have ended at −17, too low.

5. Just before take-off, a plane's display shows an outside air temperature of 12°C. At cruising height it shows −49°C. The plane lands in a city where the air is −11°C.

(a) Find the change in the outside temperature from take-off to cruising height.

(b) Find the change from cruising height to landing.

ANSWER

(a) −61 degrees, a fall of 61 degrees. (b) 38 degrees, a rise of 38 degrees.

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SOLUTION

(a) Later minus earlier: −49 − 12 = −61. The change is negative, so the air outside cooled 61 degrees on the climb.

(b) Later minus earlier: −11 − (−49) = −11 + 49 = 38. The change is positive, a rise of 38 degrees, even though the landing reading is still below zero. Check: −49 + 38 = −11.

6. Between 3 p.m. and 9 p.m. the temperature at Jack's campsite fell 14 degrees. Between 9 p.m. and dawn it fell 6 more degrees, and at dawn the thermometer read −16°F.

(a) What was the temperature at 9 p.m.?

(b) What was it at 3 p.m.?

ANSWER

(a) −10°F (b) 4°F

SOLUTION

(a) A fall of 6 is a change of −6. Undo it: earlier = later − change = −16 − (−6) = −16 + 6 = −10. At 9 p.m. it was −10°F.

(b) Undo the fall of 14 the same way: −10 − (−14) = −10 + 14 = 4. At 3 p.m. it was 4°F.

Check: 4 + (−14) = −10 and −10 + (−6) = −16.

7. On a winter evening the thermometer inside Maya's cabin reads 17°C and the one outside reads −7°C.

(a) How many degrees warmer is it inside than outside?

(b) Overnight the stove goes out. By morning the inside temperature has fallen 4 degrees and the outside temperature has fallen 9 degrees. Find both morning readings.

(c) In the morning, are the two readings closer together or farther apart than in the evening, and by how many degrees?

ANSWER

(a) 24 degrees (b) inside 13°C, outside −16°C (c) farther apart, by 5 degrees

SOLUTION

(a) How far apart is the higher minus the lower: 17 − (−7) = 17 + 7 = 24 degrees.

(b) Add each fall as a negative change. Inside: 17 + (−4) = 13, so 13°C. Outside: −7 + (−9) = −16, so −16°C.

(c) In the morning they are 13 − (−16) = 13 + 16 = 29 degrees apart, against 24 in the evening. They are farther apart, by 29 − 24 = 5 degrees: the outside fell 9 − 4 = 5 degrees more than the inside.

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