Chapter 9 Linear Inequalities

Section 9.1

Section 9.1 Page 13 Question 5

a) The phrase "at least" corresponds to the inequality sign "≥". If Brent scored at least 3 points in each basketball game this season then his scoring could be symbolized by: $x \geq 3$.

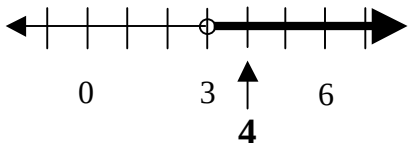
b) The phrase "fewer than" corresponds to the inequality sign "<". Maggie never had fewer than 7 words spelled correctly on her weekly spelling quiz: $x < 7$.

c) The phrase "maximum" refers to the inequality sign "≤". The maximum temperature in a region of Northern Alberta is –13: $x \leq -13$.

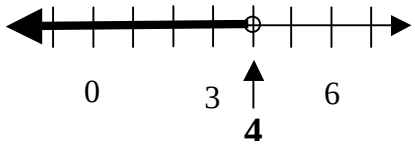
d) The phrase "must exceed" corresponds to the inequality sign ">". The temperature of the solution must exceed $-1.5°C$ in order for the reaction to occur: $x > -1.5$.

Section 9.1 Page 13 Question 6

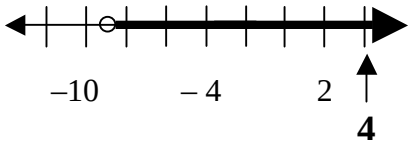
a) First, since 4 is greater than 3 then 4 is a possible value of x. Second, graph the inequality, $x > 3$, and then verify that 4 lies in the solution range.



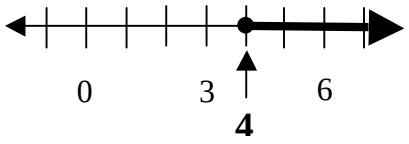
b) No, 4 is not a solution because it is the boundary value and this value is not included in $x < 4$. Graphically, the value of 4 is not part of the solution.



c) Yes, 4 is greater than –9, so it is part of the set of solutions. Graphically, 4 lies in the solution range.



d) Yes, 4 is the boundary point in this inequality and it is part of the solution range.



Section 9.1 Page 13 Question 7

a) All values greater than or equal to 8 is represented by $y \geq 8$. The boundary value of 8 is included. Three possible values are: 11, 15 and 22.

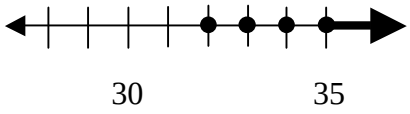
b) All values less than –12 are included. The boundary value is not included. Three possible values are: –14, –21.5 and –100.

c) All values that are less than or equal to 6.4 are included. The boundary value of 6.4 is included. Three possible values are: 1, 3 and 6.4.

d) All values that exceed –12.7 are included. The boundary value is not included. Three possible values are: –11, 0 and 33.

Section 9.1 Page 13 Question 8

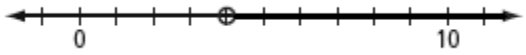
a) The solution includes the boundary value of 32 and all integers larger than 32. Place solid circles at 32, 33, 34 and 35. Extend the arrow to the right from 35.



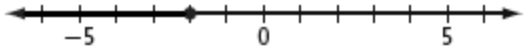
b) Let l represent the length of the fish that qualifies for the prize. Then, $l \geq 32$.

Section 9.1 Page 13 Question 9

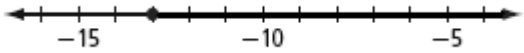
a) The boundary value is at 4 and is not part of the solution. The solution includes values that are to the right of the boundary value. "All values greater than 4."



b) The boundary value is at –2 and the closed circle indicates that it is included in the solution. The values to the left of the boundary are also included. "All values less than or equal to –2."

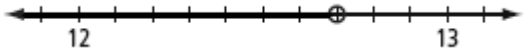


c) The boundary value is –13 and the closed circle indicates that it is included in the solution. The values to the right of the boundary value are also included. "All values greater than or equal to –13."

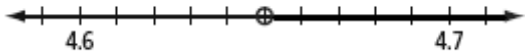


Section 9.1 Page 13 Question 10

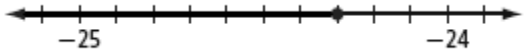
a) The boundary value is 12.7 and the arrow indicates that all values less than 12.7 are included: $x < 12.7$ or $12.7 > x$.



b) The boundary value is 4.65 and it is not part of the solution: $y > 4.65$ or $4.65 < y$.



c) The boundary value is –24.1 and it is part of the solution set: $y \leq -24.1$ or $-24.1 \geq y$.

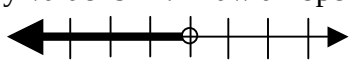


Section 9.1 Page 13 Question 11

a) The boundary value is 3. Place an open circle above 3 and extend the arrow to the right.

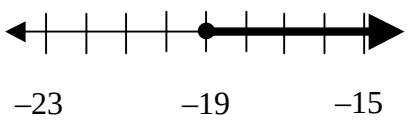
0 3 6

b) The boundary value is 12. Draw an open circle at 12 and then extend the line to the left.

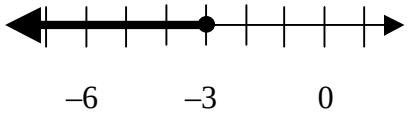


9 12 15

c) The boundary value is –19. This value is included in the solution so place a closed circle at –19 and extend the arrow to the right.

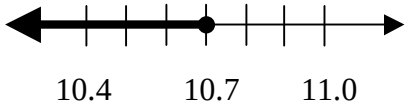


d) The boundary value is –3. This value is included in the solution so place a closed circle at –3 and extend the arrow to the left.

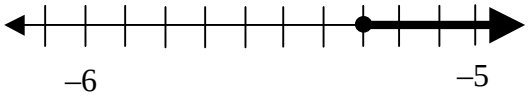


Section 9.1 Page 13 Question 12

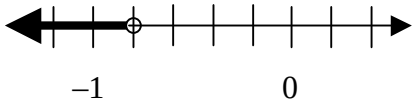
a) Place a closed circle at 10.7. Then extend an arrow to the left to represent the solutions less than or equal to 10.7.



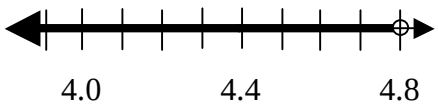
b) Place a closed circle at –5.3 and then draw an arrow directed to the right on the number line.



c) Draw an open circle at $-\frac{4}{5}$ and then construct an arrow directed to the left.

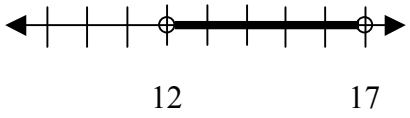


d) Place an open circle at 4.8, and then construct an arrow directed to the left.

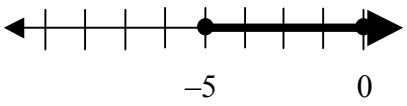


Section 9.1 Page 13 Question 13

a) Place open circles at 12 and 17, and then join the circles.

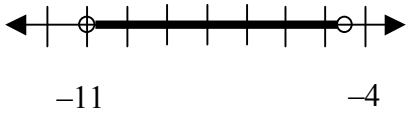


b) Draw closed circles at −5 and 0, and then join the circles.



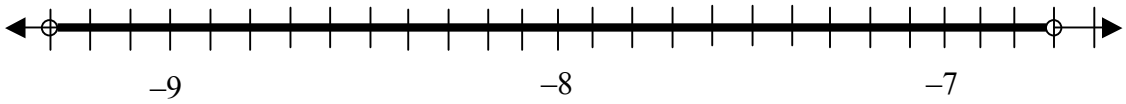
c) Draw closed circles at $1\frac{3}{4}$ and 4, and then join the circles.

d) Place open circles at $-4\frac{1}{2}$ and −11, and then join the circles.

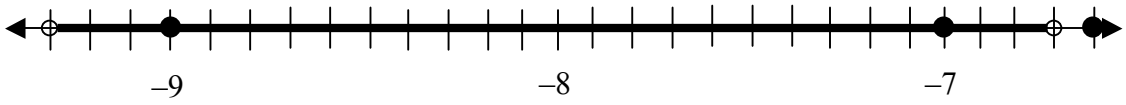


Section 9.1 Page 13 Question 14

a) Construct open circles at −6.7 and −9.3 then join them.

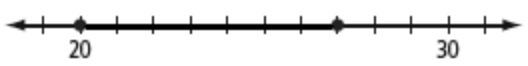


b) Select three values on the displayed number line for 14a. If the number is between −9.3 and −6.7 on the number line then it is part of the solution; otherwise it is not part of the solution. The two values, −9 and −7 are solution values whereas the value of −6.6 is not part of the solution.

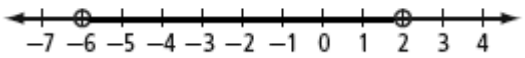


Section 9.1 Page 13 Question 15

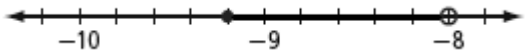
a) All values between the boundary values of 20 and 27, including the boundary values.
$20 \leq x \leq 27$



b) All values between –6 and 2, not including the boundary values.
$-6 < x < 2$



c) All values between –9.2 and –8, including the –9.2 but not including the –8.
$-9.2 \leq x < -8$



Section 9.1 Page 14 Question 16

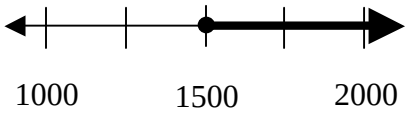
a) The minimum value (boundary value) of 18 000 is included: $m \geq 18\,000$.

b) The boundary value of 8 is included as part of the solution: $t \leq 8$.

c) The boundary value of 700 is not included: $d > 700$.

Section 9.1 Page 14 Question 17

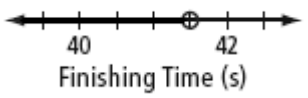
a) The boundary value of $1500 is included in the solution. Construct a closed circle at 1500 and extend the arrow to the right.



b) As long as her balance is at least $1500, Emily will not pay any fees: $x \geq 1500$.

Section 9.1 Page 14 Question 18

a) The boundary value is 41.5 and the open circle indicates that it is not part of the solution. Paul will beat the record if he finishes the race in less than 41.5 seconds.

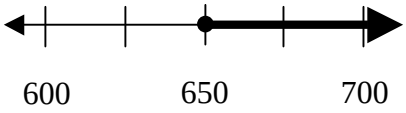


b) Let t represent the time in seconds for Paul to finish the race. Then the inequality can be expressed as $t < 41.5$.

Section 9.1 Page 14 Question 19

a) Example: A school environmental club hopes to recycle at least 650 cans per month.

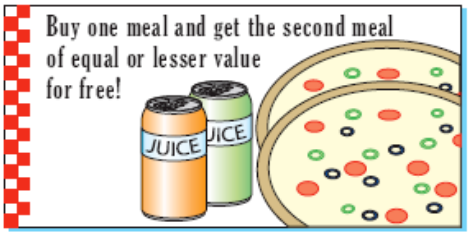
b) Draw a closed circle at 650 and then extend the arrow to the right along the number line.



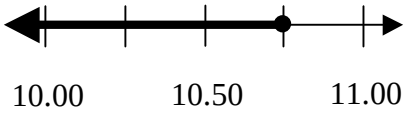
c) Let c represent the number of cans that are recycled each month. The inequality that models this situation is $c \geq 650$.

Section 9.1 Page 14 Question 20

a) The boundary value of \$10.75 is included in the solution: $m \leq 10.75$.



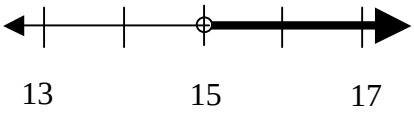
b) Draw a closed circle at 10.75 and extend the arrow to the left.



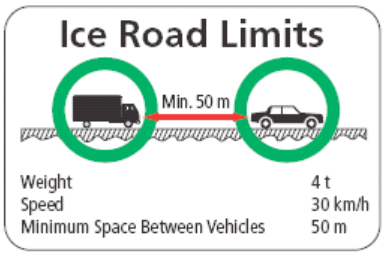
Section 9.1 Page 14 Question 21

a) Shanelle will have to pay more insurance if the distance between her home and workplace is further than 15 km.

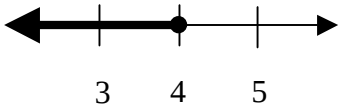
b) The boundary value of 15 km is not included in the range of distances that will require higher insurance costs. Construct an open circle at 15 and extend the arrow to the right.



Section 9.1 Page 14 Question 22

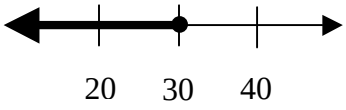


a) weight limit of $4t$



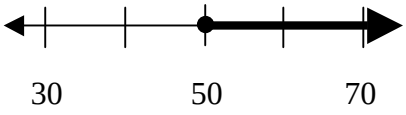
b) $w \leq 4$

speed limit of 30 km/h



$s \leq 30$

minimum space of 50 m

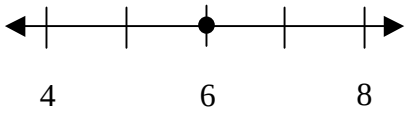


$m \geq 50$

Section 9.1 Page 15 Question 23

a) Combine both inequalities: $6 \leq x \leq 6$.

b) The only value that satisfies these conditions is 6: $x = 6$.



Section 9.1 Page 15 Question 24

The longest side is given as 80 cm. Therefore, the maximum length of the remaining side must be less than 80 cm. The minimum length of the remaining side must be greater than 50 cm (80 – 30). Let s represent the length of the remaining side of the triangle in centimetres. The inequality that models this situation is $50 < s < 80$.

Section 9.1 Page 15 Question 25

a) x must be greater than 4 and x must be less than 7. x can be any number between 4 and 7, not including 4 or 7.

b) x must be less than 4 and x must be less than 7. x can be any number less than 4, not including 4.

c) x must be greater than 4 and x must be greater than 7. x can be any number greater than 7, not including 7.

d) x must be less than 4 and x must be greater than 7. There is no number that satisfies both of these conditions.