Optimization — Greatest & Least — Practice

CKSTEM Math Problem Solving · Grades 5–8

1 OBJECTIVE VS CONSTRAINT

What is the largest even whole number that is no greater than 87?

WORK IT OUT HERE

2 OBJECTIVE VS CONSTRAINT

What is the smallest three-digit whole number that is a multiple of 7?

WORK IT OUT HERE

3 OBJECTIVE VS CONSTRAINT

What is the greatest whole number n such that n squared is at most 200?

WORK IT OUT HERE

4 BOTTLENECK RULE

A bakery builds identical gift boxes. Each box needs 2 cookies and 3 candies. The shop has 17 cookies and 14 candies. What is the greatest number of complete boxes they can make?

WORK IT OUT HERE

5 BOTTLENECK RULE

Each food kit uses 3 cans, 2 packets, and 1 bottle. The pantry holds 26 cans, 19 packets, and 8 bottles. What is the greatest number of complete food kits?

WORK IT OUT HERE

6 BOTTLENECK RULE

A hygiene pack uses 4 soap bars, 6 wipe packs, and 3 toothbrushes. The store has 35 soap bars, 50 wipe packs, and 22 toothbrushes. What is the greatest number of complete hygiene packs?

WORK IT OUT HERE

7 TAKE THE BIGGEST FIRST

Coins come in values of 1, 5, and 10 dollars. What is the least number of coins needed to pay exactly $73?

WORK IT OUT HERE

8 TAKE THE BIGGEST FIRST

Tickets are sold in books of 2, 10, and 50. What is the least number of books needed to total exactly 138 tickets?

WORK IT OUT HERE

9 TAKE THE BIGGEST FIRST

Supply boxes hold 3, 12, or 60 packs. What is the least number of boxes needed to deliver exactly 159 packs?

WORK IT OUT HERE

10 SQUEEZE THE REST

Five different positive whole numbers add up to 60, and one of them is 20. What is the largest possible value of one of the other four numbers?

WORK IT OUT HERE

11 SQUEEZE THE REST

Six different positive whole numbers add to 150. One of them is 30. What is the greatest value the largest number could be?

WORK IT OUT HERE

12 SQUEEZE THE REST

Eight different positive whole numbers add up to 400, and one of them is 75. What is the largest possible value of one of the other seven numbers?

WORK IT OUT HERE

13 ROUND UP TO GUARANTEE

An arrival count is reported as 30, rounded to the nearest 10. Each arrival needs 2 ration packs. What is the smallest number of packs that guarantees everyone is fed?

WORK IT OUT HERE

14 ROUND UP TO GUARANTEE

A family count is reported as 70 (nearest 10). Each family needs 3 kits, and 20% extra kits must be packed as spare. What is the smallest whole number of kits that guarantees coverage?

WORK IT OUT HERE

15 ROUND UP TO GUARANTEE

A family count is reported as 80 (nearest 10). Each family needs 4 kits, plus 15% spare, and kits ship only in cartons of 12. What is the smallest whole number of cartons that guarantees enough?

WORK IT OUT HERE

16 SHAPE THE EXTREME

A rectangle has whole-number sides, perimeter 24, and length greater than width. What is its greatest possible area?

WORK IT OUT HERE

17 SHAPE THE EXTREME

A rectangle has whole-number sides, perimeter 40, and length greater than width. What is its greatest possible area?

WORK IT OUT HERE

18 SHAPE THE EXTREME

Ten unit squares are connected edge-to-edge into one connected path along a grid. What is the greatest possible perimeter of the path?

WORK IT OUT HERE

19 TEST THE BOUNDARY

A truck carries at most 50 kg. A food crate weighs 5 kg and helps 12 families; a water crate weighs 8 kg and helps 14 families. There must be at least 3 food crates and strictly more water crates than food crates. What is the greatest number of families helped?

WORK IT OUT HERE

20 TEST THE BOUNDARY

A truck carries at most 100 kg. A food crate weighs 6 kg and helps 15 families; a water crate weighs 8 kg and helps 16 families. There must be at least 4 food crates and strictly more water crates than food crates. What is the greatest number of families helped?

WORK IT OUT HERE

21 TEST THE BOUNDARY

A shelter shipment is at most 100 packs total. A small shelter uses 12 packs and houses 5 families; a large shelter uses 22 packs and houses 11 families. What is the greatest number of families that can be housed?

WORK IT OUT HERE

22 CORNER OF THE REGION

Tent type A uses 3 metres of cloth and 2 metres of rope and sleeps 3 people; tent type B uses 2 metres of cloth and 3 metres of rope and sleeps 4 people. The team has 24 m of cloth and 21 m of rope and must build at least 1 of each type. What is the greatest number of people who can sleep in the tents?

WORK IT OUT HERE

23 CORNER OF THE REGION

Each Type A kit uses 4 packs of X and 3 packs of Y and helps 4 people; each Type B kit uses 3 packs of X and 5 packs of Y and helps 5 people. With 27 packs of X, 34 packs of Y, and at least 2 of each kit, what is the greatest number of people helped?

WORK IT OUT HERE

24 CORNER OF THE REGION

Each Type A aid kit uses 5 of supply 1 and 4 of supply 2 and helps 5 people; each Type B kit uses 4 of supply 1 and 6 of supply 2 and helps 6 people. With 80 units of supply 1, 78 units of supply 2, and at least 3 of each kit, what is the greatest number of people helped?

WORK IT OUT HERE

25 OPTIMIZATION DETECTIVE

Identical lunches are assembled. Each lunch needs 2 sandwiches and 1 piece of cheese. The kitchen has 50 sandwiches and 30 pieces of cheese. What is the greatest number of complete lunches?

WORK IT OUT HERE

26 OPTIMIZATION DETECTIVE

A field count reports about 60 families (rounded to the nearest 10), and each family needs 3 ration packs. What is the smallest number of ration packs needed to guarantee enough?

WORK IT OUT HERE

27 OPTIMIZATION DETECTIVE

A relief station has 25 identical care packs to hand out. Every family that receives any packs must receive a different odd number of packs. What is the greatest number of families that can each receive packs?

WORK IT OUT HERE

Answer Key

Each answer comes with a hint that names the move. The tag says which video to rewatch if you are stuck.

1. 86 — *Objective vs Constraint*
Name the edge: push 'even' as high as you can without crossing the ceiling of 87.

2. 105 — *Objective vs Constraint*
Name the edge: walk up the multiples of 7 from below and stop the moment you clear the 100 floor.

3. 14 — *Objective vs Constraint*
Name the edge: push n upward and stop the step before n squared crosses 200.

4. 4 boxes — *Bottleneck Rule*
Floor each supply by its per-box need; the smallest of those counts wins.

5. 8 kits — *Bottleneck Rule*
Three supplies, three floors; the scarcest one sets the cap.

6. 7 packs — *Bottleneck Rule*
Compute floor of each stock divided by its per-pack need and take the smallest.

7. 10 coins — *Take the Biggest First*
Take as many tens as fit, then the largest size down that still fits, until the leftover is zero.

8. 9 books — *Take the Biggest First*
Start with the 50-books; whatever is left, switch to 10-books, then 2-books.

9. 6 boxes — *Take the Biggest First*
60-boxes first, then 12-boxes for the leftover, then 3-boxes to close the gap.

10. 34 — *Squeeze the Rest*
Lock the 20, push the value you want to maximize, and squeeze the OTHER three to be the three smallest distinct positives.

11. 110 — *Squeeze the Rest*
Lock the 30 in place; to grow one number as large as possible, push the other four numbers down to the smallest distinct positives the rule allows. What is left is your maximum.

12. 304 — *Squeeze the Rest*
Lock the 75, push the value you want to maximize, and squeeze the OTHER six to be the smallest distinct positives.

13. 68 packs — *Round Up to Guarantee*
Bump 30 up to its worst-case value first, then multiply by the per-person need.

14. 267 kits — *Round Up to Guarantee*
Un-round the 70 up, multiply by kits per family, add the 20% spare, then ceiling to a whole kit.

15. 33 cartons — *Round Up to Guarantee*
Worst-case the 80, multiply by 4 and by 1.15, ceiling to whole kits, then ceiling again to whole cartons.

16. 35 square units — *Shape the Extreme*
Half the perimeter is the sum of the two sides; pick the pair closest to a square with length still greater than width.

17. 99 square units — *Shape the Extreme*
Sides sum to half the perimeter; the area peaks when length and width are as close as the rule allows.

18. 22 units — *Shape the Extreme*
Each added square exposes 3 new sides and buries 1; stretch the tiles into a single row to keep that exposure maximal.

19. 92 families — *Test the Boundary*
Try only the food counts that survive the weight cap, push water as high as the cap allows, and check the more-water-than-food rule on each row.

20. **218 families** — *Test the Boundary*
List the food counts from 4 upward, max the water crates within the weight cap on each row, and keep only rows where water exceeds food.

21. **49 families** — *Test the Boundary*
Enumerate large-shelter counts from 0 upward; for each, fill the remaining packs with as many small shelters as fit, then compare row totals.

22. **30 people** — *Corner of the Region*
Treat both constraints as lines, look for the integer pair where they meet, and check that floors are still respected.

23. **37 people** — *Corner of the Region*
Find the integer corner where both supply lines are tight at the same time, then confirm both floors are met.

24. **90 people** — *Corner of the Region*
Solve the two supply equalities for the integer corner where neither line has slack, then verify it satisfies the floors.

25. **25 lunches** — *Optimization Detective*
Identical bundles plus uneven stocks signals the floor-and-take-the-smallest move.

26. **192 packs** — *Optimization Detective*
Rounded counts plus a 'guarantee' word signals the un-round-up move before any multiplication.

27. **5 families** — *Optimization Detective*
Different positive odd numbers signals a structural cap; line up the smallest such numbers in order and stop when their running total reaches the limit.