

Phone Plan Showdown — Answer Key & Assessment

Grade 8 · Linear Relationships

Standards assessed

- 8.F.B.4 — Modeling linear relationships
- 8.F.A.2 — Comparing functions across representations
- 8.EE.C.8.c — Real-world systems problems
- 8.EE.C.8.a — Solutions as points of intersection

Learning target

I can model each phone plan as a linear function, compare the plans using tables, graphs and equations, find break-even points, and recommend a plan for a specific customer with evidence.

Success criteria

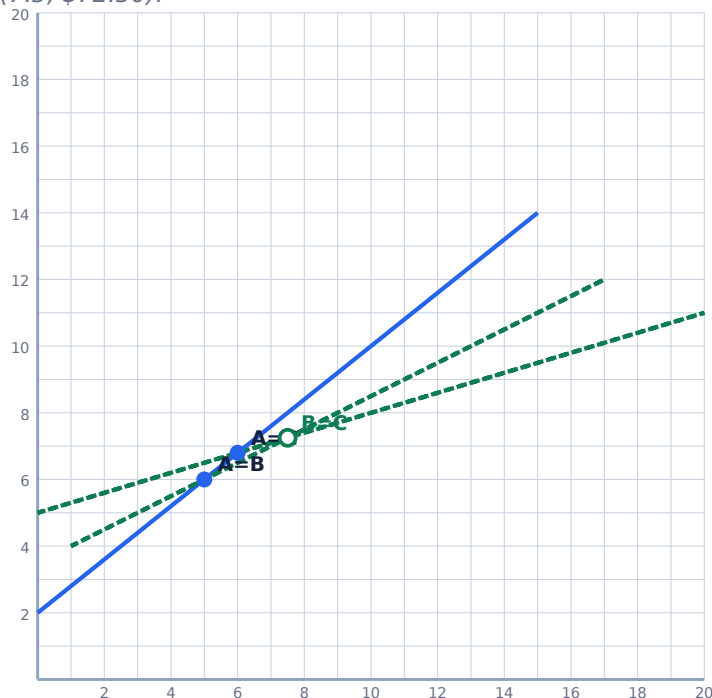
- I can write $y = mx + b$ for a plan from its monthly fee and per-GB rate, and say what m and b each mean in dollars.
- I can complete a cost table and graph all three plans on shared axes.
- I can find a break-even point from the graph and confirm it with the equations.
- I can recommend a plan for a customer's usage and defend it with slope, intercept and intersection evidence.

Formative vs summative

- Formative: The warm-up meanings of 6 and 25 — the m/b interpretation is the lesson's foundation stone.
- Formative: Cheapest-cell circles in the table during team work: the region structure appearing early.
- Formative: Customer clinic reasoning: costs computed under all plans BEFORE the recommendation.
- Summative: The exit ticket (Plan D), scored with the four-criterion rubric.

The worked result

Answer view: A wins below 5 GB, B wins from 5 to 7.5 GB, C wins beyond 7.5 GB. Crossings: A=B at (5, \$60), A=C at (6, \$68), B=C at (7.5, \$72.50).



Completed table

Completed cost table. Watch the lead change hands as x grows.

Data used	Plan A: $8x + 20$	Plan B: $5x + 35$	Plan C: $3x + 50$
0 GB	\$20	\$35	\$50
2 GB	\$36	\$45	\$56
5 GB	\$60	\$60	\$65
8 GB	\$84	\$75	\$74
10 GB	\$100	\$85	\$80
15 GB	\$140	\$110	\$95

Practice answers

Find Plan A's cost at 6 GB, from the equation.

Answer: \$68.

Complete the 8 GB row of the cost table.

Answer: A \$84, B \$75, C \$74 — Plan C by one dollar.

Find the exact A=B break-even by setting the equations equal, and state what the point means.

Answer: $8x + 20 = 5x + 35 \rightarrow 3x = 15 \rightarrow x = 5$; cost $8(5) + 20 = \$60$. At exactly 5 GB both plans charge \$60 — the lines cross at (5, 60).

Find the B=C break-even. Why was the graph not enough for this one?

Answer: $5x + 35 = 3x + 50 \rightarrow 2x = 15 \rightarrow x = 7.5$, cost \$72.50. The crossing sits between gridlines — the graph estimates, the equation decides.

The Family uses 42 GB. Compute all three plans, recommend one, and give the ANNUAL savings over the runner-up.

Answer: A: \$356. B: \$245. C: \$176. Plan C; saves \$69/month over B — \$828 per year (and \$2,160 over A).

Design Plan D to beat Plan A for heavy users but lose to it for light users. Give the equation and its break-even against A.

Answer: Any higher fee with lower rate, e.g. $y = 6x + 25$: crosses A where $8x + 20 = 6x + 25 \rightarrow x = 2.5$. D loses below 2.5 GB, wins above.

Challenge answers

A fourth carrier wants a plan that is NEVER the cheapest but also never the most expensive. Design one and defend it.

Answer: Answers vary; e.g. $y = 5.5x + 32$ threads between the others across 0–15 GB (check at 0, 5, 7.5, 15). Defense requires comparing against each region's winner and loser.

For plans $y = mx + b$ and $y = nx + c$ with $m > n$, find the break-even in symbols. What happens when $m = n$?

Answer: $mx + b = nx + c \rightarrow x = (c - b)/(m - n)$. If $m = n$ the denominator is zero: parallel lines — no break-even (or every point, if also $b = c$). The three-verdicts trichotomy returns.

Homework answers

Find a real fee-plus-rate price (streaming, transit card, utility). Write its equation and compute a light month and a heavy month.

Answer: Answers vary; check m and b are correctly identified from the pricing page and the two evaluations are right.

A parent asks: 'Why not just take the \$20 plan? It's obviously cheapest.' Write the two-sentence answer, with one number in it.

Answer: Answers vary; must state that the low fee pairs with the highest per-GB rate and cite a crossover (e.g. beyond 5 GB, Plan B is cheaper; at 10 GB the '\$20 plan' costs \$100).

Observation checklist

- ☐ Identifies m and b from a verbal plan description, with units.
- ☐ Graphs intercept-first, then slope steps.
- ☐ Confirms graph crossings by setting equations equal.
- ☐ Quotes break-evens as full coordinates (usage AND cost).
- ☐ Recommends by region, not by a single point.
- ☐ Handles off-grid customers (42 GB) by equation without hesitation.

Worked answers

Cost table, all rows.

Answer: 2 GB: 36/45/56. 5 GB: 60/60/65. 8 GB: 84/75/74. 10 GB: 100/85/80. 15 GB: 140/110/95.

Circle the cheapest per row: A, tie, C, C, C — with B's window visible only between 5 and 7.5 GB. The table alone nearly tells the whole story.

Break-even A = B.

Answer: $8x + 20 = 5x + 35 \rightarrow x = 5$, \$60 — the point (5, 60) on both lines.

The tie row of the table, the crossing on the graph and the solved equation are the same fact three ways — say so explicitly.

Break-even A = C.

Answer: $8x + 20 = 3x + 50 \rightarrow 5x = 30 \rightarrow x = 6$, \$68.

Between table rows; a good check that equations interpolate where tables cannot.

Break-even B = C.

Answer: $5x + 35 = 3x + 50 \rightarrow x = 7.5$, \$72.50.

Deliberately off-grid: this is the one the graph can only estimate. Expect and honor 'about 7 and a half' from graph-readers, then nail it algebraically.

Customer clinic.

Answer: Emma (3 GB): A at \$44 — under budget; B \$50, C \$59. Alex (18 GB): C at \$104 versus B \$125, A \$164. Family (42 GB): C at \$176; saves \$828/yr over B, \$2,160/yr over A. Traveler: A wins the usual months (\$36 at 2 GB); the two 12-GB months cost \$116 on A vs \$95 on C — annual totals favor A: $10(36) + 2(116) = \$592$ versus C's $10(56) + 2(86) = \$732$. Streamer (6–9 GB): conditional — B in 5–7.5, C above 7.5.

The Traveler is the judgment case: the 'wrong' plan for the worst month is the right plan for the year. Annual arithmetic settles what instinct starts.

Exit ticket answers

- Plan D costs \$15 per month plus \$7 per GB. Write its equation and find the cost of 9 GB. $\rightarrow y = 7x + 15$; at 9 GB, $7(9) + 15 = \$78$.
- In one sentence: what does Plan D's slope mean, in dollars? $\rightarrow$ Every additional gigabyte adds \$7 to the bill.
- At 9 GB, is Plan D cheaper or pricier than Plan B (\$35 + \$5/GB)? Show the evidence. $\rightarrow$ B at 9 GB: $5(9) + 35 = \$80$. D is \$2 cheaper (\$78 vs \$80).

Rubric

Criterion	4 — Strong	3 — Proficient	2 — Developing	1 — Beginning
Modeling plans	All three equations correct with m and b interpreted in dollars.	Equations correct; one interpretation shaky.	One equation has fee and rate swapped.	Equations not connected to the plans.
Tables and graphs	Table complete and accurate; three labeled lines with intercept-and-slope construction.	Table accurate; graph has a plotting slip that doesn't change conclusions.	Table errors propagate to the graph, or lines unlabeled.	Representations missing or inconsistent.
Break-even analysis	All three intersections found exactly by equation and located on the graph, with meaning stated.	Two intersections exact; one estimated only.	Crossings read from the graph without algebraic confirmation.	Intersections not identified.

Recommendation and evidence	Recommendation cites computed costs, the relevant break-even, and speaks to the customer's actual usage pattern.	Recommendation cites computed costs.	Recommendation with partial or single-point evidence.	Opinion without computation.
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Misconceptions to watch for

- “The lowest monthly fee is the cheapest plan.” — Compute all three at 10 GB: the \$20 plan costs \$100 and the \$50 plan costs \$80. The fee is one-time; the rate compounds with usage.
- “The slope is the monthly fee, since it's the bigger deal.” — Evaluate at 0 GB: only b survives — that is the fee. The slope shows up exactly when usage does.
- “Lines crossing means the plans have the same data usage.” — Both plans always allow any usage. Crossing means same COST at that usage: the x is the usage, the y is the shared price.
- “Whichever line is on top is winning.” — Top means most expensive — this graph's y is cost. The winner is the LOWEST line in each region.
- “Compare plans at one usage level and you're done.” — A wins at 2 GB, C wins at 10. A single x proves nothing global — the regions and their fences are the full answer.

Differentiation notes

Provide partially completed tables; extend with nonlinear add-ons.