

Pumpkin Chunk-Off Lab: $F = m \times a$ ANSWER KEY



FOR THE TEACHER

Don't copy for students

TEKS 8.7A · Every launch pauses at the start of the swing. Write down the sling pull, the friction and the pumpkin's mass, then do the math here. Round each acceleration to a tenth, and always write the unit.

Net force = sling pull – friction (they point in opposite directions) **Acceleration** = net force ÷ mass $F = m \times a$ · N = kg × m/s²

PART 1. LAUNCH LOG

Practice launches

The first row is the tutorial. Add a row for each practice launch you use.

Throw	Pumpkin	Mass (kg)	Counterweight (kg)	Angle	Sling pull (N)	Friction (N)	Net force (N)	Acceleration (m/s ²)	Distance (m)
Tutorial	Sugar Pie	3.06	5,000	35°	51	11	40	13.1	371

Official throws

Your three official throws. The best one also goes in the box at the end of the worksheet.

Throw	Pumpkin	Mass (kg)	Counterweight (kg)	Angle	Sling pull (N)	Friction (N)	Net force (N)	Acceleration (m/s ²)	Distance (m)
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LOOK FOR: every row, net force = sling pull minus friction, and acceleration = net force ÷ mass to a tenth, with units. Rows differ because students pick different settings; the same pumpkin and counterweight always give the same sling pull and friction. A burst throw still has start-of-swing numbers; its distance is 0 m. **CATCHES:** adding the two forces; dividing the sling pull (not the net force) by the mass.

PART 2. SOLVE IT

NOTE: no launch in the lab gives the numbers in questions 1, 4 and 5, so students can't copy these answers from a partner's screen.

1. A sling pulls a 4.08 kg pumpkin 64 N toward the back. Friction pushes it 14 N toward the front. The up and down forces are balanced. What is the pumpkin's acceleration?

- A. 15.7 m/s² B. 12.3 m/s² C. 19.1 m/s² D. 3.4 m/s²

B. Net force = 64 – 14 = 50 N toward the back; 50 ÷ 4.08 = 12.3 m/s².

CATCHES: dividing one force by the mass (A, D) or adding the two forces (C), the same mistakes behind the wrong choices on STAAR 2025 item 13.

2. A 4.49 kg pumpkin has an acceleration of 12 m/s². What net force acts on it?

F = m × a = 4.49 × 12 = 53.9 N (accept 53.88 N or 54 N)

3. A net force of 45 N gives a pumpkin an acceleration of 15 m/s². What is its mass?

m = F ÷ a = 45 ÷ 15 = 3 kg

LOOK FOR: the right operation for the unknown, and the unit (N for force, kg for mass). **CATCHES:** dividing when the formula needs multiplying.

4. Find each pumpkin's acceleration, then rank them from greatest to least acceleration.

Pumpkin	Net force	Mass	Acceleration (m/s ²)
Sugar Pie	45 N	3.06 kg	14.7
La Estrella	45 N	4.49 kg	10.0
Cinderella	57 N	4.08 kg	14.0
Knucklehead	72 N	5.44 kg	13.2

Greatest to least: **Sugar Pie (14.7), Cinderella (14.0), Knucklehead (13.2), La Estrella (10.0)**

LOOK FOR: every acceleration worked out before ranking. Ranking by force alone puts Cinderella second; ranking by mass alone puts Sugar Pie first. **CATCHES:** "the biggest force always wins" and "the lightest always wins" (STAAR 2026 item 5 compares a table the same way).

5. A sling pulls a 4.49 kg pumpkin 68 N toward the back. Friction pushes it 17 N toward the front. The up and down forces are balanced. Find the net force and the acceleration. Show your work and write the units.

Net force = 68 N – 17 N = 51 N toward the back. Acceleration = 51 N ÷ 4.49 kg = 11.4 m/s² toward the back.

LOOK FOR (2 points, like STAAR 2026 item 13): the net force with its unit and direction, and the acceleration with its unit.

PART 3. ANALYZE IT

Use practice launches for questions 6 and 7. If a pumpkin bursts, you still get its numbers under This launch.

6. Test it in the lab. Launch **Sugar Pie at 5,500 kg with a 50° release angle** and **La Estrella at 3,500 kg**. Fill in the table.

Pumpkin	Mass (kg)	Sling pull (N)	Friction (N)	Net force (N)	Acceleration (m/s ²)
Sugar Pie, 5,500 kg	3.06	53	11	42	13.7
La Estrella, 3,500 kg	4.49	59	17	42	9.4

Both pumpkins have the same net force. Which one speeds up more, and why? Use $F = m \times a$ in your answer.

LOOK FOR: Sugar Pie; the same net force on a smaller mass gives a bigger acceleration ($a = F \div m$). **CATCHES:** "a heavier object falls/moves faster" and "force and acceleration are the same thing".

Sugar Pie speeds up more (13.7 m/s² vs 9.4 m/s²). Both have a 42 N net force, and $a = F \div m$, so the pumpkin with less mass gets the bigger acceleration.

7. Your friend says, "A heavier pumpkin always speeds up less." Launch **Sugar Pie at 3,000 kg** and **La Estrella at 5,000 kg**, and fill in the table.

Pumpkin	Mass (kg)	Sling pull (N)	Friction (N)	Net force (N)	Acceleration (m/s ²)
Sugar Pie, 3,000 kg	3.06	37	12	25	8.2
La Estrella, 5,000 kg	4.49	74	17	57	12.7

Do you agree or disagree with your friend? Use numbers from the table.

LOOK FOR: disagree. La Estrella has more mass but speeds up more (12.7 vs 8.2 m/s²), because its net force is much bigger (57 N vs 25 N). Acceleration depends on both the net force and the mass; a heavier object speeds up less only if the net force isn't big enough to make up for the mass. **CATCHES:** treating mass as the only thing that sets acceleration.

Disagree. La Estrella is heavier, but it speeds up more (12.7 m/s² vs 8.2 m/s²) because its net force is much bigger (57 N vs 25 N). Acceleration depends on the net force and the mass.

8. You want a pumpkin to speed up more at the start of the swing. Name two ways to do it, and use net force or mass in each.

LOOK FOR: a bigger net force on the same mass (more counterweight, same pumpkin), or the same net force on less mass (like question 6). Either one raises $a = F \div m$. A lighter pumpkin at the same counterweight barely helps here (the sling pulls it less hard, so the accelerations come out within half a m/s²); accept it only if the student backs it with numbers from their log.

Use more counterweight with the same pumpkin, so the net force is bigger. Or give a pumpkin with less mass the same net force, like Sugar Pie in question 6.

My best official throw. Pumpkin _____ Counterweight _____ kg Angle _____° Distance _____ m

At the start of its swing: net force = _____ N, acceleration = _____ m/s². Show the math.

LOOK FOR: net force = its sling pull minus its friction (both on the Chunk Card), acceleration = that net force $\div$ its mass. The best throws land about 440 to 480 m, and each student's best differs because their pumpkins' burst limits differ. If all three official throws burst, the student uses their best practice throw (the Chunk Card says so).

Answers vary. Sample: La Estrella, 5,500 kg, 40°, 440 m: 78 N - 17 N = 61 N; 61 $\div$ 4.49 = 13.6 m/s².