Newton’s laws: ranking tasks and a trolley practical

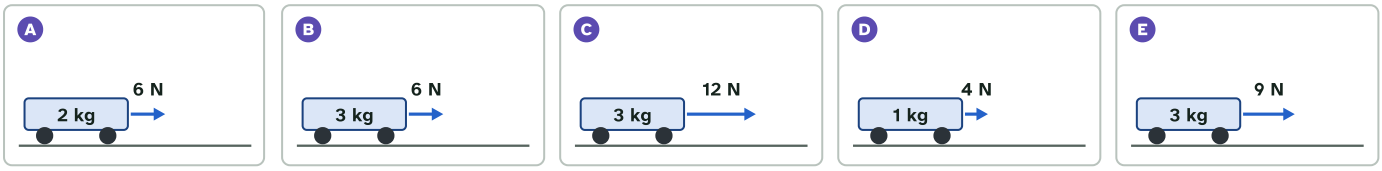
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Page 1 has two ranking tasks: rank the cases first, then explain how you decided. Page 2 is a practical that measures how the net force on a trolley and a falling mass changes their acceleration.

RANKING TASK 1 Trolleys pulled by a steady force

Each trolley is pulled by a steady net force. Rank the trolleys by their acceleration.

Give the greatest a 1. If two or more are equal, give them the same number.



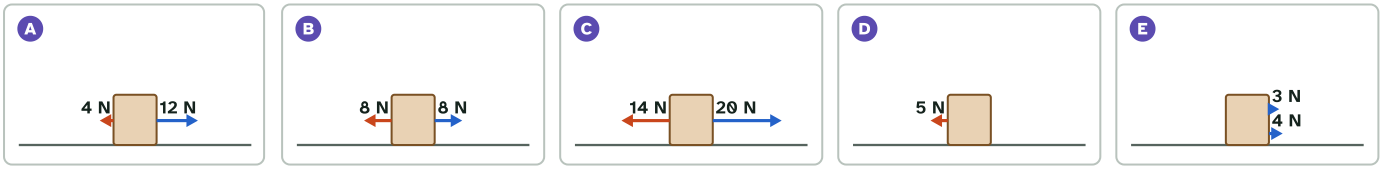
Rank: A ☐ B ☐ C ☐ D ☐ E ☐

Explain how you decided.

RANKING TASK 2 Forces on a box

Each drawing shows the forces pushing or pulling a box along the floor. Rank the boxes by the size of the net force on each one.

Give the greatest a 1. If two or more are equal, give them the same number.



Rank: A ☐ B ☐ C ☐ D ☐ E ☐

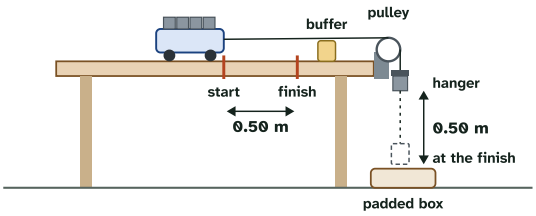
Explain how you decided, and say which way each box accelerates, if it does.

Then check your rankings: work out each trolley’s acceleration with a = F ÷ m, and add up the forces on each box, taking their directions into account.

PRACTICAL Pulling a trolley with a falling mass

Aim: To find out how the net force on the trolley and hanger together (the weight of the hanging masses) changes their acceleration when their total mass stays the same.

Each group needs: a trolley, a smooth bench at least 1.5 m long, a pulley that clamps to the end of the bench, about 1 m of string, a 50 g mass hanger with five 50 g slotted masses, a metre ruler, masking tape, a stopwatch (or light gates) and a padded box.

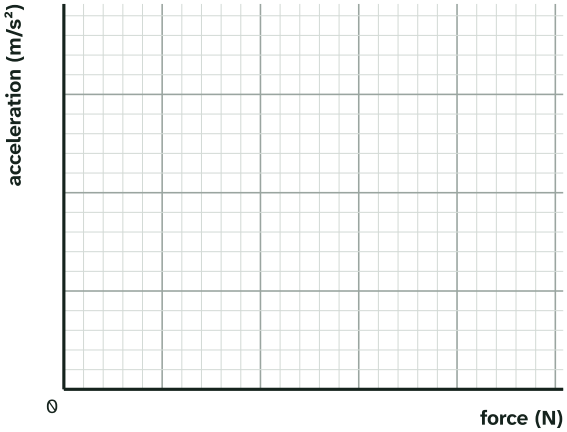


> **Safety.** Put the padded box on the floor under the pulley to catch the masses, and keep your feet out from under them. Put a buffer, such as a book wrapped in a cloth, on the bench in front of the pulley, so the trolley stops before it reaches the pulley.

1. Clamp the pulley to the end of the bench. Tie the string to the trolley, run it over the pulley and tie the hanger to the other end. Put four masses on the trolley and one on the hanger, so the hanger and its mass come to 100 g.
2. Pull the trolley back until the hanger is just below the pulley, and mark a start line at the front of the trolley with masking tape. Mark a finish line 0.50 m further on, before the buffer. Check that the hanger can fall more than 0.50 m before it reaches the padded box, so the string still pulls when the trolley crosses the finish line.
3. Hold the trolley with its front on the start line, then let it go. Time it from the start line to the finish line. Do this three times.
4. Move one mass from the trolley to the hanger, and do step 3 again. Keep going until all five masses are on the hanger.
5. Work out each net force: the hanging mass in kilograms × 9.8 N/kg. If friction is left out, this is the net force on the trolley, masses and hanger together. For example, 100 g is 0.100 kg, and 0.100 × 9.8 = 0.98 N.
6. Work out each acceleration from the average time: a = 2 × distance ÷ time² = 2 × 0.50 ÷ time².

Hanging mass (g)	Net force (N)	Time 1 (s)	Time 2 (s)	Time 3 (s)	Average time (s)	Acceleration (m/s²)
100						
150						
200						
250						
300						

Plot acceleration up the side against force along the bottom, then draw a line of best fit.



1. Describe the pattern in your graph. What happens to the acceleration when the force doubles?

2. Why do you move masses from the trolley to the hanger, instead of adding new masses to the hanger?

3. Friction also acts on the trolley. How would it change your results?

4. How could you make your times more precise?