Year 12 Science: Momentum, energy and springs

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. What is the momentum of a 1200 kg car travelling at 15.0 m s^{-1}?

2. A 0.0600 kg tennis ball hits a wall at 20.0 m s^{-1} and bounces straight back at 15.0 m s^{-1}. What is its change in momentum?

3. A 60.0 kg skater and a 40.0 kg skater stand still on ice and push each other apart. The 60.0 kg skater moves off at 2.00 m s^{-1}. What is the other skater's velocity?

4. A 60.0 kg student runs up stairs 3.50 m high in 4.00 s. What power does she develop lifting herself?

5. A spring with k = 50.0 N m^{-1} is stretched by 0.120 m. How much elastic potential energy does it store?

Exam-style question: coupling rail wagons

In a rail yard, a 1500 kg wagon rolls at 2.00 m s^{-1} towards a stationary 1000 kg wagon on a level track. They couple together and move off as one. Ignore friction.

6. Calculate the momentum of the moving wagon, with its unit.

7. Calculate the speed of the coupled wagons.

8. Show that kinetic energy is not conserved in the coupling, and say where it goes.

9. The coupled wagons then run into a spring buffer with k = 2.40 × 10^{5} N m^{-1}. Calculate how far the buffer compresses as it stops them.

10. Discuss whether a stiffer buffer (bigger k) would be better for the wagons and their load.

Fix the mistake

11. Correct this statement: "A ball hits the wall at 20 m s^{-1} and bounces back at 15 m s^{-1}, so Δv = 20 − 15 = 5 m s^{-1}."

12. Correct this statement: "Momentum was conserved in the collision, so the kinetic energy must have been conserved too."

13. Correct this statement: "Doubling the compression of a spring doubles the energy it stores."

14. Correct this statement: "Work to climb stairs = 60 kg × 3.5 m = 210 J."