

Test Review Motion 7

Q

Q1

A model truck A of mass 1.2 kg is travelling due west with a speed of 0.90 m s^{-1} . A second truck B of mass 4.0 kg is travelling due east towards A with a speed of 0.35 m s^{-1} .

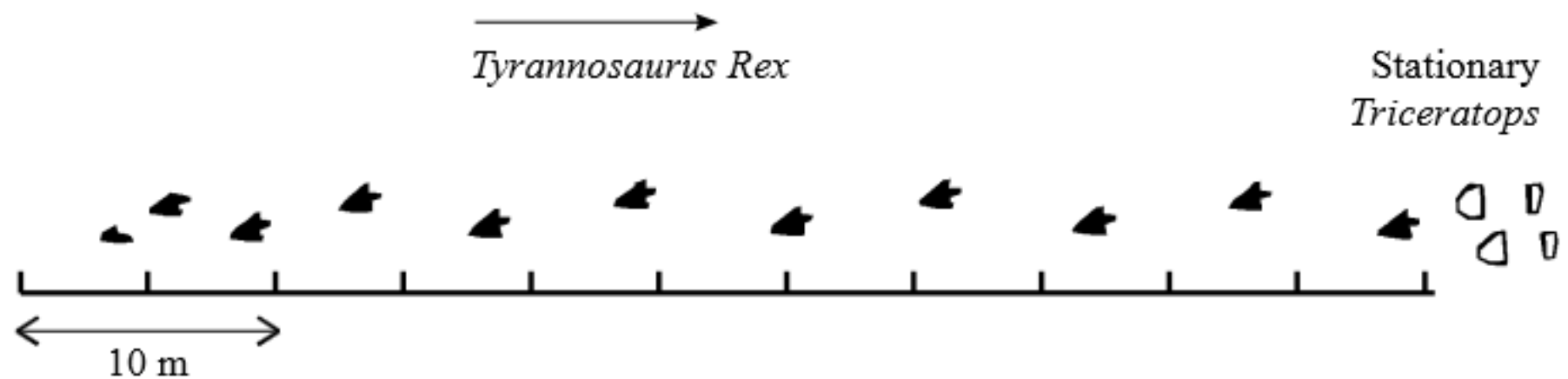
Calculate the magnitude of the total momentum of the trucks.

The trucks collide and stick together. Determine their velocity after the collision.

Q2

Palaeontologists are able to deduce much about the behaviour of dinosaurs from the study of fossilised footprints.

The tracks below show the path of a *Tyrannosaurus Rex* as it attacks a stationary *Triceratops*.



The time between footprints is 0.62 s. Show that the maximum speed of the *Tyrannosaurus Rex* is about 10 m s^{-1} .

Q2 continued

Tyrannosaurus Rex is believed to have attacked its prey by charging and locking its jaws on the prey. *Tyrannosaurus Rex* would be at its maximum speed when it hit the stationary prey.

This *Tyrannosaurus Rex* has a mass of 7000 kg. Calculate its momentum just before it hits the *Triceratops*.

Triceratops has a mass of 5000 kg. Calculate their combined speed immediately after the collision.

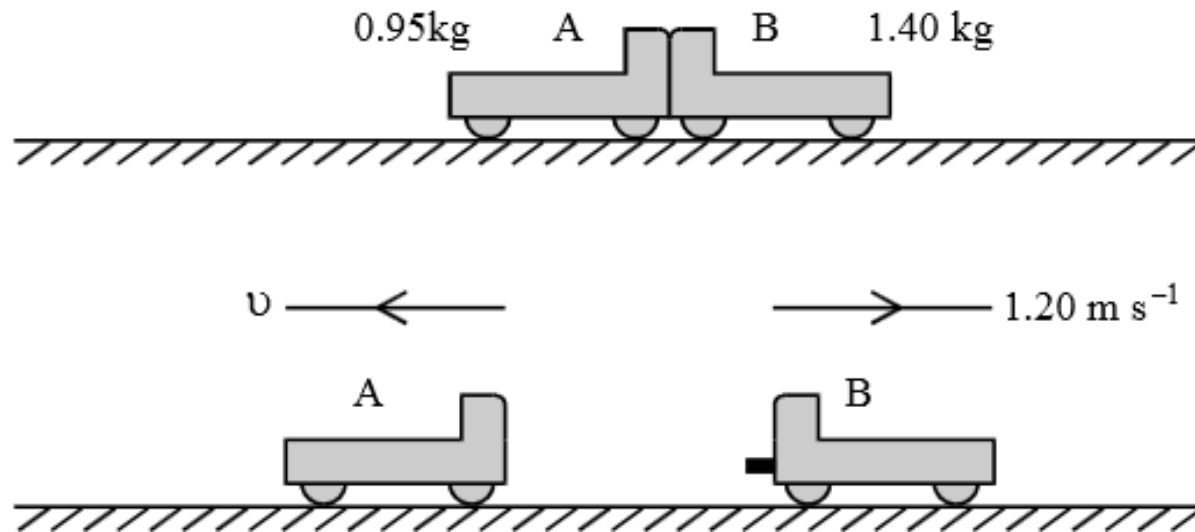
Q2 continued

The skull of *Tyrannosaurus Rex* is heavily reinforced to withstand the force produced in such a collision.

Calculate the force exerted on the *Tyrannosaurus Rex* if the time taken to reach their combined speed after the collision is 0.30 s.

Q3

The diagram shows an experiment with two trolleys.



State the total momentum of the trolleys as they move apart, and explain your answer.

Q3 continued

The masses of A and B are 0.95 kg and 1.40 kg respectively. B moves off at 1.20 m s^{-1} . Calculate the speed v of A.

Q5 continued

- (ii) the average force the club exerts on the ball.

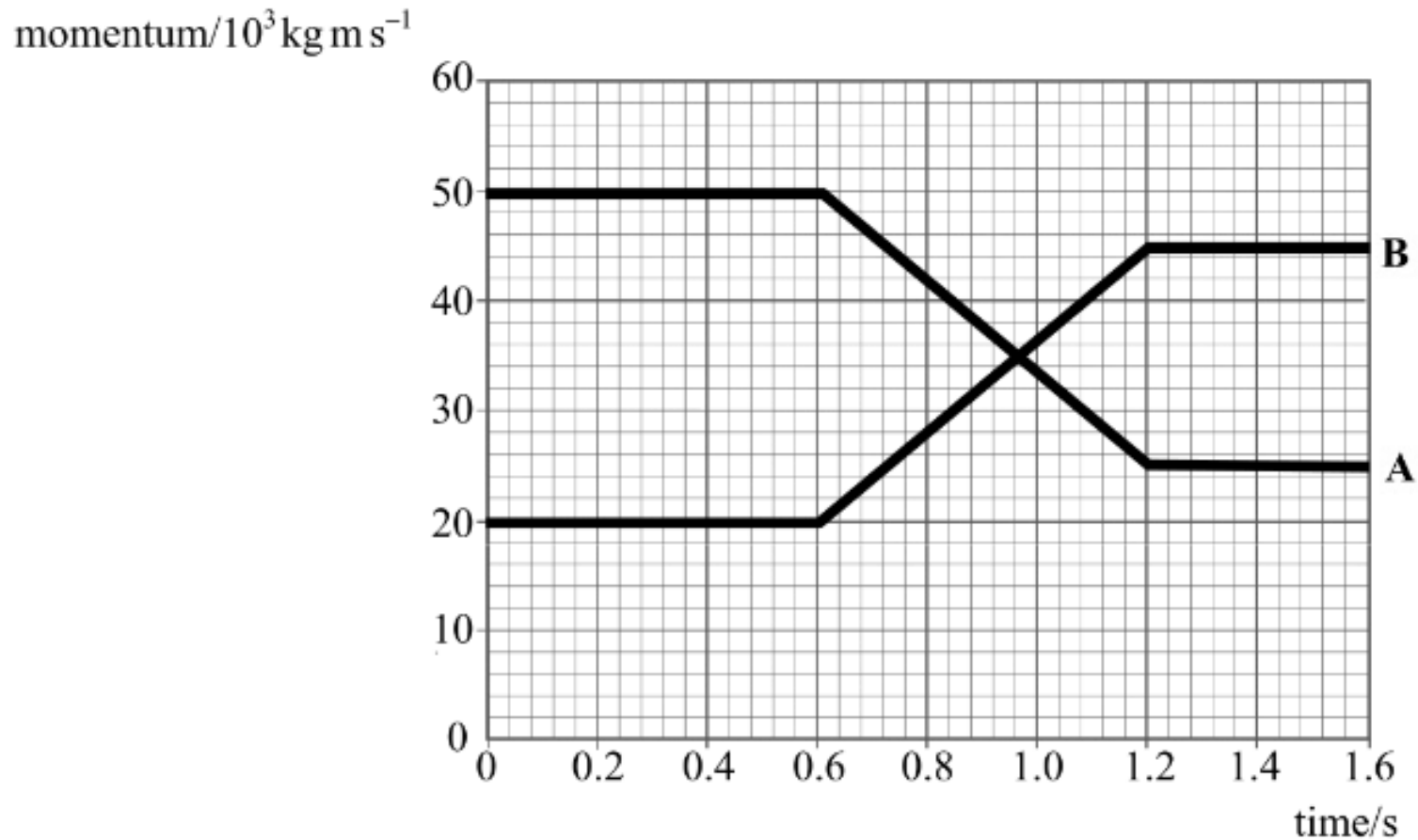
Q5 continued

(c) (i) State the value of the force exerted by the ball on the club and give its direction.

(ii) Explain how your answer to part (i) follows from an appropriate law of motion.

Q6

The graph shows how the momentum of two colliding railway trucks varies with time. Truck **A** has a mass of $2.0 \times 10^4 \text{ kg}$ and truck **B** has a mass of $3.0 \times 10^4 \text{ kg}$. The trucks are travelling in the same direction.



Q6 continued

(a) Calculate the change in momentum of

(i) truck **A**,

(ii) truck **B**.

Q6 continued

(b) Complete the following table.

	initial velocity/ m s^{-1}	final velocity/ m s^{-1}	initial kinetic energy/J	final kinetic energy/J
truck A				
truck B				

Q6 continued

- (c) State and explain whether the collision of the two trucks is an example of an elastic collision.

Q7

(a) State **two** quantities that are conserved in an elastic collision.

(b) A gas molecule makes an elastic collision with the walls of a gas cylinder. The molecule is travelling at 450 m s^{-1} at right angles towards the wall before the collision.

(i) What is the magnitude and direction of its velocity after the collision?

Q7 continued

- (ii) Calculate the change in momentum of the molecule during the collision if it has a mass of 8.0×10^{-26} kg.

Use Newton's laws of motion to explain how the molecules of a gas exert a force on the wall of a container.