3.4 Mechanics and Materials: 10-minute Pack

AQA 7408 · Calculator allowed · about 10 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Two ice skaters, initially at rest and in contact, push apart on frictionless ice. Skater A has mass 55 kg and skater B has mass 75 kg. After the push, skater A moves off at 3.2 m/s.

(a) Explain, with reference to Newton's third law, why the total momentum of the two-skater system remains zero after the push. **(2)**

(b) Calculate the speed at which skater B moves off. **(3)**

(c) Calculate the total kinetic energy generated during the push-off. **(3)**

(Total for Question 1 is 8 marks)

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Mark scheme · 3.4 Mechanics and Materials: 10-minute Pack

Question 1

(a) by Newton's third law the force exerted by A on B is equal and opposite to the force exerted by B on A, and they act for the same time **B1**

(a) so the impulses (changes in momentum) of A and B are equal and opposite, meaning the total momentum change of the system is zero and momentum is conserved (no external horizontal forces act) oe **B1**

(a) Answer: The push forces on A and B form a Newton's third law pair, equal in magnitude and opposite in direction, acting for the same time, so the impulses (and hence momentum changes) of A and B are equal and opposite; with no external horizontal force, total momentum stays at zero.

(b) use conservation of momentum: mA vA = mB vB (momenta equal and opposite, total zero) **M1**

(b) substitute vB = (55 x 3.2) / 75 **M1**

(b) vB = 2.3 m/s cao **A1**

(b) Answer: 2.3 m/s

(c) KE(A) = 0.5 x 55 x 3.2^2 = 282 J **M1**

(c) KE(B) = 0.5 x 75 x 2.347^2 = 207 J **M1**

(c) total KE = 488 J cao **A1**

(c) Answer: 488 J

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