3.4 Forces: Test Pack

AQA 8461 · Calculator allowed · about 50 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Give the name and symbol of the SI unit used for force.

(Total for Question 1 is 1 mark)

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2 Forces can be split into two groups: contact forces and non-contact forces.

(a) Define what is meant by a contact force. **(1)**

(b) State whether each of the following is a contact force or a non-contact force: (i) friction (ii) magnetic force (iii) air resistance (iv) gravitational force. **(4)**

(Total for Question 2 is 5 marks)

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3 A cyclist sets off from a lamp post, travels 500 m due north, then turns around and travels 500 m due south back to the same lamp post.

(a) State the difference between a scalar quantity and a vector quantity, giving one example of each. **(2)**

(b) State the cyclist's total distance travelled and total displacement for the whole journey. **(2)**

(Total for Question 3 is 4 marks)

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4 A skydiver jumps from a plane and falls for several seconds before opening their parachute.

(a) State the two forces acting on the skydiver as they fall, before the parachute opens. **(2)**

(b) Explain, in terms of these two forces, why the skydiver's acceleration decreases as their falling speed increases, until they reach terminal velocity. **(3)**

(Total for Question 4 is 5 marks)

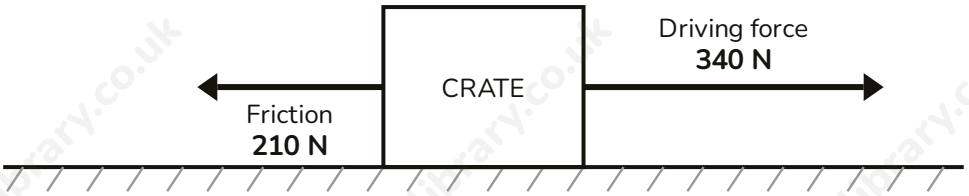
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5 Describe what is meant by terminal velocity and explain why the skydiver does not accelerate at terminal velocity.

(Total for Question 5 is 2 marks)

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6 A crate is pulled along a warehouse floor. A horizontal driving force of 340 N acts on the crate in the forward direction. Friction acts on the crate with a force of 210 N in the backward direction.



(a) Calculate the resultant force acting on the crate, including its direction. **(2)**

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(b) Describe the effect of this resultant force on the motion of the crate. **(2)**

.....

.....

(Total for Question 6 is 4 marks)

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7 Use the Physics Equations Sheet: work done (J) = force (N) x distance moved in the direction of the force (m), i.e. W = F s. A gardener pushes a lawnmower with a steady force of 85 N through a distance of 12 m.

(a) Calculate the work done by the gardener. **(2)**

.....

(b) State the main energy transfer that takes place as the gardener does this work. **(1)**

(Total for Question 7 is 3 marks)

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8 A student investigates motion on a rough horizontal surface. They pull a 2.5 kg block at constant speed with a horizontal force of 12 N and measure displacement of 4.0 m.

(a) Calculate the work done by the pulling force. **(1)**

.....

(b) State the increase in thermal energy of the block and surface and explain any assumption. **(3)**

.....

.....

.....

(Total for Question 8 is 4 marks)

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9 A force-time graph shows a constant force of 6.0 N applied to a 2.0 kg mass for 4.0 s, then the force is removed. The mass starts from rest.

(a) Calculate the acceleration while the force is applied. **(1)**

.....

(b) Calculate the speed of the mass at the moment the force is removed. **(1)**

.....

(c) State the distance travelled during the 4.0 s while the force is applied. **(1)**

(Total for Question 9 is 3 marks)

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10 Newton's Second Law can be written as: resultant force (N) = mass (kg) x acceleration (m/s^2), i.e. F = m a.

(a) Define inertial mass, referring to the equation F = m a. **(2)**

(Total for Question 10 is 2 marks)

11 A collision between two trolleys on a straight track is analysed. Trolley A of mass 0.80 kg moves right at 2.0 m/s and collides elastically with trolley B of mass 1.6 kg initially at rest. Calculate the velocities after the collision.

(a) Using conservation of momentum and kinetic energy for an elastic collision, calculate the final speed of trolley A and trolley B. Positive direction is the original direction of A. **(4)**

(Total for Question 11 is 4 marks)

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Mark scheme · 3.4 Forces: Test Pack

Question 1

newton or N cao **B1**

Answer: Newtons (N).

Question 2

(a) a force that only acts when two objects are physically touching (in contact), oe **B1**

(a) Answer: A force that acts only when two objects are physically touching.

(b) friction = contact force **B1**

(b) magnetic force = non-contact force **B1**

(b) air resistance = contact force **B1**

(b) gravitational force = non-contact force **B1**

(b) Answer: (i) contact (ii) non-contact (iii) contact (iv) non-contact

Question 3

(a) scalar has magnitude only; vector has magnitude and direction, oe **B1**

(a) correct example of each, e.g. speed/distance (scalar) and velocity/displacement/force (vector) **B1**

(a) Answer: Scalar = magnitude only (e.g. speed). Vector = magnitude and direction (e.g. velocity).

(b) distance = 1000 m, cao **B1**

(b) displacement = 0 m (or zero), cao **B1**

(b) Answer: Distance = 1000 m; displacement = 0 m

Question 4

(a) weight, acting downwards (due to gravity) **B1**

(a) air resistance (drag), acting upwards **B1**

(a) Answer: Weight (downwards) and air resistance (upwards).

(b) as speed increases, air resistance increases **B1**

(b) air resistance gets closer to (and eventually equals) weight, so the resultant force decreases, so acceleration decreases, oe **B1**

(b) at terminal velocity, air resistance = weight, resultant force = zero, so the skydiver falls at a constant velocity **B1**

(b) Answer: As speed increases, air resistance increases and reduces the resultant force, reducing acceleration, until air resistance equals weight and the skydiver falls at a constant (terminal) velocity.

Question 5

defines terminal velocity: constant speed reached when downward weight equals upward air resistance **M1**

states that resultant force is zero so no acceleration (forces balanced) cao **A1**

Answer: Terminal velocity is the constant speed when air resistance equals weight; the resultant force is zero so the skydiver does not accelerate.

Question 6

(a) 340 - 210 **M1**

(a) 130 N forward (in the direction of the driving force), cao **A1**

(a) Answer: 130 N forward

(b) the forces are unbalanced (resultant force is not zero), ft direction from 6a **B1**

(b) the crate accelerates in the forward direction (direction of the resultant force), oe **B1**

(b) Answer: The crate accelerates forwards because the forces on it are unbalanced.

Question 7

(a) 85 x 12 **M1**

(a) 1020 J, cao **A1**

(a) Answer: 1020 J

(b) energy is transferred (by work done) from the gardener's chemical energy store to the thermal energy stores of the lawnmower/ground/surroundings (due to friction), oe **B1**

(b) Answer: Energy is transferred from the gardener's chemical energy store to thermal energy stores (due to friction).

Question 8

(a) work = F x s = 12 x 4.0 = 48 J cao **B1**

(a) Answer: 48 J

(b) states thermal energy increase equals work done if kinetic energy unchanged, so 48 J **M1**

(b) gives value 48 J cao **A1**

(b) states assumption that block moves at constant speed so no change in kinetic energy and no other energy transfers (eg sound) significant, oe **A1**

(b) Answer: Increase in thermal energy = 48 J, assuming constant speed so no change in kinetic energy and negligible other energy losses.

Question 9

(a) a = F/m = 6.0 / 2.0 = 3.0 m/s^2 cao **B1**

(a) Answer: 3.0 m/s^2

(b) v = u + at = 0 + 3.0 x 4.0 = 12 m/s cao **B1**

(b) Answer: 12 m/s

(c) s = ut + 0.5 a t^2 = 0 + 0.5 x 3.0 x 16 = 24 m cao **B1**

(c) Answer: 24 m

Question 10

(a) inertial mass is a measure of how difficult it is to change the velocity of an object (its resistance to acceleration), oe **B1**

(a) it is given by the ratio of force to acceleration, m = F / a **B1**

(a) Answer: Inertial mass measures how difficult it is to change an object's velocity; it is given by m = F/a.

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Question 11

(a) sets up momentum: $0.80 \times 2.0 + 1.6 \times 0 = 0.80\ vA + 1.6\ vB$ **M1**

(a) uses elastic collision relation or conservation of KE: $0.5 \times 0.80 \times 2.0^2 = 0.5 \times 0.80\ vA^2 + 0.5 \times 1.6\ vB^2$ or uses relative speed method **M1**

(a) vA = -0.667 m/s (to 3 s.f.) cao **A1**

(a) vB = 1.33 m/s (to 3 s.f.) cao **A1**

(a) Answer: vA = -0.667 m/s, vB = 1.33 m/s

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