Forces and Motion

GCSE Science • **Combined and Triple** • Grades 3–6

WORKED SOLUTIONS

Name: worked example Class: _____ Total: 53 / 53

Show all your working. Marks are given for correct method as well as the final answer.

1. Explain the difference between a scalar and a vector quantity. **[2 marks]**

scalar: size only, like speed
vector: size and direction, like velocity

Answer: a vector has direction as well as size

2. Give one example each of a contact and a non-contact force. **[2 marks]**

contact: friction, air resistance, tension
non-contact: gravity, magnetism, electrostatic

Answer: friction; gravity

3. Write down the equation for weight. **[1 mark]**

mass × gravitational field strength

Answer: $W = mg$

4. Work out the weight of a 60 kg person. Take $g = 9.8$ N/kg. **[2 marks]**

60×9.8
$= 588$ N

Answer: 588 **N**

5. Explain why an object's mass is the same on the Moon but its weight is not. **[3 marks]**

mass does not change
the Moon has a weaker gravitational field
so $W = mg$ gives a smaller weight

Answer: mass is the amount of matter; weight depends on g

6. A car has 4 000 N driving force and 1 500 N drag. Work out the resultant force. **[2 marks]**

$4000 - 1500$
$= 2500$ N forwards

Answer: 2500 **N**

7. Describe what happens to an object when the resultant force on it is zero. **[2 marks]**

constant velocity, NOT it stops

Answer: it stays still or keeps a constant velocity

8. State Newton's second law as an equation. **[1 mark]**

resultant force = mass × acceleration

Answer: $F = ma$

9. A 1 200 kg car has a resultant force of 3 600 N. Work out its acceleration. **[3 marks]**

$a = F \div m$
$3600 \div 1200 = 3\ m/s^2$

Answer: 3 m/s^2

10. A force of 250 N gives an acceleration of 5 m/s^2. Work out the mass. **[3 marks]**

$m = F \div a$
$250 \div 5 = 50\ kg$

Answer: 50 kg

11. State Newton's third law. **[2 marks]**

the forces act on DIFFERENT objects
that is why they do not cancel out

Answer: every action has an equal and opposite reaction

12. Write down the equation for acceleration. **[1 mark]**

change in velocity ÷ time taken

Answer: $a = \frac{\Delta v}{t}$

13. A car speeds up from 5 m/s to 25 m/s in 8 s. Work out its acceleration. **[3 marks]**

change in velocity = 25 − 5 = 20
$20 \div 8 = 2.5\ m/s^2$

Answer: 2.5 m/s^2

14. Describe what the gradient of a distance-time graph represents. **[1 mark]**

distance ÷ time

Answer: speed

15. Describe what the AREA under a velocity-time graph represents. **[1 mark]**

area, not gradient -- gradient is acceleration

Answer: distance travelled

16. Explain what terminal velocity is. **[3 marks]**

as speed rises, air resistance rises
eventually it balances the weight
resultant force is zero, so the speed stays constant

Answer: when drag equals weight, so the resultant force is zero

17. Write down the two parts that make up stopping distance. **[2 marks]**

thinking: during the reaction time
braking: once the brakes are applied

Answer: thinking distance + braking distance

18. Give two factors that increase thinking distance. **[2 marks]**

anything that slows the REACTION time
wet roads affect braking, not thinking

Answer: tiredness, alcohol, drugs, distractions

19. A car travels at 20 m/s and the driver's reaction time is 0.7 s.

(a) Work out the thinking distance. **[3 marks]**

distance = speed × time

20 × 0.7

= 14 m

(b) Give two factors that would increase the BRAKING distance. **[2 marks]**

wet or icy road, worn tyres

worn brakes, greater speed, heavier load

Answer: ____ 14 m ; wet road, worn tyres____

20. A 0.5 kg ball is kicked and reaches 12 m/s.

(a) Write down the equation for momentum and work out the ball's momentum. **[3 marks]**

p = mv

0.5 × 12

= 6 kg m/s

(b) The ball is stopped in 0.2 s. Work out the force on it. **[3 marks]**

F = change in momentum ÷ time

6 ÷ 0.2

= 30 N

Answer: ____ 6 kg m/s ; 30 N____

21. A skydiver falls from a plane.

(a) Explain why she accelerates at first. **[3 marks]**

weight is bigger than air resistance

so there is a downward resultant force

F = ma means she accelerates

(b) Explain what happens to her speed when the parachute opens. **[3 marks]**

the parachute increases air resistance

air resistance is now bigger than weight

so she DECELERATES to a new, lower terminal velocity

she slows down -- she does not go upwards

Answer: ____ weight exceeds drag ; she decelerates to a lower terminal velocity____

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