How Forces Affect Motion

Standard difficulty · 20 questions · 40 marks · Time: 36 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. A force acting on a mass of 9 kg gives it an acceleration of 6 m/s^2. The force is:
(a) 1.5 N **(b)** 15 N **(c)** 108 N **(d)** 54 N

2. A force of 180 N acts on a body of mass 20 kg. Its acceleration is:
(a) 9 m/s^2 **(b)** 3600 m/s^2 **(c)** 20 m/s^2 **(d)** 11 m/s^2

3. The momentum of a 32 kg object moving at 2 m/s is:
(a) 16 kg m/s **(b)** 34 kg m/s **(c)** 65 kg m/s **(d)** 64 kg m/s

4. An 8 kg body speeds up from 8 m/s to 10 m/s. The change in its momentum is:
(a) 16 kg m/s **(b)** 80 kg m/s **(c)** 144 kg m/s **(d)** 2 kg m/s

5. The tendency of an object to resist a change in its state of rest or motion is called:
(a) inertia **(b)** force **(c)** acceleration **(d)** momentum

6. A 24 kg body's velocity changes from 5 m/s to 53 m/s in 8 s. The force acting on it is:
(a) 168 N **(b)** 1152 N **(c)** 1272 N **(d)** 144 N

7. A bullet of mass 15 g is fired at 500 m/s from a gun of mass 6 kg. The recoil speed of the gun is:
(a) 1.25 m/s **(b)** 2.25 m/s **(c)** 12.5 m/s **(d)** 1,250 m/s

8. Assertion (A): A force of 36 N gives a mass of 6 kg an acceleration of 6 m/s^2.
Reason (R): By Newton's second law of motion, F = ma.
(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

Section B — Short answer — 8 × 2 = 16 marks

9. A car of mass 1,600 kg speeds up from 5 m/s to 13 m/s in 9 s. Find the force on it. (Give the answer to 2 decimal places where needed.)

10. A trolley of mass 2 kg moving at 20 m/s hits a 7 kg trolley at rest, and they move off together. Find their common velocity. (Give the answer to 2 decimal places where needed.)

11. A vehicle of mass 2,200 kg moving at 20 m/s stops in 3 s. Find the retarding force. (Give the answer to 2 decimal places where needed.)

12. A ball of mass 180 g hits a wall at 21 m/s and bounces straight back at 17 m/s. Find the change in its momentum. (Give the answer to 2 decimal places where needed.)

13. The same force acts on two bodies of masses 14 kg and 18 kg. Find the ratio of their accelerations.

14. A force of 126 N gives a body an acceleration of 7 m/s^2. Find its mass.

15. A 1 kg ball moving at 15 m/s hits a 2 kg ball moving the same way at 4 m/s. After the collision the first ball moves at 1 m/s. Find the speed of the second ball.

16. A force of 34 N acts on a 17 kg body moving at 7 m/s for 5 s. Find its final velocity.

Section C — Word problems — 4 × 4 = 16 marks

17. A fielder catches a cricket ball of mass 167 g moving at 18 m/s, stopping it in 0.4 s. Find the average force on the fielder's hands. (Give the answer to 2 decimal places where needed.)

18. A hockey ball of mass 250 g travelling at 15 m/s is hit back along its path at 7 m/s. Find the change in its momentum. (Give the answer to 2 decimal places where needed.)

19. A truck of mass 8 tonnes starts from rest and covers 380 m in 19 s with uniform acceleration. Find its acceleration and the force acting on it. (Give the answer to 2 decimal places where needed.)

20. A rifle of mass 5 kg fires a bullet of mass 35 g at 600 m/s. Find the recoil velocity of the rifle. (Give the answer to 2 decimal places where needed.)

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Answer key

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Q	Answer	Working
1	**(d) 54 N**	F = ma = 9 × 6
2	**(a) 9 m/s^2**	a = F ÷ m = 180 ÷ 20
3	**(d) 64 kg m/s**	p = mv = 32 × 2
4	**(a) 16 kg m/s**	m(v − u) = 8 × 2
5	**(a) inertia**	—
6	**(d) 144 N**	F = m(v − u) ÷ t = 24 × 48 ÷ 8
7	**(a) 1.25 m/s**	0.015 × 500 = 6 × v; v = 1.25
8	**(a) Both A and R are true, and R is the correct explanation of A.**	A is true: F = ma = 6 × 6 = 36 N. R is true and explains A.
9	**1,422.22 N**	F = m(v − u) ÷ t = 1600 × 8 ÷ 9
10	**4.44 m/s**	momentum is conserved: 2 × 20 = (2 + 7) × v
11	**14,666.67 N**	F = m × (0 − 20) ÷ 3; its size is 14,666.67 N
12	**6.84 kg m/s**	the direction reverses: 0.18 × (21 + 17)
13	**9 : 7**	a = F/m, so $a_1 : a_2$ = 18 : 14
14	**18 kg**	m = F ÷ a = 126 ÷ 7
15	**11 m/s**	1 × 15 + 2 × 4 = 1 × 1 + 2 × v
16	**17 m/s**	a = 34 ÷ 17 = 2 m/s^2; v = 7 + 2 × 5
17	**7.52 N**	F = m v ÷ t = 0.167 × 18 ÷ 0.4
18	**5.5 kg m/s**	the velocity reverses: 0.25 × (15 + 7)
19	**2.11 m/s^2; 16,842.11 N**	s = ½at^2, so a = 2 × 380 ÷ 19^2; F = 8000 × a
20	**4.2 m/s**	total momentum stays zero: 5 × v = 0.035 × 600

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