Lesson 1 Momentum Solutions

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Lesson 1 Homework:

1) The momentum of an object depends upon the object's _____. (Pick two quantities.)

a. mass - how much stuff it has

b. acceleration - the rate at which the stuff changes its velocity

c. weight - the force by which gravity attracts the stuff to Earth

d. velocity - how fast and in what direction it's stuff is moving

e. position - where the stuff is at

(ans: a, d)

2) Momentum is a _____ quantity. a. scalar b. vector

(ans: b)

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3) Which are complete, correct descriptions of the momentum of an object? Circle all that apply.

a. 2.0 kg/s b. 7.2 kg·m/s, right c. 6.1 kg·m/s^2, down

d. 4.2 m/s, east e. 1.9 kg·m/s, west f. 2.3 kg·m/s

(ans: b, e) Note: (f) is a momentum magnitude, but it's missing a direction

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4) The two quantities needed to calculate an object's momentum are mass and velocity.

(see #1 for the answer)

5) Consider the mass and velocity values of Objects A and B below.

Compared to Object B, Object A has _____ momentum.

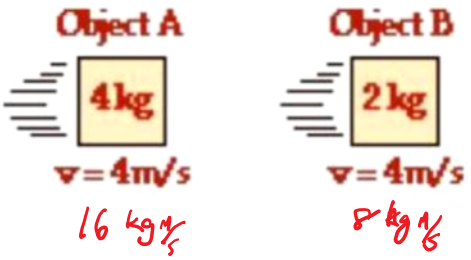
a. two times the b. four times the

c. eight times the d. the same

e. one-half the f. one-fourth the

g. ... impossible to tell without knowledge of the F and a.

Ans: a



16 kg m/s 8 kg m/s

6. Calculate the momentum of ... (Include appropriate units on your answers.)

a. ... a 2.0-kg brick moving through the air due west at 12 m/s.

$\vec{p} = m\vec{v} = (2)(12) = 24$ kg m/s West

b. ... a 3.5-kg wagon moving south along the sidewalk at 1.2 m/s.

(ans: 24 kg m/s West, 4.2 kg m/s South)

$\vec{p} = m\vec{v} = (3.5)(1.2) = 4.2$ kg m/s South

7. With what velocity must a 0.53-kg softball be moving to equal the momentum of a 0.31-kg baseball moving at 21 m/s? (12.3 m/s)

Baseball

$\vec{p} = m\vec{v} = (.31)(21) = 6.51$ kg m/s

Softball

$\vec{p} = m\vec{v}$

$\vec{v} = \frac{\vec{p}}{m} = \frac{6.51}{0.53} = 12.3$ m/s

8. Calculate the momentum of a 1.60×10^3 kg car traveling at West at 20.0 m/s. (32000 kg m/s west)

$\vec{p} = m\vec{v} = (1.6 \times 10^3)(20) = 3.2 \times 10^3$ kg m/s West

9. Calculate the momentum of a 2.50×10^3 kg truck traveling north at 110 km/h. (76400 kg m/s north)

$\div 3.6$

$\vec{p} = m\vec{v} = (2.5 \times 10^3)\left(\frac{110}{3.6}\right) = 76400$ kg m/s North

10. How fast is a 1.50 kg ball moving if it has a momentum of 4.50 kg m/s east? (3.0 m/s east)

$\vec{p} = m\vec{v} \rightarrow \vec{v} = \frac{\vec{p}}{m} = \frac{4.5}{1.5} = 3.0$ m/s East

11. A 75.0 g ball is rolling at a speed of 57.0 cm/s. Calculate the magnitude of the ball's momentum. (0.043 kg m/s ← check the units carefully!)

$m = 75 g \times \frac{kg}{10^3 g} = .075$ kg

$\vec{v} = 57 \frac{cm}{s} \times \frac{10^{-2} m}{cm} = .57$ m/s

$\vec{p} = m\vec{v}$

$\vec{p} = (.075)(.57) = 0.043$ kg m/s

12. A 5.00 kg ball traveling at 6.0 m/s accelerates at a rate of 2.00 m/s^2 for 1.50 seconds. Calculate the ball's momentum after the acceleration. (45 kg m/s)

$\vec{p} = m\vec{v}_f$

$v_f = ?$ $v_i = 6$ $a = 2$ $t = 1.5$

$v_f = v_i + at = 6 + (2)(1.5) = 9$

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$\vec{p} = (5)(9) = 45 \text{ kg m/s}$

13. A 2.00 kg rock is dropped from the top of a 30.0 m high building. Calculate the ball's momentum at the time that it strikes the ground. (-48.5 kg m/s or 48.5 kg m/s down)

$\vec{p} = m\vec{v}$

$\vec{p} = (2)(-24.2)$

$v_f = ?$ $v_i = 0$ $a = -9.8$ $\vec{d} = -30$

$\vec{v_f}^2 = \cancel{v_i^2} + 2\vec{a}\vec{d}$

$v_f = \sqrt{2(-9.8)(-30)} = -24.2 \text{ m/s}$

$\vec{p} = 48.5 \text{ kg m/s}$ down

14. A 1.50 kg rock is thrown up into the air from ground level, reaches a maximum height of 7.00 m, and then returns to the ground. Calculate the rock's momentum as it strikes the ground. (-17.6 kg m/s or 17.6 kg m/s down)

$\vec{p} = m\vec{v}$

$\vec{p} = (1.5)(-11.7)$

$v_f = ?$ At top $v_i = 0$ $a = -9.8$ $d = -7$

$v_f = \sqrt{2ad} = \sqrt{2(-9.8)(-7)} = -11.7 \text{ m/s}$

$\vec{p} = 17.6 \text{ kg m/s}$ down