T-1. A truck travels 400 meters in 20 seconds. What is its average speed?

	m/s

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Solution:

$v = d/t = (400\ m)/(20\ s) = 20 m/s$

20 m/s

A-1. Two cars on opposite sides of a highway, traveling towards each other, are 800 m apart at time t=0 s. The first car is traveling at 15 m/s and the second is traveling at 35 m/s. At what time do the cars pass each other?

s

A-1. Two cars on opposite sides of a highway, traveling towards each other, are 800 m apart at time t=0 s. The first car is traveling at 15 m/s and the second is traveling at 35 m/s. At what time do the cars pass each other?

Solution:

t = (800 m)/(15 m/s+35 m/s) = 16 s

16 s

A-2. An object of mass 2 kg traveling at 5 m/s hits an object of mass 5 kg initially at rest. If the first object comes to rest how fast does the second object move?

	m/s

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Solution:
Momentum conservation
$m_1 * v_1 = m_2 * v_2$
$\rightarrow 2\ kg * 5\ m/s = 5\ kg * v_2 \rightarrow v_2 = 2\ m/s$

2 m/s

A-3. A ball thrown downward from the top of a tower with an initial speed of 5 m/s takes 5 seconds to hit the ground. How tall is the tower in meters?
(Use g=10 m/s² for the free-fall acceleration and neglect air resistance.)

m

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(Use g=10 m/s² for the free-fall acceleration and neglect air resistance.)

Solution:
$y_0 = 0.5*g* t^2 + v_0 * t$
$v_0 = 5$ m/s and $t=5$ s

150 m

A-4. If 400 g of water at 70 ºC is mixed with 200 g of water at 40 ºC, what will the equilibrium temperature of the mixture be?

	ºC

A-4. If 400 g of water at 70 ºC is mixed with 200 g of water at 40 ºC, what will the equilibrium temperature of the mixture be?

Solution:

Heat flow = mcDT. Total inward flow=0

0 =200g*c*(T-40ºC) + 400g*c*(T-70ºC)

60 ºC

B-1. A car is turning through a curve of radius 20 m at a constant speed of 10 m/s. What is the magnitude of its acceleration?

	m/s^2

B-1. A car is turning through a curve of radius 20 m at a constant speed of 10 m/s. What is the magnitude of its acceleration?

Solution:

$a = v^2/r = (10\ \text{m/s})^2/(20\ \text{m}) = 5\ \text{m/s}^2$

$5 \quad \text{m/s}^2$

B-2. Two resistors, 2 ohms and 3 ohms, are connected in parallel with each other across a 12 volt battery. What is the current drawn from the battery?

apms

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Solution:

$1/R_{tot} = 1/R1 + 1/R2 = 5/6$

$I = V/R_{tot} = 12*(5/6) = 10$ amps

10 apms

B-3. An object of mass 5 kg is accelerated by a constant force from rest to a speed of 4 m/s in a distance of 2 m. What is the magnitude of F?
(The object moves in the same direction as that of the force.)

	N

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(The object moves in the same direction as that of the force.)

Solution:
Work: W=F*distance=F*2m
Kinetic Energy: $K=0.5*5kg*(4m/s)^2$
W=K → F=20 N

20 N

B-4. A boy of mass 36 kg sits on one end of a seesaw at a distance of 1 m from the pivot point. When his younger sister is sitting on the other end at a distance of 1.2 m from the pivot, the seesaw is balanced. What is the mass of the sister?

kg

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Solution:

36 kg * 1 m= X kg * 1.2 m

→ M=36 kg * (1 m/1.2 m)=30 kg

30 kg

C-1. An object is dropped from rest at a height of 45 m. How long does it take to hit the ground?
(Use g=10 m/s² for the free-fall acceleration and neglect air resistance.)

	S

C-1. An object is dropped from rest at a height of 45 m. How long does it take to hit the ground?
(Use g=10 m/s² for the free-fall acceleration and neglect air resistance.)

Solution:
$t^2 = 2\ y_0/g = 2\ (45\ m)/(10\ m/s^2) \rightarrow 9\ s^2$

3 S

C-2. A block with a mass of 2 kg moving at a speed of 10 m/s collides and sticks to a 3 kg block that is initially at rest. What is the speed of the two blocks after the collision?

	m/s

C-2. A block with a mass of 2 kg moving at a speed of 10 m/s collides and sticks to a 3 kg block that is initially at rest. What is the speed of the two blocks after the collision?

Solution:

$m_1 * v_1 = (m_1 + m_2) * v$

$2\ \text{kg} * 10\ \text{m/s} = (2\ \text{kg} + 3\ \text{kg}) * v$

$\rightarrow v = 4\ \text{m/s}$

4 m/s

C-3. A soccer ball is kicked upward from the ground at a speed of 30 m/s at an angle of 30 degrees above the horizontal. At t = 2 s after it is kicked, the ball just clears a wall. What is the height of the wall?
(Use g=10 m/s² for the free-fall acceleration and neglect air resistance.)

m

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(Use g=10 m/s² for the free-fall acceleration and neglect air resistance.)

Solution:
$v_y=(30\ m/s) * \sin[30^o]=15\ m/s$
$h= (15 m/s)*(2\ s)-0.5*(10\ m/s^2)*(2\ s)^2$
$=10\ m$

10 m

C-4. An astronaut that weighs 800 N on Earth goes to a planet whose mass is 9 times that of the earth, and whose radius is 3 times that of Earth. What is his weight on that planet?

N

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Solution:

$F(\text{earth}) = GMm/r^2 = 800\ \text{N}$

$F(\text{planet}) = G(9M)m/(3\ r)^2 = GMm/r^2 = F(\text{earth}) = 800\ \text{N}$

800 N

D-1. A car of mass 1500 kg is parked on a hill inclined at an angle of 30 degrees from the horizontal. What is the force of static friction on the car?
(Use g=10 m/s² for the free-fall acceleration.)

N

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(Use g=10 m/s² for the free-fall acceleration.)

Solution:
Friction force cancels gravity component along plane,
$F = m * g * \sin[30^\circ]$
$= 1500 * 10 * 0.5 = 7500$

7500 N

D-2. On a frictionless track, a roller coaster has a speed of 4 m/s when it is at a height of 2 m. What is its speed when it is at its minimum height of 1 m?
(Use g=10 m/s² for the free-fall acceleration.)

	m/s

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(Use g=10 m/s² for the free-fall acceleration.)

Solution:
Energy conservation
$0.5\ M\ (4\ m/s)^2 + M\ (10\ m/s^2)\ (2\ m)$
$= 0.5\ M\ v^2 + M\ (10\ m/s^2)\ (1\ m)$

6 m/s

D-3. A 0.4 kg mass is suspended from the ceiling by a massless spring with the force constant of 8 N/m. How much will the spring stretch when the mass is at rest? (Use g=10 m/s² for the free-fall acceleration.)

	m

D-3. A 0.4 kg mass is suspended from the ceiling by a massless spring with the force constant of 8 N/m. How much will the spring stretch when the mass is at rest?
(Use g=10 m/s² for the free-fall acceleration.)

Solution:

$(8\ \text{N/m})\ L = (0.4\ \text{kg})\ (10\ \text{m/s}^2)$

$\rightarrow x = 0.5\ \text{m}$

0.5 m

D-4. Masses of 6.0 kg and 1.5 kg are connected by a massless string, which passes over a massless and frictionless pulley. When the masses are released, what is the magnitude of the acceleration of the 6.0 kg mass?
(Use g=10 m/s² for the free-fall acceleration.)

m/s²

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(Use g=10 m/s² for the free-fall acceleration.)

Solution:

$F = (6.0\ kg + 1.5\ kg) * a,$

$F = (6.0\ kg - 1.5\ kg) * 10\ m/s^2$

$\rightarrow\ a = 6\ m/s^2$

6 m/s²

S-1. How much energy is required to raise the temperature of 200 g of water from 10 ºC to 34 ºC?
(The specific heat of water is 1 cal/gºC.)

	cal

S-1. How much energy is required to raise the temperature of 200 g of water from 10 ºC to 34 ºC?
(The specific heat of water is 1 cal/gºC.)

Solution:
Energy =(34º - 10º) * 200 g * 1 cal/gºC = 4800 calories

4800 cal

S-2. A stone is thrown from the top of a building with a speed of 10 m/s straight upward. The building is 15 m high, and the stone just misses the edge of the roof on its way down. Determine the speed of the stone when it hits the ground.
(Use g=10 m/s² for the free-fall acceleration)

	m/s

S-2. A stone is thrown from the top of a building with a speed of 10 m/s straight upward. The building is 15 m high, and the stone just misses the edge of the roof on its way down. Determine the speed of the stone when it hits the ground.
(Use g=10 m/s² for the free-fall acceleration.)

Solution:
By energy conservation,
0.5 M (10 m/s)^2 + M (10 m/s²) (15 m) = 0.5 M v² → v^2=400 (m/s)² →v=20 m/s

20 m/s

S-3. An object of mass 7 kg skids across a rough horizontal surface. The coefficient of kinetic friction between the object and the surface is 0.30. If the initial speed of the object is 15 m/s, how long does it take for the object to come to a stop?
(Use g=10 m/s² for the free-fall acceleration)

s

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(Use g=10 m/s² for the free-fall acceleration.)

Solution:
Acceleration from the friction force
= -(10 m/s²)*0.3== -3 m/s²
15 m/s - (3 m/s²) t=0

5 s

S-4. To leave Earth, an escape velocity of 11.2 km/s is required. What is the required escape velocity to leave a planet that has the same radius as Earth but 9 times Earth's density.

	m/s^2

S-4. To leave Earth, an escape velocity of 11.2 km/s is required. What is the required escape velocity to leave a planet that has the same radius as Earth but 9 times Earth's density.

Solution:
Escape velocity v=sqrt[2 G M/R]
The mass of the planet is 9 times greater than Earth. V=sqrt[2 G (9 M)/R]=3*v

33.6 m/s^2