T-1. A truck travels 500 meters in 20 seconds. What is its average speed?

	m/s

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Solution:
$v = d/t = 500\text{m} / 20\text{s} = 25\text{m/s}$

25 m/s

A-1. The brakes are applied to a car traveling at 16 m/s, and it accelerates at -4.0 m/s^2. How far does the car travel before it comes to rest?

	m

A-1. The brakes are applied to a car traveling at 16 m/s, and it accelerates at -4.0 m/s². How far does the car travel before it comes to rest?

Solution:
Time to stop: $t=16\ (m/s)/(\ 4.0\ m/s^2)=4\ s$
Distance: $16*t+0.5*(-4)*\ t^2$
$=64-32=32$

32	m

A-2. An object of mass 2.0 kg traveling at 10 m/s hits an object of mass 5.0 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
2.0 kg * 10 m/s = 5.0 kg *v

4 m/s

A-3. A rock thrown downward from a cliff with an initial speed of 5 m/s takes 5 s to hit the river below. How high is the cliff? (Use g=10 m/s² for the free-fall acceleration, and neglect air resistance.)

	m

A-3. A rock thrown downward from a cliff with an initial speed of 5 m/s takes 5 s to hit the river below. How high is the cliff? (Use g=10 m/s² for the free-fall acceleration, and neglect air resistance.)

Solution:

$y_0 = 0.5*g* t^2 + v_0 * t$

$=0.5*10*5^2+5*5$

150 m

A-4. An object of mass 5 kg travels a distance of 2 m, during which it is accelerated from rest to a speed 4 m/s by a constant force F. What is the magnitude of F?

	N

A-4. An object of mass 5 kg travels a distance of 2 m, during which it is accelerated from rest to a speed 4 m/s by a constant force F. What is the magnitude of F?

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

20 N

B-1. A massless spring with a force constant of 40 N/m is suspended from the ceiling. A 2 kg mass is attached to the end and lowered to its equilibrium position. How much does the mass cause the spring to stretch? (Use g=10 m/s² for the free-fall acceleration.)

	m

B-1. A massless spring with a force constant of 40 N/m is suspended from the ceiling. A 2 kg mass is attached to the end and lowered to its equilibrium position. How much does the mass cause the spring to stretch? (Use g=10 m/s² for the free-fall acceleration.)

Solution:

$40\ \text{N/m} * x = 2\ \text{kg} * 10\ \text{m/s}^2$

→ $x = 0.5\ \text{m}$

0.5 m

B-2. A ball is thrown straight up into the air with a speed 30 m/s. How long will it take to return to the initial position? (Use $g=10\ m/s^2$ for the free-fall acceleration, and neglect air resistance.)

	s

B-2. A ball is thrown straight up into the air with a speed 30 m/s. How long will it take to return to the initial position? (Use g=10 m/s^2 for the free-fall acceleration, and neglect air resistance.)

Solution:

$30-gt= -30$

$t=(60m/s) /(10\ m/s^2)=6s$

6 s

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

	A

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

Solution:

$1/R_{tot} = 1/R + 1/R = 2/R$

$V = IR_{tot} = IR/2$

$I = 2V/R = 2 * 12v / 3 \text{ ohms} = 8 \text{ amps}$

8	A

B-4. If 150 g of water at 20 ºC is mixed with 50 g of water at 60 ºC, what is the equilibrium temperature?

	ºC

B-4. If 150 g of water at 20 ºC is mixed with 50 g of water at 60 ºC, what is the equilibrium temperature?

Solution:
Heat flow = mcDT. Total inward flow=0.
0 =150g*c*(T-20ºC) + 50g*c*(T-60ºC),
where c is the specific heat of water.

30 ºC

C-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

C-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:

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

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

C-2. A bullet of mass 0.05 kg hits and gets embedded in a wooden block of mass 0.25 kg. Afterwards, the block with bullet embedded is traveling at a speed of 30 m/s. What was the initial speed of the bullet?

	m/s

C-2. A bullet of mass 0.05 kg hits and gets embedded in a wooden block of mass 0.25 kg. Afterwards, the block with bullet embedded is traveling at a speed of 30 m/s. What was the initial speed of the bullet?

Solution:

$$m_1 * v_1 = (m_1+m_2)*v_2$$

$$0.05\ v_1 = (0.05+0.25) * 30$$

180 m/s

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

	N

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

Solution:

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

$F(\text{planet}) = G(3M)m/(2r)^2$

$= (3/4)*GMm/r^2 = (4/4)*F(\text{Earth})$

600 N

C-4. On a frictionless track a roller coaster has speed 4 m/s when it is at height 1 m. What is its speed when it is at its minimum height of 0 m? (Use g=10 m/s² for the free-fall acceleration, and neglect air resistance.)

	m/s

C-4. On a frictionless track a roller coaster has speed 4 m/s when it is at height 1 m. What is its speed when it is at its minimum height of 0 m? (Use g=10 m/s² for the free-fall acceleration, and neglect air resistance.)

Solution:
Energy conservation
0.5 v_0^2 + g*h = 0.5 v^2
8+10=0.5 v^2 → v=6

6 m/s

D-1. A 2-meter stick has a mass of 200 g. A small 400 g mass is attached at the 160 cm mark. At which mark is the center of mass?

	cm

D-1. A 2-meter stick has a mass of 200 g. A small 400 g mass is attached at the 160 cm mark. At which mark is the center of mass?

Solution:
(200 g* 100 cm+400 g * 160 cm)/(200g +400 g) = 140 cm

140 cm

D-2. Masses of 5 kg and 3 kg hang vertically and are connected by a massless string that passes over a massless and frictionless pulley. When the masses are released, what is the magnitude of the acceleration of the 3 kg mass? (Use g=10 m/s^2 for the free-fall acceleration, and neglect air resistance.)

	m/s^2

D-2. Masses of 5 kg and 3 kg hang vertically and are connected by a massless string that passes over a massless and frictionless pulley. When the masses are released, what is the magnitude of the acceleration of the 3 kg mass? (Use g=10 m/s² for the free-fall acceleration, and neglect air resistance.)

Solution:

$F = (5\ kg + 3\ kg) * a,$

$F = (5\ kg - 3\ kg) * 10\ m/s^2$

$\rightarrow\ a = 2.5\ m/s^2$

$2.5\ m/s^2$

D-3. A car of mass 1700 kg is parked on a hill inclined at angle 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

D-3. A car of mass 1700 kg is parked on a hill inclined at angle 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)

Solution:
Friction force cancels gravity component along plane, mg sin(theta) = 1700 * 10 * 0.5 = 8500

8500 N

D-4. To leave the Earth, an escape velocity of 11.2 km/s is required. What is a required escape velocity to leave a planet that has the same radius as Earth and 36 times Earth's density.

	km/s

D-4. To leave the Earth, an escape velocity of 11.2 km/s is required. What is a required escape velocity to leave a planet that has the same radius as Earth and 36 times Earth's density.

Solution:
Escape velocity v=sqrt[2 G M/R]
The mass of the planet is 36 times greater than Earth. V=sqrt[2 G (36 M)/R]=6*v

67.2 km/s

S-1. There is a 50 kg block on a frictionless, horizontal surface. A woman pushes it with a force of 300 N. What is the acceleration of the block?

	m/s^2

S-1. There is a 50 kg block on a frictionless, horizontal surface. A woman pushes it with a force of 300 N. What is the acceleration of the block?

Solution:

$F=ma \rightarrow a = F/m = (300\ N)/(50\ kg)$

$6\ m/s^2$

S-2. A man stands on a bathroom scale in an elevator, which reads 800 N when the elevator is stopped. What would the reading be while the elevator is accelerating upward at 6 m/s²? (Use g=10 m/s² for the free-fall acceleration.)

	N

S-2. A man stands on a bathroom scale in an elevator, which reads 800 N when the elevator is stopped. What would the reading be while the elevator is accelerating upward at 6 m/s²? (Use g=10 m/s² for the free-fall acceleration.)

Solution:

Total acceleration =a=g+ 6 m/s²=16 m/s²

800N*(a/g)=1280 N

1280 N

S-3. A ball is thrown at a vertical wall 30 meters away, with a velocity 30 m/s at an angle of 45º. At what height above the starting point will it strike the wall? (Use g=10 m/s² for the free-fall acceleration.)

	m

S-3. A ball is thrown at a vertical wall 30 meters away, with a velocity 30 m/s at an angle of 45º. At what height above the starting point will it strike the wall? (Use g=10 m/s² for the free-fall acceleration.)

Solution:

$v_x = 30 \text{ m/s} * \cos 45 = 15\sqrt{2}$

$\rightarrow t = x/v_x = \sqrt{2}$ s

$h = v_y * t - gt^2/2 = 30 - 10 = 20$

20 m

S-4. A stone thrown from the top of a building with a speed 10 m/s straight upward. The building is 15 m high. Determine a speed of the stone when it hits the ground. (Use g=10 m/s² for the free-fall acceleration.)

	m/s

S-4. A stone thrown from the top of a building with a speed 10 m/s straight upward. The building is 15 m high. Determine a 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