Name Key **Level 3 Review**

314. A roller coaster, traveling with an initial speed of 15 meters per second, decelerates uniformly at –7.0 meters per second² to a full stop. Approximately how far does the roller coaster travel during its deceleration?

A) 1.0 m B) 2.0 m
[✓ C) 16 m] D) 32 m

$V_i = 15 m/s$
$a = -7 m/s^2$
$V_f = 0$
$d = ?$

$V_f^2 = V_i^2 + 2ad$
$0 = (15 m/s)^2 + 2(-7 m/s^2)(d$

315. A book of mass *m* falls freely from rest to the floor from the top of a desk of height *h*. What is the speed of the book upon striking the floor?

[✓ A) $\sqrt{2gh}$] B) $2gh$
C) mgh D) mh

$V_f^2 = V_i^2 + 2ad$
$V_f = \sqrt{2ad}$

316. A ball is thrown straight downward with a speed of 0.50 meter per second from a height of 4.0 meters. What is the speed of the ball 0.70 second after it is released? [Neglect friction.]

A) 0.50 m/s [✓ B) 7.4 m/s]
C) 9.8 m/s D) 15 m/s

$V_i = .5 m/s$ $t = .7 s$
$d_y = 4 m$
$V_f = ?$

$V_f = V_i + at$
$V_f = (.5 m/s) + (9.8 m/s^2)(.7 s)$

317. A 5.0-kilogram sphere, starting from rest, falls freely 22 meters in 3.0 seconds near the surface of a planet. Compared to the acceleration due to gravity near Earth's surface, the acceleration due to gravity near the surface of the planet is approximately

A) the same
B) twice as great
[✓ C) one-half as great]
D) four times as great

$d = \frac{1}{2}at^2$
$a = \frac{2d}{t^2} = \frac{2(22m)}{3s^2}$
$a = 4.9 m/s$

318. A rock falls from rest a vertical distance of 0.72 meter to the surface of a planet in 0.63 second. The magnitude of the acceleration due to gravity on the planet is

A) 1.1 m/s² B) 2.3 m/s²
[✓ C) 3.6 m/s²] D) 9.8 m/s²

$d = .72 m$
$t = .63 s$
$a = ?$

$a \frac{2d}{t^2} = \frac{2(.72 m)}{(.63 s)^2} = 3.6 m/s^2$

319. Starting from rest, object *A* falls freely for 2.0 seconds, and object *B* falls freely for 4.0 seconds. Compared with object *A*, object *B* falls

A) one-half as far B) twice as far
C) three times as far [✓ D) four times as far]

A	B
d =	d
t = 2s	= 4s
20m	80m

$d = \frac{1}{2}at^2$

320. A laboratory cart with a mass of 5 kilograms rolls through a distance of 2 meters in 10 seconds. Which of the following mathematical statements can be used to determine the momentum?

[✓ A) 5 kg × 2m/10s] B) 5 kg × 10s/2m
C) 5kg + 2m/10s D) 5 kg + 10s/2m

$p = mv$ $p = \frac{md}{t}$

321. A motorcycle being driven on a dirt path hits a rock. Its 60.-kilogram cyclist is projected over the handlebars at 20. meters per second into a haystack. If the cyclist is brought to rest in 0.50 second, the magnitude of the average force exerted on the cyclist by the haystack is

A) 6.0 × 10¹ N B) 5.9 × 10² N
C) 1.2 × 10³ N [✓ D) 2.4 × 10³ N]

$m = 60 kg$
$V_i = 20 m/s$
$t = .5 s$
$F = ?$
$V_f = 0$

$J = \Delta p$
$Ft = m\Delta v$
$F = \frac{m\Delta v}{t} = \frac{(60 kg)(20 m/s)}{.5 s}$
$F = 2400 N$

---

or

$a = \frac{\Delta v}{t} = \frac{-20 m/s}{.5 s} = -40 m/s^2$ $F_{net} = ma = (60 kg)(-40$
$= 2400 N$

322. A 6.0-kilogram block, sliding to the east across a horizontal, frictionless surface with a momentum of 30. kilogram•meters per second, strikes an obstacle. The obstacle exerts an impulse of 10. newton•seconds to the west on the block. The speed of the block after the collision is

A) 1.7 m/s [✓ B) 3.3 m/s]
C) 5.0 m/s D) 20. m/s

$V_i = 5 m/s$
$m = 6kg$
$p = 30 kg\,m/s$
$J = \Delta p = -10 Ns$
$V_f = 0$

$P_f = P_i + \Delta p$
$= 30 kg\,m/s - 10 Ns$
$P_f = 20 kg\,m/s$

$V_f = \frac{P_f}{m} = \frac{20 kg\,m/s}{6 kg}$
$= 3.3 m/s$

323. A 2.0-kilogram laboratory cart is sliding across a horizontal frictionless surface at a constant velocity of 4.0 meters per second east. What will be the cart's velocity after a 6.0-newton westward force acts on it for 2.0 seconds?

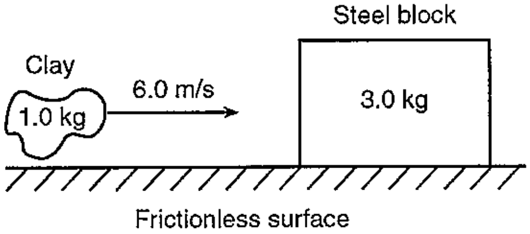
A) 2.0 m/s east [✓ B) 2.0 m/s west]
C) 10. m/s east D) 10. m/s west

$V_f = ?$
$m = 2kg$
$V_i = 4 m/s$
$F = -6N$
$t = 2s$

$Ft = m\Delta V$
$(-6N)(2s) = (2kg)(\Delta V)$
$-12 Ns = 2kg\, \Delta V$
$\Delta V = -6 m/s$

$V_f = V_i + \Delta V$
$V_f = 4 m/s + -6 m/s$
$V_f = -2 m/s$

324. A 3.0-kilogram steel block is at rest on a friction-less horizontal surface. A 1.0-kilogram lump of clay is propelled horizontally at 6.0 meters per second toward the block as shown in the diagram below.



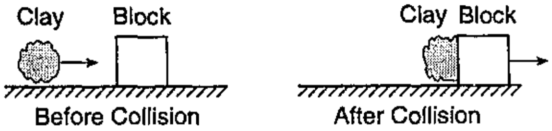
Upon collision, the clay and steel block stick together and move to the right with a speed of

[✓ A) 1.5 m/s] B) 2.0 m/s
C) 3.0 m/s D) 6.0 m/s

$m_i = 1kg$
$V_i = 6 m/s$

	1	2	1+2
m	1kg	3kg	4kg
V	6m/s	0	1.5m/s
P	6kg m/s		6kg m/s

325. As shown in the diagrams below, a lump of clay travels horizontally to the right toward a block at rest on a frictionless surface. Upon collision, the clay and the block stick together and move to the right.

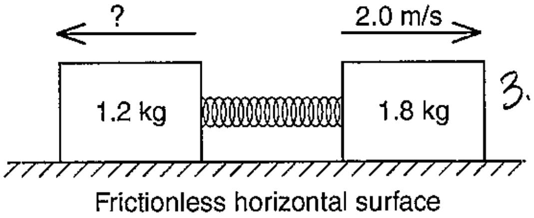


Compared to the total momentum of the clay and the block before the collision, the momentum of the clay-block system after the collision is

A) less B) greater
[✓ C) the same]

$P_{before} = P_{after}$

326. A 1.2-kilogram block and a 1.8-kilogram block are initially at rest on a frictionless, horizontal surface. When a compressed spring between the blocks is released, the 1.8-kilogram block moves to the right at 2.0 meters per second, as shown.



3.6 kg m/s

What is the speed of the 1.2-kilogram block after the spring is released?

A) 1.4 m/s B) 2.0 m/s
[✓ C) 3.0 m/s] D) 3.6 m/s

$P_{before} = P_{after}$
$0 = m_1 V_1 + m_2 V_2$
$(1.2kg)(V_1)\ (1.8 kg\,m/s)(2 m/s)$
$V_1 = 3 m/s$

327. A rock is thrown straight up into the air. At the highest point of the rock's path, the magnitude of the net force acting on the rock is

A) less than the magnitude of the rock's weight, but greater than zero

B) greater than the magnitude of the rock's weight

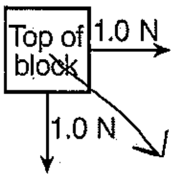
[✓ C) the same as the magnitude of the rock's weight]

D) zero

projectile $F_{Net} = F_g = \text{Weight}$

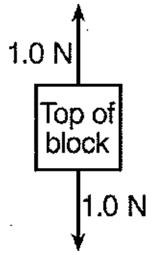
328. A number of 1.0-newton horizontal forces are exerted on a block on a frictionless, horizontal surface. Which top-view diagram shows the forces producing the greatest magnitude of acceleration of the block?

[✓ A)]



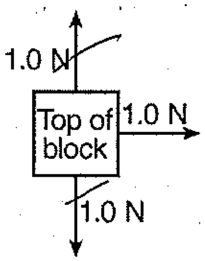
$F = \sqrt{F_x^2 + F_y^2}$

B)



0 $\Sigma F_y = 0$

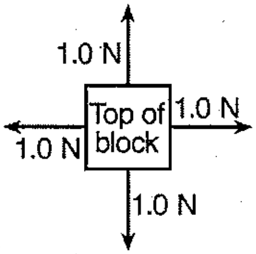
C)



1N $\Sigma F_x = 1N$

$\Sigma F_y = 0$

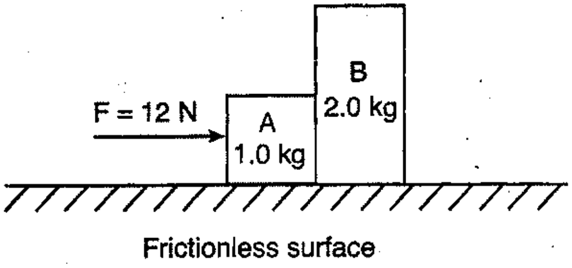
D)



0 $\Sigma F_x = 0$

$\Sigma F_y = 0$

329. The diagram below shows a horizontal 12-newton force being applied to two blocks, *A* and *B*, initially at rest on a horizontal, frictionless surface. Block *A* has a mass of 1.0 kilogram and block *B* has a mass of 2.0 kilograms.



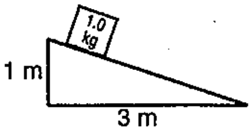
The magnitude of the acceleration of block *B* is

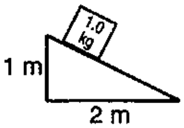
A) 6.0 m/s^2
B) 2.0 m/s^2
C) 3.0 m/s^2
[✓ D) 4.0 m/s^2]

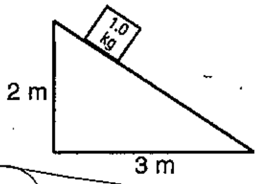
$F_{net} = 12N$
$m = 3kg$
$a = ?$

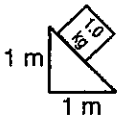
$a = \frac{F_{net}}{m} = \frac{12N}{3kg}$
$= 4 m/s^2$

330. A 1.0-kilogram block is placed on each of four frictionless planes inclined at different angles. On which inclined plane will the acceleration of the block be greatest?

A)


B)


C)


[✓ D)]


highest Slope

331. As a meteor moves from a distance of 16 Earth radii to a distance of 2 Earth radii from the center of Earth, the magnitude of the gravitational force between the meteor and Earth becomes

A) $\frac{1}{8}$ as great
B) 8 times as great
[✓ C) 64 times as great]
D) 4 times as great

$r \div 8$ $F_g \times 64$ $F_g = \frac{Gm_1m_2}{r^2}$

332. A 2.00-kilogram object weighs 19.6 newtons on Earth. If the acceleration due to gravity on Mars is 3.71 meters per second^2, what is the object's mass on Mars?

A) 2.64 kg
[✓ B) 2.00 kg]
C) 19.6 N
D) 7.42 N

$m = 2kg$

mass is constant

333. Base your answer to the following question on the information and table below.

The weight of an object was determined at five different distances from the center of Earth. The results are shown in the table below. Position *A* represents results for the object at the surface of Earth.

Look for the pattern

Position	Distance from Earth's Center (m)	Weight (N)
A	6.37×10^6 r	1000 1.0×10^3 F
B	1.27×10^7 rx2	250 2.5×10^2 F/4
C	1.91×10^7 rx3	110 1.1×10^2 F/9
D	2.55×10^7 rx4	63 6.3×10^1 F/16
E	3.19×10^7 rx5	40 4.0×10^1 F/25

rx6 28 F/36

F/36

At what distance from the center of Earth is the weight of the object approximately 28 newtons?

A) 3.5×10^7 m [✓ B) 3.8×10^7 m] C) 4.1×10^7 m D) 4.5×10^7 m

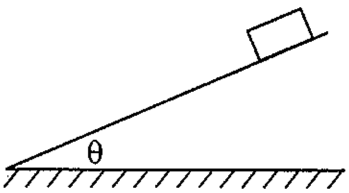
6r

334. An 8.0-newton wooden block slides across a horizontal wooden floor at constant velocity. What is the magnitude of the force of kinetic friction between the block and the floor?

[✓ A) 2.4 N] B) 3.4 N
C) 8.0 N D) 27 N

$F_N = F_g = 8N$
$F_{net} = 0$ (equilibrium)
$F_f = ?$
$\mu = .30$ (kinetic)

335. The diagram below shows a block sliding down a plane inclined at angle θ with the horizontal.



As angle θ is increased, the coefficient of kinetic friction between the bottom surface of the block and the surface of the incline will

A) decrease B) increase
[✓ C) remain the same]

μ doesn't change unless surfaces change

336. What is the minimum horizontal force needed to start a 300. kilogram steel block on a steel table in motion?

A) 5.70 N B) 7.40 N
C) 1710 N D) 2220 N

$F_f = \mu_s F_N$ $\mu_s = .74$ $F_f = .74(2943N)$
$F_N = mg = 2943N$ $F_f = 2178N$

337. Two 20.-newton forces act concurrently on an object. What angle between these forces will produce a resultant force with the greatest magnitude?

[✓ A) 0°] B) 45°
C) 90.° D) 180.°

Same direction = max Resultant

338. Two concurrent forces have a maximum resultant of 45 Newtons and a minimum resultant of 5 Newtons. What is the magnitude of each of these forces?

~~A) 0 N and 45 N~~ ~~B) 5 N and 9 N~~
[✓ C) 20. N and 25 N] ~~D) 0 N and 50. N~~

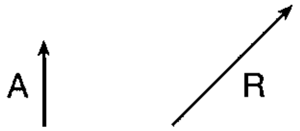
20N + 25N = 45N
25N - 20N = 5N

339. An airplane flies with a velocity of 750. kilometers per hour, 30.0° south of east. What is the magnitude of the eastward component of the plane's velocity?

A) 866 km/h [✓ B) 650 km/h]
C) 433 km/h D) 375km/h

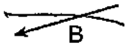
$V = \frac{750 km}{hr}$
$\theta = 30°$ in Q4
$V_x = 750 km/hr \cos 30°$

340. The diagram below represents a force vector, *A* and resultant vector, *R*.

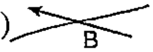


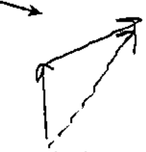
Which force vector *B* below could be added to force ~~vector A to~~ produce resultant vector, *R*.

[✓ A)] 

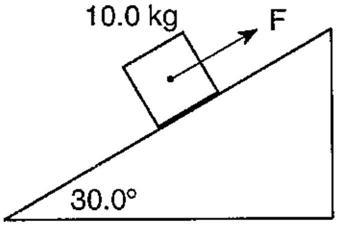
B) 

C) 

D) 



341. The diagram below shows a 10.0-kilogram mass held at rest on a frictionless 30.0° incline by force *F*.

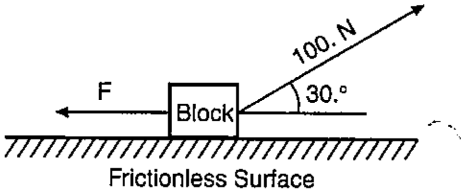


What is the approximate magnitude of force *F*?

A) 9.81 N [✓ B) 49.1 N]
C) 85.0 N D) 98.1 N

$F_{\parallel} = F_{g\parallel} + F$
$0 = F_{g\parallel} + F$
$0 = mg\sin\theta + F$
$0 = (10kg)(9.81 m/s^2) \sin 30°$
$= 49N$

342. The diagram below shows a block on a horizontal frictionless surface. A 100.- newton force acts on the block at an angle of 30.° above the horizontal.



What is the magnitude of force *F* if it establishes equilibrium?

A) 50.0 N
[✓ B) 86.6 N]
C) .100. N
D) 187 N

$F_{net} = F_{Ax} + F_f$

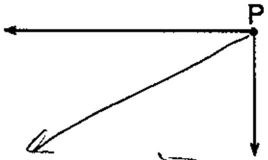
$0 = (100N \cos 36°) + F_f$

343. The vector below represents the resultant of two forces acting concurrently on an object at point *P*
.

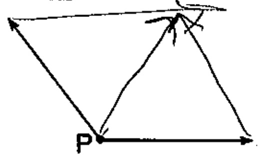
Which pair of vectors best represents two concurrent forces that combine to produce this resultant force vector?

A)

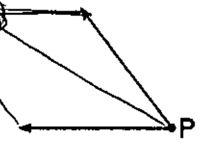
B)



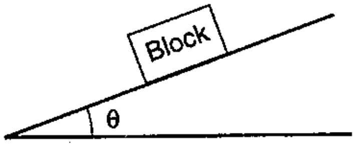
C)



[✓ D)]



344. In the diagram below, a block rests on a ramp, making angle Θ with the horizontal.

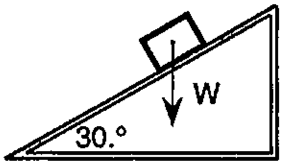


If angle Θ is increased, what will occur?

A) The block's ~~mass will decrea~~se.
B) The block's ~~weight will incr~~ease.
C) The block's component of weight parallel to the ramp will ~~decrease~~.
[✓ D) The block's component of weight parallel to the ramp will increase.]

$F_g \sin\theta$ Sin increases with angle

345. In the diagram below, the weight of a box on a plane inclined at 30. is represented by the vector *W*.



What is the magnitude of the component of the weight (*W*) that acts parallel to the incline?

A) *W*
[✓ B) 0.50 *W*]
C) 0.87 *W*
D) 1.5 *W*

$F_{g\parallel} = F_g \sin\theta$

346. During an emergency stop, a 1.5×10^3-kilogram car lost a total of 3.0×10^5 joules of kinetic energy. What was the speed of the car at the moment the brakes were applied?

A) 10. m/s
B) 14 m.s
[✓ C) 20. m/s]
D) 25 m/s

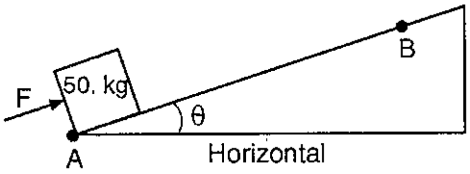
$KE = 3.0\times10^5 J$
$m = 1.5\times10^3 kg$
$v = ?$

$KE = \frac{1}{2}mv^2$
$3\times10^5 J = \frac{1}{2}(1.5\times10^3 kg)v^2$
$v^2 = 400 m^2/s^2$
$v = 20 m/s$

347. Which statement describes the kinetic energy and total mechanical energy of a block as it is pulled at constant speed up an incline?

A) Kinetic energy ~~decrease~~s and total mechanical energy increases.
B) Kinetic energy ~~decrease~~s and total mechanical energy remains the same.
[✓ C) Kinetic energy remains the same and total mechanical energy increases.]
D) Kinetic energy remains the same and total me~~chanical energy remains the same~~.

348. The diagram below shows a 50.-kilogram crate on a frictionless plane at angle *θ* to the horizontal. The crate is pushed at constant speed up the incline from point *A* to point *B* by force *F*.



If angle *θ* were increased, what would be the effect on the magnitude of force *F* and the total work *W* done on the crate as it is moved from *A* to *B*?

A) *W* would remain the same and the magnitude of *F* would decrease.
B) *W* would remain the same and the magnitude of *F* would increase.
C) *W* would increase and the magnitude of *F* would decrease.
[✓ D) *W* would increase and the magnitude of *F* would increase.]

$F_{g\parallel}$ would increase
d would remain the same
$W = Fd$

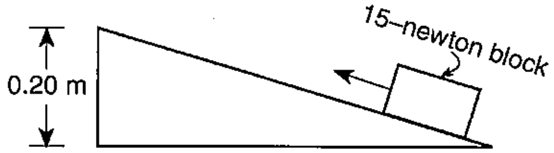
349. A horizontal force of 40 Newtons pushes a block along a level table at a constant speed of 2 meters per second. How much work is done on the block in 6 seconds?

A) 80 J
B) 120 J
C) 240 J
D) 480 J

$F_{AX} = 40N$ $V = 2 m/s$
$F_{net} = 0$ $t = 6s$
$W = ?$ $d = 12m$

$W = Fd$
$= (40N)(12m) = 480Nm$
$= 480J$

350. A block weighing 15 Newtons is pulled to the top of an incline that is 0.20 meter above the ground, as shown below.



If 4.0 joules of work are needed to pull the block the full length of the incline, how much work is done against friction?

[✓ A) 1.0 J] B) 0.0 J C) 3.0 J D) 7.0 J

Q

$Q = W_{done}$ - Energy gained
$Q = W_{done} - PE$
$= 4J - F_g d_y$
$= 4J - 3J = 1J$

351. The rate at which work is done is measured in

A) Newtons
B) joules
C) calories
[✓ D) watts]

$P = W/t = \frac{Joule}{s} = watts$

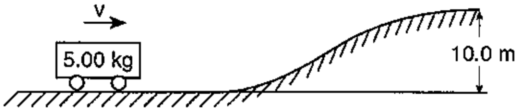
352. A 95-kilogram student climbs 4.0 meters up a rope in 3.0 seconds. What is the power output of the student?

A) 1.3 × 10² W
B) 3.8 × 10² W
[✓ C) 1.2 × 10³ W] rounded
D) 3.7 × 10³ W

$m = 95kg$
$h = 4m$
$t = 3s$

$P = \frac{W}{t} = \frac{PE}{t} = \frac{mgh}{t} = 1241.3W$

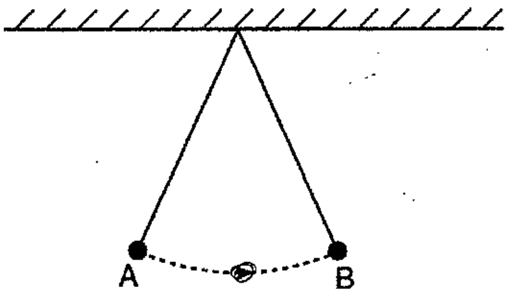
353. The diagram below shows a moving, 5.00-kilogram cart at the foot of a hill 10.0 meters high. For the cart to reach the top of the hill, what is the minimum kinetic energy of the cart in the position shown? [Neglect energy loss due to friction.]



A) 4.91 J
B) 50.0 J
C) 250. J
[✓ D) 491 J]

$KE_{bottom} = PE_{Top}$
$\frac{1}{2}mv^2 = mgh$
$= (5kg)(9.81 m/s^2)(10m)$
$KE = 491 J$

354. In the diagram below, an ideal pendulum released from position *A* swings freely to position *B*.



$PE + KE = E_T$

As the pendulum swings from *A* to *B*, its total mechanical energy

A) decreases , then increases
B) increases, only
C) increases, then decreases
[✓ D) remains the same]

---

355. A 55.0-kilogram diver falls freely from a diving platform that is 3.00 meters above the surface of the water in a pool. When she is 1.00 meter above the water, what are her gravitational potential energy and kinetic energy with respect to the water's surface?

A) *PE* = 1620 J and *KE* = 0 J
B) *PE* = 1080 J and *KE* = 540 J
C) *PE* = 810 J and *KE* = 810 J
[✓ D) *PE* = 540 J and *KE* = 1080 J]

	E_T	PE + KE
3m	1620J	1620J + 0
1m	1620J	540J + ?

$KE = E_T - PE$

$KE = 1620J - 540J$

$KE = 1080J$

356. As a block slides across a table, its speed (KE) decreases while its temperature (Q) increases. Which two changes occur in the block's energy as it slides?

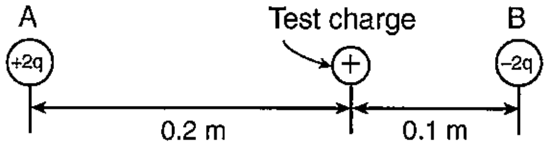
[✓ A) a decrease in kinetic energy and an increase in internal energy]
B) an ~~increase in kinetic energy~~ and a decrease in internal energy
C) a decrease in both kinetic energy and i~~nternal e~~nergy
D) an i~~ncrease in both kinetic ener~~gy and internal energy

357. A metal sphere having an excess of +5 elementary charges has a net electric charge of

A) 1.6×10^{-19} C
[✓ B) 8.0×10^{-19} C]
C) 5.0×10^{0} C
D) 3.2×10^{19} C

$$5e \times \frac{1.6\times10^{-19}C}{1e} = 8\times10^{-19}C$$

358. In the diagram below, a positive test charge is located between two charged spheres, *A* and *B*. Sphere *A* has a charge of $+2q$ and is located 0.2 meter from the test charge. Sphere *B* has a charge of $-2q$ and is located 0.1 meter from the test charge.



If the magnitude of the force on the test charge due to sphere *A* is *F*, what is the magnitude of the force on the test charge due to sphere *B*?

A) $\frac{F}{4}$ B) 2F C) $\frac{F}{2}$ [✓ D) 4F]

A to test	B to test
2q	2q
r	½r
F	

if r÷ F×4

359. What is the current in a wire if 3.4×10^{19} electrons pass by a point in this wire every 60. seconds?

A) 1.8×10^{-18} A
B) 3.1×10^{-11} A
[✓ C) 9.1×10^{-2} A]
D) 11 A

$q = 3.4\times10^{19}e \times \frac{1.6\times10^{-19}C}{1e} = 5.44C$
$t = 60s$
$I = ?$

$I = q/t = \frac{5.44C}{60s} = .091A$

360. The current through a lightbulb is 2.0 amperes. How many coulombs of electric charge pass through the lightbulb in one minute?

A) 60. C
B) 2.0 C
[✓ C) 120 C]
D) 240 C

$I = 2A$
$q = ?$
$t = 1min = 60s$

$I = q/t$ $q = It$
$= (2A)(60s)$
$= 120C$

361. If the diameter of a wire were halved, its electrical resistance would

A) quarter
[✓ B) quadruple]
C) double
D) halve

$4\times \quad R = \frac{\rho L}{A} = \frac{\rho L}{\pi r^2} \div 2$

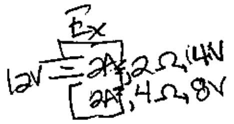
$r \propto d$

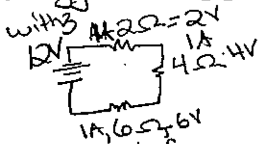
362. As more resistors are added in series across a battery, the potential drop across each resistor

[✓ A) decreases]
B) increases
C) remains the same

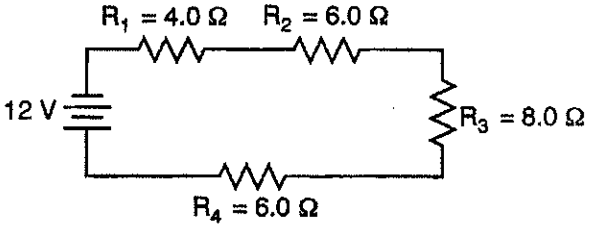
If another component is added, Some energy must be saved

with2





363. The circuit diagram below represents four resistors connected to a 12-volt source.



What is the total current in the circuit?

[✓ A) 0.50 A]
B) 2.0 A
C) 8.6 A
D) 24 A

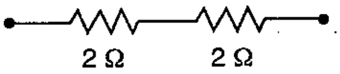
$V: 12V$

$R_{eq} = R_1 + R_2 + R_3 + R_4$
$= 4\Omega + 6\Omega + 8\Omega + 6\Omega$
$= 24\Omega$

$I = \frac{V}{R} = \frac{12V}{24\Omega} = .5A$

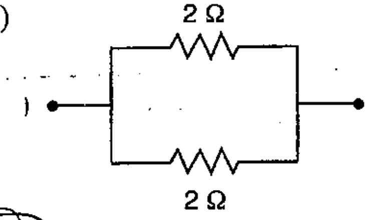
364. Which combination of resistors has the *smallest* equivalent resistance?

A)



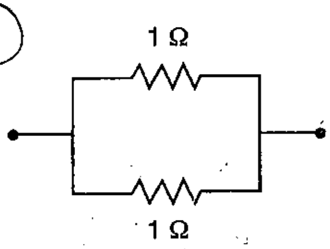
Series
4Ω

B)



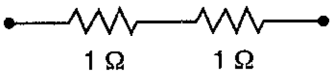
Parallel
$\frac{1}{2\Omega}+\frac{1}{2\Omega}=\frac{2}{2\Omega}$
$\frac{2\Omega}{2}=1\Omega$

[✓ C)]



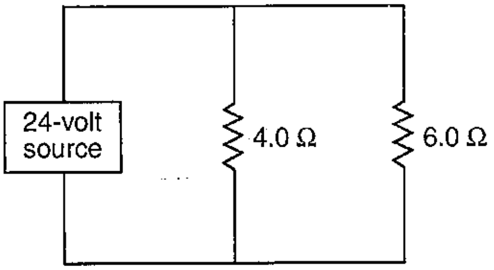
Parallel
$\frac{1}{1\Omega}+\frac{1}{1\Omega}=\frac{2}{1\Omega}=\frac{1\Omega}{2}$
$\boxed{R=.5\Omega}$

D)



2Ω
Series

365. Base your answer to the following question on the circuit diagram below, which shows two resistors connected to a 24-volt source of potential difference.



What is the total resistance of the circuit?

A) 0.42 [✓ B) 2.4] C) 5.0 D) 10

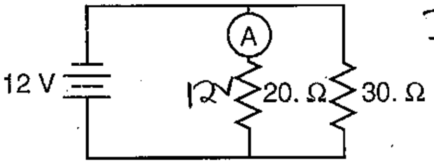
Parallel
$\frac{1}{R_{eq}}=\frac{1}{4\Omega}+\frac{1}{6\Omega}=\frac{6}{24\Omega}+\frac{4}{24\Omega}$
$=\frac{10}{24\Omega}$

	V	I	R
R_1	24V	6A	4Ω
R_2	24V	4A	6Ω
R_{eq}	24V	10A	2.4Ω

$R=\frac{V}{I}$

$R=\frac{24\Omega}{10}=2.4\Omega$

366. Base your answer to the following question on the information and diagram below. A 20.-ohm resistor and a 30.-ohm resistor are connected in parallel to a 12-volt battery as shown. An ammeter is connected as shown.



12V

$I=\frac{V}{R}=\frac{12V}{20\Omega}$
$=.6A$

What is the current reading of the ammeter?

A) 1.0 A [✓ B) 0.60 A]
C) 0.40 A D) 0.20 A

367. A light bulb operating at 120 volts draws a current of 0.50 ampere for 240 seconds. The power rating of the light bulb is

A) 30. W [✓ B) 60. W]
C) 75 W D) 120 W

V=120V
I=.5A
t=240s
P=?
P=VI
(120V)(.5A)=60W

368. A potential drop of 50. volts is measured across a 250-ohm resistor. What is the power developed in the resistor?

A) 0.20 W B) 5.0 W
[✓ C) 10. W] D) 50. W

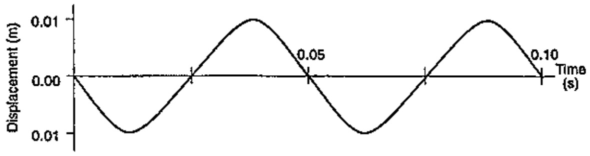
V=50V
R=250Ω
P=?
$P=\frac{V^2}{R}=\frac{(50V)^2}{250\Omega}=10W$

369. An elementary charge is accelerated by a potential difference of 9.0 volts. The total energy acquired by the charge is

[✓ A) 9.0 eV] B) 12 eV
C) 3.0 eV D) 27 eV

q=1e
V=9V
W=?
W=qV
=1e9V=9eV

370. The graph below shows displacement versus time for a particle of a uniform medium as a wave passes through the medium.



What is the frequency of the wave?

A) 10 Hz [✓ B) 20 Hz]
C) 50 Hz D) 100 Hz

$\text{frequency} = \frac{\text{cycles}}{\text{second}} = \frac{2\text{cycles}}{.1\text{s}} =$

371. A sound wave traveling eastward through air causes the air molecules to

[✓ A) vibrate east and west]
B) vibrate north and south
C) move eastward, only
D) move northward, only

Sound is mechanical longitudinal

372. A distance of 1.0×10^{-2} meter separates successive crests of a periodic wave produced in a shallow tank of water. If a crest passes a point in the tank every 4.0×10^{-1} second, what is the speed of this wave?

A) 2.5×10^{-4} m/s B) 4.0×10^{-3} m/s
C) 2.5×10^{-2} m/s D) 4.0×10^{-1} m/s

$\lambda = 1\times10^{-2}\text{m}$
$T = 4\times10^{-1}\text{s}$

$V = \frac{\lambda}{T} = \frac{1\times10^{-2}\text{m}}{4\times10^{-1}\text{s}}$
$= .25\times10^{-1}\text{m/s}$
$= 2.5\times10^{-2}\text{m/s}$

373. A source of waves and an observer are moving relative to each other. The observer will detect a steadily increasing frequency if

A) he moves toward the source at a constant speed
B) the source moves away from him at a constant speed
[✓ C) he accelerates toward the source]
D) the source accelerates away from him

374. The time required for light to travel a distance of 1.5×10^{11} meters is closest to

[✓ A) 5.0×10^{2} s] B) 2.0×10^{-3} s
C) 5.0×10^{-1} s D) 4.5×10^{19} s

$V = c = 3\times10^{8}\text{m/s}$
$d = 1.5\times10^{11}\text{m}$
t

$V = d/t$ $t = d/V = \frac{1.5\times10^{11}\text{m}}{3\times10^{8}\text{m/s}}$
$t = .5\times10^{3}\text{s}$
$= 5\times10^{2}\text{s}$

375. What is the speed of light ($f = 5.09 \times 10^{14}$ Hz) in ethyl alcohol?

n 1.36

A) 4.53×10^{-9} m/s B) 2.43×10^{2} m/s
C) 1.24×10^{8} m/s [✓ D) 2.21×10^{8} m/s]

$V = \frac{c}{n} = \frac{3\times10^{8}\text{m/s}}{1.36} = 2.2\times10^{8}\text{m/s}$

376. What is the speed of light in a medium having an absolute index of refraction of 2.3?

A) 0.77×10^{8} m/s [✓ B) 1.3×10^{8} m/s]
C) 1.5×10^{8} m/s D) 2.3×10^{8} m/s

$V = \frac{c}{n} = \frac{3\times10^{8}\text{m/s}}{2.3} = 1.3\times10^{8}\text{m/s}$

☆ 377. What is the energy equivalent of a mass of 0.026 kilogram?

[✓ A) 2.34×10^{15} J B) 2.3×10^{15} J]
C) 2.34×10^{17} J D) 2.3×10^{17} J

$E = mc^2$
$= (.026\text{kg})(3\times10^{8}\text{m/s})^2 =$

Both A & B

378. A photon is emitted as the electron in a hydrogen atom drops from the $n = 5$ energy level directly to the $n = 3$ energy level. What is the energy of the emitted photon?

A) 0.85 eV [✓ B) 0.97 eV]
C) 1.51 eV D) 2.05 eV

$\Delta E = {.}97eV, \frac{1.6\times10^{-19}}{1}$

379. Which type of photon is emitted when an electron in a hydrogen atom drops from the $n = 3$ to the $n = 2$ energy level?

A) ultraviolet B) infrared
C) radio wave [✓ D) visible light]

$\Delta E = 1.89eV \times \frac{1.6\times10^{-19}J}{eV} = 3.024\times10^{-19}J$

$f = \frac{E}{h} = \frac{3.024\times10^{-19}J}{6.63\times10^{-34}Js} = 4.56\times10^{14}Hz$

380. The bright-line emission spectrum of an element can best be explained by

[✓ A) electrons transitioning between discrete energy levels in the atoms of that element]
~~B) protons acting as both particles and waves~~
~~C) electrons being located in the nucleus~~
~~D) protons being dispersed uniformly throughout the atoms of that element~~

$+\frac{2}{3}e$

381. A top quark has an approximate charge of

A) -1.07×10^{-19} C B) -2.40×10^{-19} C
[✓ C) $+1.07 \times 10^{-19}$ C] D) $+2.40 \times 10^{-19}$ C

382. What is the minimum total energy released when an electron and its antiparticle (positron) annihilate each other?

[✓ A) 1.64×10^{-13} J] B) 8.20×10^{-14} J
C) 5.47×10^{-22} J D) 2.73×10^{-22} J

$E = mc^2 = (1.82\times10^{-30}Kg)(3\times10^{8}m/s)^2 = 1.64\times10^{-13}J$

$m = m_{e} + m_{e^-} = (9.11\times10^{-31}Kg)(2) = 1.82\times10^{-30}Kg$

$c = 3\times10^{8}m/s$

383. A golf ball is hit at an angle of 40.0° above the horizontal. The horizontal component of the golf ball's initial velocity is 16.0 meters per second. What is the magnitude of the ball's initial velocity?

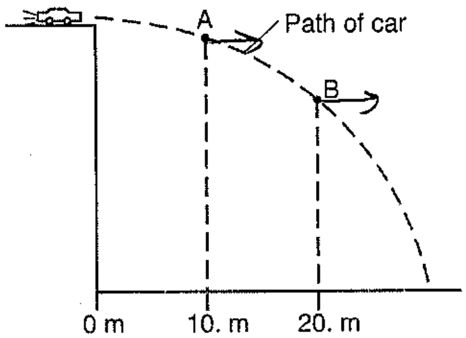
A) 12.3 m/s B) 24.9 m/s
[✓ C) 20.9 m/s] D) 10.3 m/s

$V_y = 16 m/s$
$\theta = 40^{\circ}$
$V = ?$

$V_x = V\cos\theta$
$16 m/s = V\cos 40^{\circ}$
$V = 20.9 m/s$

384. **Note that the question below only has three choices.**

The diagram below represents the path of a stunt car that is driven off a cliff, neglecting friction.



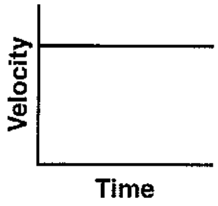
Compared to the horizontal component of the car's velocity at point A, the horizontal component of the car's velocity at point B is

A) smaller B) greater
[✓ C) the same]

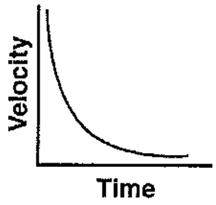
V_x is constant
no acceleration in x

385. Which graph best represents the relationship between the velocity of an object thrown straight upward from Earth's surface and the time that elapses while it is in the air? [Neglect friction.]

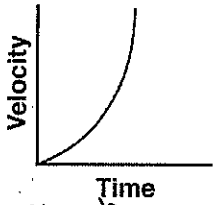
A)



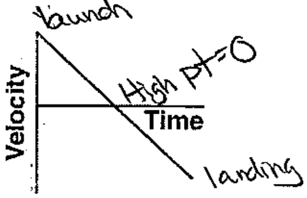
B)



C)



[✓ D)]



386. A projectile is launched at an angle above the ground. The horizontal component of the projectile's velocity. v_x, is initially 40. meters per second. The vertical component of the projectile's velocity, v_y, is initially 30. meters per second. What are the components of the projectile's velocity after 2.0 seconds of flight? [Neglect friction.]

[✓ A) v_x = 40. m/s and v_y = 10. m/s]
B) v_x = 40. m/s and ~~v_y = 30. m/s~~
C) v_x = 20. m/s and v_y = 10. m/s
D) v_x = 20. m/s and v_y = 30. m/s

V_x remains the same

$V_{fy} = V_{iy} + at$

$10 \text{ m/s} = 30 \text{ m/s} + (-10 \text{ m/s}^2)(2s)$

387. A soccer ball kicked on a level field has an initial vertical velocity component of 15.0 meters per second. Assuming the ball lands at the same height from which it was kicked, what is the total time the ball is in the air? [Neglect friction.]

A) 0.654 s
B) 1.53 s
[✓ C) 3.06 s]
D) 6.12

$V_{iy} = 15 \text{ m/s}$

$V_{fy} = -15 \text{ m/s}$

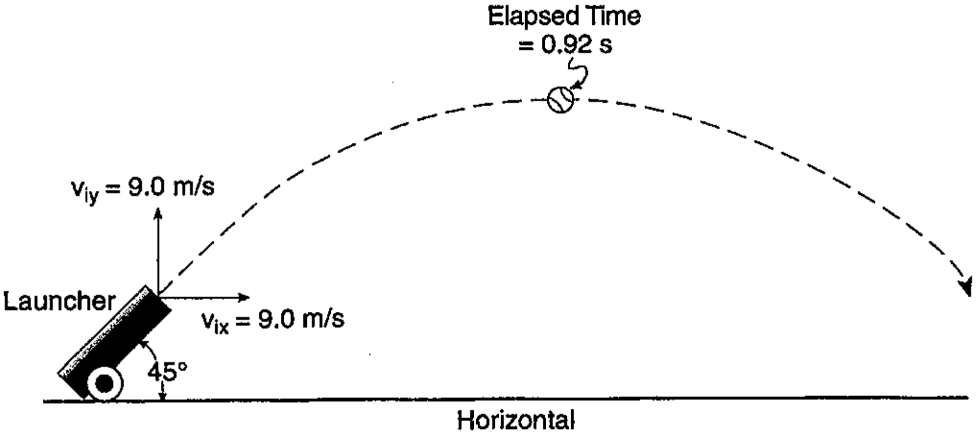
$t = \frac{\Delta v_y}{a} = \frac{-30 \text{ m/s}}{9.81 \text{ m/s}^2}$

388. A ball thrown vertically upward reaches a maximum height of 30. meters above the surface of Earth. At its maximum height, the speed of the ball is

[✓ A) 0.0 m/s]
B) 9.8 m/s
C) 3.1 m/s
D) 24 m/s

389. Base your answer to the following question on the diagram and information below.

A machine launches a tennis ball at an angle of 45° with the horizontal, as shown. The ball has an initial vertical velocity of 9.0 meters per second and an initial horizontal velocity of 9.0 meters per second. The ball reaches its maximum height 0.92 second after its launch. [Neglect air resistance and assume the ball lands at the same height above the ground from which it was launched.]



The speed at which the launcher fires tennis balls is constant, but the angle between the launcher and the horizontal can be varied. As the angle is decreased from 45° to 30.°, the range of the tennis balls

[✓ A) decreases]
B) increases
C) remains the same

45° is max range

---

390. Four cannonballs, each with mass M and initial velocity V, are fired from a cannon at different angles relative to the Earth. Neglecting air friction, which angular direction of the cannon produces the greatest projectile height?

[✓ A) 90°] B) 70° C) 45° D) 20°

Most v_{iy}

391. Base your answer to the following question on the information below.

A ball is projected vertically upward from the surface of the Earth with an initial speed of +49 meters per second. The ball reaches its maximum height in 5.0 seconds. (Disregard air resistance.)

What is the maximum height reached by the ball?

A) 24.5 m
B) 49.0 m
[✓ C) 122.5 m]
D) 245 m

$V_i = 49 \text{ m/s}$
$V_f = 0$
$a = -9.8 \text{ m/s}^2$
$d = ?$

$V_f^2 = V_i^2 + 2ad$
$0 = (49 \text{ m/s})^2 + 2(-9.81 \text{ m/s}^2)d$

392. An object travels in a circular orbit. If the speed of the object is doubled, its centripetal acceleration will be

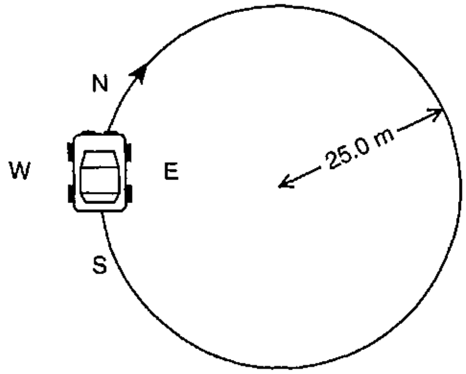
A) halved B) doubled

C) quartered [✓ D) quadrupled]

2^2 $a_c = \frac{v^2 (\times 2)}{r}$

393. Base your answer to the following question on the information and diagram below.

A 1.00×10^3 -kilogram car is driven clockwise around a flat circular track of radius 25.0 meters. The speed of the car is a constant 5.00 meters per second.



What minimum friction force must exist between the tires and the road to prevent the car from skidding as it rounds the curve?

A) 1.25×10^5 N B) 9.80×10^4 N

C) 5.00×10^3 N [✓ D) 1.00×10^3 N]

m = 1000kg
r = 25m
v = 5m/s

$$F_f = F_c = \frac{mv^2}{r} = \frac{(1000kg)(5m/s)^2}{25m}$$

$$= 1000N$$