Name

Regents Review
Phase Two

132. A strobe light is used to photograph a rolling ball. Which of the following represents the location of the ball over time if the ball is experiencing a positive acceleration? speeding up

A)
B)
C)
D)

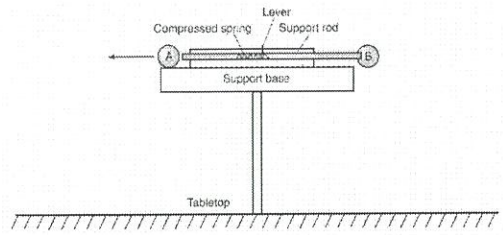
133. One car travels 40. meters due east in 5.0 seconds, and a second car travels 64 meters due west in 8.0 seconds. During their periods of travel, the cars definitely had the same

A) average velocity vector (2 different directions)
B) total displacement vector
C) total distance
D) average speed $\frac{40m}{5s} = \frac{64m}{8s}$

134. As a car is driven south in a straight line with *decreasing* speed, the acceleration of the car must be

A) directed northward
B) directed southward
C) zero
D) constant, but not zero

135. The diagram below represents a setup for demonstrating motion.



When the lever is released, the support rod withdraws from ball *B*, allowing it to fall. At the same instant, the rod contacts ball *A*, propelling it horizontally to the left. Which statement describes the motion that is observed after the lever is released and the balls fall? [Neglect friction.]

A) Ball *A* travels at constant velocity. velocity constant in "x" but not in "y"
B) Ball *A* hits the tabletop at the same time as ball *B*. same height
C) Ball *B* hits the tabletop before ball *A*.
D) Ball *B* travels with an increasing acceleration. y acceleration is constant

136. A rock is dropped from a bridge. What happens to the magnitude of the acceleration and the speed of the rock as it falls? [Neglect friction.] $a = g = 9.81 m/s^2$

A) Both ~~acceleration~~ and speed increase.
B) Both acceleration and ~~speed re~~main the same.
C) Acceleration ~~increases~~ and speed decreases.
D) Acceleration remains the same and speed increases.

137. Two stones, *A* and *B*, are thrown horizontally from the top of a cliff. Stone *A* has an initial speed of 15 meters per second and stone *B* has an initial speed of 30. meters per second. Compared to the time it takes stone *A* to reach the ground, the time it takes stone *B* to reach the ground is

A | B
$V_x = 15$ m/s | $V_x = 30$ m/s
dy | = dy
same height

A) the same
B) twice as great
C) half as great
D) four times as great

138. Cart *A* has a mass of 2 kilograms and a speed of 3 meters per second. Cart *B* has a mass of 3 kilograms and a speed of 2 meters per second. Compared to the inertia and magnitude of momentum of cart *A*, cart *B* has

A | B
m = 2kg | m = 3kg
V = 3m/s | V = 2m/s
p = 6kgm/s | p = 6kgm/s
m = inertia

A) the same inertia and a smaller magnitude of momentum
B) the same inertia and the same magnitude of momentum
C) greater inertia and a smaller magnitude of momentum
D) greater inertia and the same magnitude of momentum

139. Which quantity has both a magnitude and a direction? ie which is a vector

A) inertia
B) impulse
C) speed
D) time

140. A 1.0-kilogram laboratory cart moving with a velocity of 0.50 meter per second due east collides with and sticks to a similar cart initially at rest. After the collision, the two carts move off together with a velocity of 0.25 meter per second due east. The total momentum of this frictionless system is

momentum is a conserved quantity

A) zero before the collision
B) zero after the collision
C) the same before and after the collision
D) greater before the collision than after the collision

141. The total momentum of a system that consists of a moving rocket and its exhaust gases will

A) decrease
B) increase
C) remain the same

142. If a block is in equilibrium, the magnitude of the block's acceleration is

equilibrium means $a = 0$, $F_{net} = 0$

A) zero
B) decreasing
C) increasing
D) constant, but not zero

143. When the sum of all the forces acting on a block on an inclined plane is zero, the block

$F_{net} = 0$ means $a = 0$ means not speeding up, slowing down or changing direction

A) ~~must be at rest~~
B) ~~must be accelerating~~
C) ~~may be slowing down~~
D) may be moving at constant speed

projectile
$F_{net} = F_g$

144. 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

not speeding up slowing down or changing direction

145. Which body is in equilibrium?

A) a satellite orbiting Earth in a circular orbit
B) a ball falling freely toward the surface of Earth
C) a car moving with a constant speed along a straight, level road
D) a projectile at the highest point in its trajectory

146. A student is standing in an elevator that is accelerating downward. The force that the student exerts on the floor of the elevator $= F_N$ must be

A) less than the weight of the student when at rest
B) greater than the weight of the student when at rest
C) less than the force of the floor on the student Not possible by Newton's 3rd Law
D) greater than the force of the floor on the student

so $F_{net}\downarrow$ so $a\downarrow$

F_N

F_g

So $F_g > F_N$

147. A carpenter hits a nail with a hammer. Compared to the magnitude of the force the hammer exerts on the nail, the magnitude of the force the nail exerts on the hammer during contact is

A) less B) greater
C) the same

Newton's 3rd Law

148. A man is pushing a baby stroller. Compared to the magnitude of the force exerted on the stroller by the man, the magnitude of the force exerted on the man by the stroller is

A) zero
B) smaller, but greater than zero
C) larger
D) the same

Newton's 3rd Law

149. Which statement describes the gravitational force and the electrostatic force between two charged particles?

A) The gravitational force may be either attractive or ~~repulsive~~, whereas the electrostatic force must be attractive.
B) The gravitational force must be attractive, whereas the electrostatic force may be either attractive or repulsive.
C) Both forces may be either attractive or repulsive
D) Both forces must be attractive.

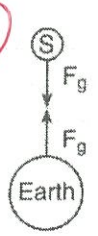
gravity is always attractive electrostatic depends on charges

150. Which diagram best represents the gravitational forces, F_g, between a satellite, S, and Earth?

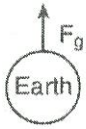
A)

B)

C)



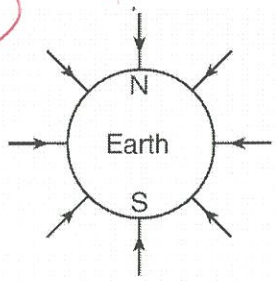
D)



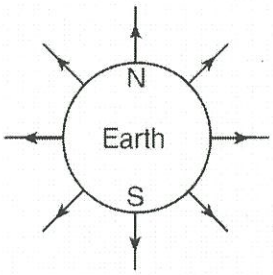
gravity always is attractive - pulls things together Forces are equal

151. In which diagram do the field lines best represent the gravitational field around Earth?

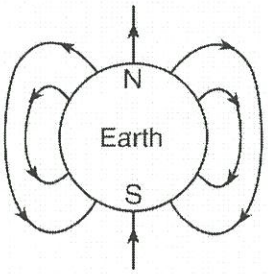
A)



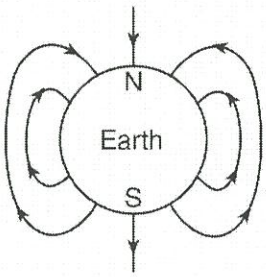
B)



C)



D)

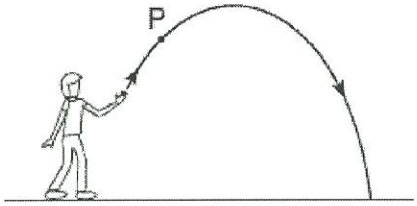


152. As an astronaut travels from the surface of Earth to a position that is four times as far away from the center of Earth, the astronaut's

A) mass decreases
B) mass remains the same
C) weight increases
D) weight remains the same

mass is constant
F_g (weight) changes with location
F_g would have been 1/16F

153. The diagram below represents the path of a thrown ball through the air.



Which arrow best represents the direction in which friction acts on the ball at point *P*?

Friction opposes motion

A) 

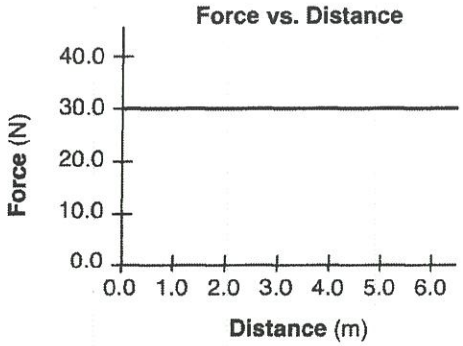
B) 

C)

D)

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

A boy pushes his wagon at constant speed along a level sidewalk. The graph below represents the relationship between the horizontal force exerted by the boy and the distance the wagon moves.



Energy = W
Work against friction is called internal energy
W = Fd = area of graph

As the boy pushes the wagon, what happens to the wagon's energy?

A) Gravitational potential energy increases. PE depends on height
B) Gravitational potential energy decreases.
C) Internal energy increases.
D) Internal energy decreases.

155. The force required to start an object sliding across a uniform horizontal surface is larger than the force required to keep the object sliding at a constant velocity. The magnitudes of the required forces are different in these situations because the force of kinetic friction

A) is greater than the force of static friction
B) is less than the force of static friction
C) ~~increases as the speed of the object relative to the surface increases~~
D) ~~decreases as the speed of the object relative to the surface increases~~

$\mu_K < \mu_S$

F_f is not dependent on speed or surface area

156. A box is pushed toward the right across a classroom floor. The force of friction on the box is directed toward the

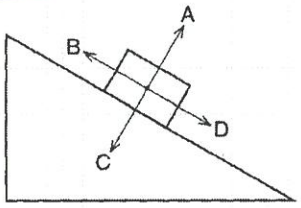
A) left
B) right
C) ceiling
D) floor

157. In the diagram below, the upward drag force acting on a parachute is equal in magnitude but opposite in direction to the weight of the parachutist and equipment.

As a result of the forces shown, the parachutist may be moving

A) downward with decreasing speed
B) downward at constant speed
C) upward with decreasing speed
D) upward with constant acceleration

158. The diagram below represents a block sliding down an incline.



Which vector best represents the frictional force acting on the block?

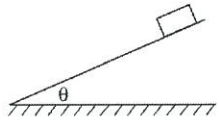
A) *A* B) *B* C) *C* D) *D*

Friction opposes motion

159. Sand is often placed on an icy road because the sand

A) decreases the coefficient of friction between the tires of a car and the road
B) increases the coefficient of friction between the tires of a car and the road
C) decreases the gravitational force on a car
D) increases the normal force of a car on the road

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



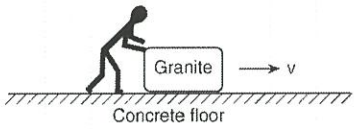
As angle θ *is increased, the coefficient of kinetic friction between the bottom surface of the block and the surface of the incline will*

A) decrease
B) increase
C) remain the same

μ does not change

$F_f \propto F_N$ but μ is constant

161. The diagram below shows a granite block being slid at constant speed across a horizontal concrete floor by a force parallel to the floor.



Which pair of quantities could be used to determine the coefficient of friction for the granite on the concrete?

A) mass and ~~speed of the block~~
B) mass and normal force on the block
C) frictional force and ~~speed of the block~~
D) frictional force and normal force on the block

Same thing really you need them to find F_N

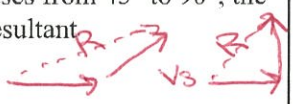
$F_f = \mu F_N$

162. Compared to the force needed to start sliding a crate across a rough level floor, the force needed to keep it sliding once it is moving is

A) less B) greater
C) the same

$F_s > F_k$ because $\mu_s > \mu_k$

163. As the angle between two concurrent displacements increases from 45° to 90°, the magnitude of their resultant



A) decreases
B) increases
C) remains the same

R is greatest for 2 vectors with closest angle (same direction)

164. Which term identifies a scalar quantity?

A) displacement B) acceleration
C) velocity D) energy

165. A unit used for a vector quantity is

A) watt Power B) newton Force
C) kilogram mass D) second time

166. A shopping cart slows as it moves along a level floor. Which statement describes the energies of the cart?

A) The kinetic energy increases and the gravitational potential energy remains the same.
B) The kinetic energy increases and the gravitational potential energy decreases.
C) The kinetic energy decreases and the gravitational potential energy remains the same.
D) The kinetic energy decreases and the gravitational potential energy increases.

v↓ h↔
KE↓ PE↔

167. When a teacher shines light on a photocell attached to a fan, the blades of the fan turn. The brighter the light shone on the photocell, the faster the blades turn. Which energy conversion is illustrated by this demonstration?

A) light → thermal → mechanical
B) light → nuclear → thermal
C) light → electrical → mechanical
D) light → mechanical → chemical

168. As an object moves upward at a constant speed, its kinetic energy

$KE = \frac{1}{2}mv^2$

A) decreases
B) increases
C) remains the same

v constant → KE constant

169. The gravitational potential energy, with respect to Earth, that is possessed by an object is dependent on the object's

A) acceleration B) momentum
C) position D) speed

$PE = mgh$

170. Which situation describes a system with *decreasing* gravitational potential energy? $PE = mgh$

A) a girl stretching a horizontal spring
B) a bicyclist riding up a steep hill ↑PE
C) a rocket rising vertically from Earth ↑PE
D) a boy jumping down from a tree limb ↓PE

171. The potential energy stored in a compressed spring is to the change in the spring's length as the kinetic energy of a moving body is to the body's

$PE_s = \frac{1}{2}kx^2$
$KE = \frac{1}{2}mv^2$

A) speed B) mass
C) radius D) acceleration

172. Which statement best explains why a "wet saw"used to cut through fine optical crystals is constantly lubricated with oil?

A) Lubrication decreases friction and minimizes the increase of internal energy.
B) Lubrication decreases friction and maximizes the increase of internal energy.
C) Lubrication increases friction and minimizes the increase of internal energy.
D) Lubrication increases friction and maximizes the increase of internal energy.

173. When a force moves an object over a rough, horizontal surface at a constant velocity, the work done against friction produces an increase in the object's

A) weight
B) momentum
C) potential energy
D) internal energy

174. Work energy is completely converted to heat energy when all of the work done on an object is used to overcome

A) momentum B) gravity
C) inertia D) friction

175. Which quantity is a measure of the **rate at which work** is done?

A) energy B) power
C) momentum D) velocity

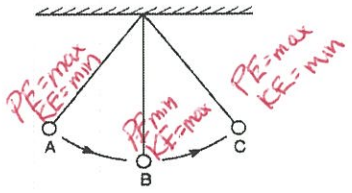
W/t = Power

176. The work done in accelerating an object along a frictionless horizontal surface is equal to the change in the object's

A) momentum
B) velocity
C) potential energy
D) kinetic energy

$W = \Delta KE$

177. Spider-man swings like a pendulum on his web. The diagram below shows three positions, *A*, *B*, and *C*, in Spider-man's swing, released from rest at point *A*. [Neglect friction.]



Which statement is true about Spider-man's swing?

A) The potential energy at A equals the kinetic energy at *C*.
B) The speed of the pendulum at A equals the speed of the pendulum at *B*.
C) The potential energy at *B* equals the potential energy at *C*.
D) The potential energy at *A* equals the kinetic energy at *B*.

Energy is a conserved quantity

178. At what point in its fall does the kinetic energy of a freely falling object equal its potential energy?

A) at the start of the fall
B) halfway between the start and the end
C) at the end of the fall
D) at all points during the fall

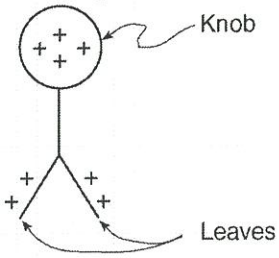
made up #'s

	PE	KE	E_T
Top	10J	0	=10J
Mid	5J	5J	=10J
Bottom	0J	10J	=10J

179. **This question has only three choices.** As a ball falls freely toward the ground, its total mechanical energy Sum of PE&KE

A) decreases
B) increases
C) remains the same

180. An electroscope is a device with a metal knob, a metal stem, and freely hanging metal leaves used to detect charges. The diagram below shows a positively charged leaf electroscope.



As a positively charged glass rod is brought near the knob of the electroscope, the separation of the electroscope leaves will

A) decrease
B) increase
C) remain the same

more electrons will move out of leaves toward + rod. increase charge of leaves

181. A glass rod becomes positively charged when it is rubbed with silk. This net positive charge accumulates because the glass rod

A) gains electrons B) gains protons
C) loses electrons D) loses protons

only electrons can be transferred

182. In a process called pair production, an energetic gamma ray is converted into an electron and a positron. It is *not* possible for a gamma ray to be converted into two electrons because

A) charge must be conserved
B) momentum must be conserved
C) mass-energy must be conserved
D) baryon number must be conserved

183. Which fundamental force is primarily responsible for the attraction between protons and electrons? quark

A) ~~strong~~ lepton requires quarks
B) weak
C) gravitational
D) electromagnetic

184. A positively charged glass rod attracts object *X*. The net charge of object *X*.

A) may be zero or negative
B) may be zero or positive
C) must be negative
D) must be positive

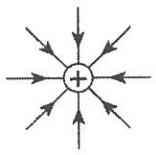
charge objects attract opposite & neutral

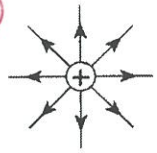
185. An electrostatic force exists between two $+3.20 \times 10^{-19}$ -coulomb point charges separated by a distance of 0.030 meter. As the distance between the two point charges is decreased, the electrostatic force of

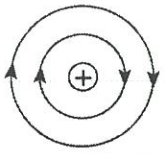
A) ~~attraction~~ between the two charges decreases
B) ~~attraction~~ between the two charges increases
C) repulsion between the two charges decreases
D) repulsion between the two charges increases

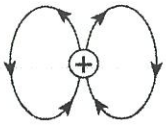
likes repel
if r↓ Fe↑

186. Which diagram best represents the electric field near a positively charged conducting sphere?

A) 

B) 

C) 

D) 

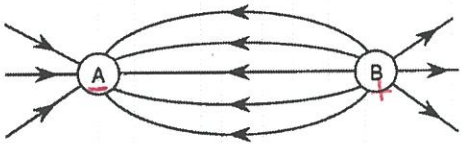
electric field lines go away from (+)

187. Two protons are located one meter apart. Compared to the gravitational force of attraction between the two protons, the electrostatic force between the protons is

A) stronger and repulsive
B) weaker and repulsive
C) stronger and attractive
D) weaker and attractive

gravity is always attractive and weakest of 4 forces

188. The diagram below represents the electric field lines in the vicinity of two isolated electrical charges, *A* and *B*.

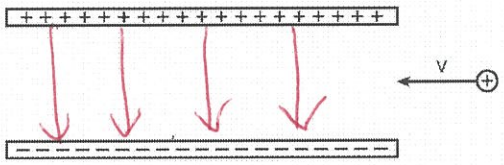


Which statement identifies the charges of *A* and B?

A) *A* is negative and *B* is positive.
B) *A* is positive and *B* is negative.
C) *A* and *B* are both positive.
D) *A* and *B* are both negative.

Field lines go away from (+) toward (−)

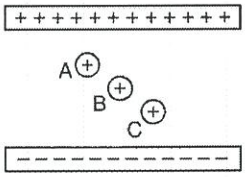
189. The diagram below represents a positively charged particle about to enter the electric field between two oppositely charged parallel plates.



The electric field will deflect the particle

A) into the page
B) out of the page
C) toward the top of the page
D) toward the bottom of the page

190. Identical charges *A*, *B*, and *C* are located between two oppositely charged parallel plates, as shown in the diagram below.

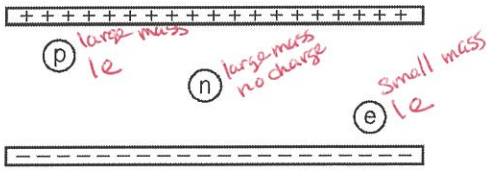


uniform field

The magnitude of the force exerted on the charges by the electric field between the plates is

A) least on *A* and greatest on *C*
B) greatest on *A* and least on *C*
C) the same on *A* and *C*, but less on *B*
D) the same for *A*, *B*, and *C*

191. In the diagram below, proton *p*, neutron *n*, and electron *e* are located as shown between two oppositely charged plates.



The magnitude of acceleration will be greatest for the

A) neutron, because it has the greatest mass
B) neutron, because it is neutral
C) electron, because it has the smallest mass
D) proton, because it is farthest from the negative plate

192. Gravitational field strength is to Newtons per kilogram as electric field strength is to

A) coulombs per joule
B) coulombs per newton
C) joules per coulomb
D) newtons per coulomb

193. Which electrical unit is equivalent to one joule?

A) volt per meter
B) ampere•volt
C) volt per coulomb
D) coulomb•volt

194. Compared to insulators, metals are better conductors of electricity because metals contain more free

A) protons
B) electrons
C) positive ions
D) negative ions

195. Conductivity in metallic solids is due to the presence of free

A) nuclei
B) protons
C) neutrons
D) electrons

196. The number of electrons that pass a certain point in a conductor in a given amount of time is defined as

A) potential difference
B) charge
C) resistance
D) electric current

197. A manufacturer recommends that the longer the extension cord used with an electric drill, the thicker (heavier gauge) the extension cord should be. This recommendation is made because the resistance of a wire varies

A) directly with length and inversely with cross-sectional area
B) inversely with length and directly with cross-sectional area
C) directly with both length and cross-sectional area
D) inversely with both length and cross-sectional area

198. Which change decreases the resistance of a piece of copper wire?

A) increasing the wire's length
B) increasing the wire's resistivity
C) decreasing the wire's temperature
D) decreasing the wire's diameter

199. As the temperature of a metallic conductor increases, its resistance usually

A) decreases
B) increases
C) remains the same

200. A copper wire is connected across a constant voltage source. The current flowing in the wire can be increased by increasing the wire's

A) cross-sectional area
B) length
C) resistance
D) temperature

$R = \frac{\rho L}{A}$

201. Which changes would cause the greatest increase in the rate of flow of charge through a conducting wire?

A) increasing the applied potential difference and decreasing the length of wire
B) increasing the applied potential difference and increasing the length of wire
C) decreasing the applied potential difference and decreasing the length of wire
D) decreasing the applied potential difference and increasing the length of wire

$V = IR$, $I = \frac{V}{R}$, $I = \frac{V}{\frac{\rho L}{A}}$, $I = \frac{VA}{\rho L}$

202. What is the minimum equipment needed to determine the power dissipated in a resistor of unknown value?

$P = VI$

A) a voltmeter, only
B) an ammeter, only
C) a voltmeter and an ammeter, only
D) a voltmeter, an ammeter, and a stopwatch

203. A student needs a 4-ohm resistor to complete a circuit. Only a large quantity of 1-ohm resistors are available. Which of the following should be done to complete the circuit?

In series $R_{eq} = R_1 + R_2 + R_3$

A) Connect four 1-ohm resistors in series.
B) Connect four 1-ohm resistors in parallel.
C) Connect two of the 1-ohm resistors in series and two in parallel.
D) Connect only two 1-ohm resistors in parallel.

204. When only one lightbulb blows out, an entire string of decorative lights goes out. The lights in this string must be connected in

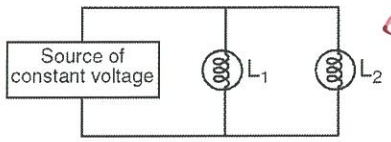
A) parallel with one current pathway
B) parallel with multiple current pathways
C) series with one current pathway
D) series with multiple current pathways

205. A 3-ohm resistor and a 6-ohm resistor are connected in parallel across a 9-volt battery. Which statement best compares the potential difference across each resistor?

Parallel $V_T = V_1 = V_2 = V_3$

A) The potential difference across the 6-ohm resistor is the same as the potential difference across the 3-ohm resistor.
B) The potential difference across the 6-ohm resistor is twice as great as the potential difference across the 3-ohm resistor.
C) The potential difference across the 6-ohm resistor is half as great as the potential difference across the 3-ohm resistor.
D) The potential difference across the 6-ohm resistor is four times as great as the potential difference across the 3-ohm resistor.

206. In the diagram below, lamps L_1 and L_2 are connected to a constant voltage power supply.



Parallel

If lamp L_1 burns out, the brightness of L_2 will

A) decrease
B) increase
C) remain the same

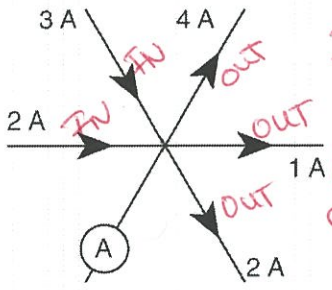
207. A physics student is given three 12-ohm resistors with instructions to create the circuit that would have the lowest possible resistance. The correct circuit would be a

A) series circuit with an equivalent resistance of 36 Ω?
B) series circuit with an equivalent resistance of 4.0 Ω?
C) parallel circuit with an equivalent resistance of 36 Ω?
D) parallel circuit with an equivalent resistance of 4.0 Ω?

$\frac{1}{R_{eq}} = \frac{1}{12\Omega} + \frac{1}{12\Omega} + \frac{1}{12\Omega} = \frac{3}{12\Omega}$

$R_{eq} = \frac{12\Omega}{3}$

208. The diagram below represents currents in a segment of an electric circuit.

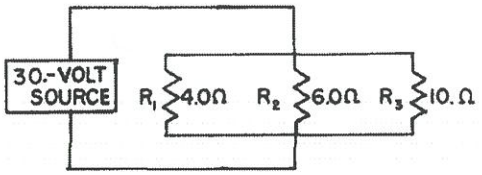


IN	OUT
3A	4A
2A	1A
2A	2A
7A	7A

What is the reading of ammeter A?

A) 1 A B) 2 A C) 3 A D) 4 A

209. Base your answer to the following question on the diagram below which represents an electrical circuit.



The equivalent resistance of the circuit must be

A) greater than 10 ohms
B) greater than 4 ohms
C) less than 4 ohms
D) zero

In parallel Req is less than the lowest "R"

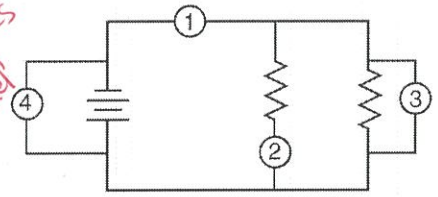
210. An electric circuit contains an operating heating element and a lit lamp. Which statement best explains why the lamp remains lit when the heating element is removed from the circuit?

A) The lamp has less resistance than the heating element.
B) The lamp has more resistance than the heating element.
C) The lamp and the heating element were connected in series.
D) The lamp and the heating element were connected in parallel.

211. As the number of resistors in a parallel circuit is increased, what happens to the equivalent resistance of the circuit and total current in the circuit?

A) Both equivalent resistance and total current decrease.
B) Both equivalent resistance and total current increase.
C) Equivalent resistance decreases and total current increases.
D) Equivalent resistance increases and total current decreases.

212. In the electric circuit diagram below, possible locations of an ammeter and a voltmeter are indicated by circles 1, 2, 3, and 4



Where should an ammeter be located to correctly measure the total current and where should a voltmeter be located to correctly measure the total voltage?

A) ammeter at 1 and voltmeter at 4
B) ammeter at 2 and voltmeter at 3
C) ammeter at 3 and voltmeter at 4
D) ammeter at 1 and voltmeter at 2

213. As the potential difference across a given resistor is increased, the power expended in moving charge through the resistor

A) decreases
B) increases
C) remains the same

214. An electric circuit contains a variable resistor connected to a source of constant voltage. As the resistance of the variable resistor is increased, the power dissipated in the circuit

A) decreases
B) increases
C) remains the same

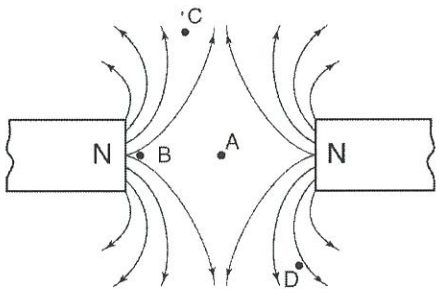
215. If the potential difference applied to a fixed resistance is doubled, the power dissipated by that resistance

A) remains the same
B) doubles
C) halves
D) quadruples

216. The electronvolt is a unit of

A) energy
B) charge
C) electric field strength
D) electric potential difference

217. The diagram below shows the lines of magnetic force between two north magnetic poles.



At which point is the magnetic field strength greatest?

A) *A* B) *B* C) *C* D) *D*

218. A magnetic field would be produced by a beam of

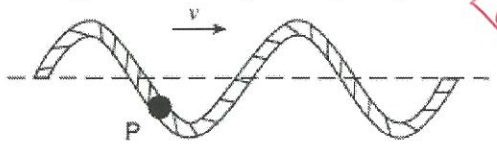
A) x rays
B) gamma rays
C) protons
D) neutrons

moving charges produce magnetic fields

219. Which particle would produce a magnetic field?

A) a neutral particle moving in a straight line
B) a neutral particle moving in a circle
C) a stationary charged particle
D) a moving charged particle

220. The diagram below shows a transverse wave moving toward the right along a rope.

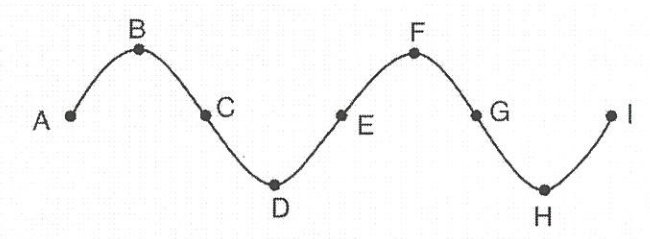


At the instant shown, point *P* on the rope is moving toward the

A) bottom of the page
B) top of the page
C) left
D) right

Crest approaching
for transverse remember particles just move up and down energy moves perpendicular

221. The diagram below shows a periodic wave.



180° = ½λ

Which two points on the wave are 180.° out of phase?

A) *A* and *C* ½λ
B) *B* and *E* ¾λ
C) *F* and *G* ¼λ
D) *D* and *H* 1λ

222. The energy of a sound wave is most closely related to the wave's

A) frequency
B) amplitude
C) wavelength
D) speed

energy of mechanical waves is related to amplitude - Sound is a longitudinal mechanical wave

223. If monochromatic light passes from water into air with an angle incidence of 35°, which characteristic of the light will remain the same?

A) frequency
B) wavelength
C) speed
D) direction

frequency remains the same when waves change medium

224. Which waves require a material medium for transmission?

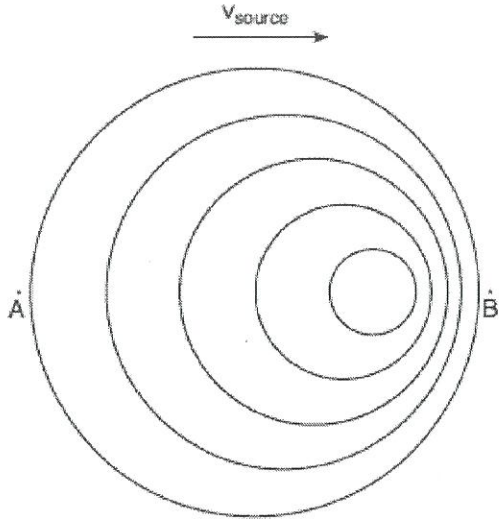
A) light waves EM
B) radio waves EM
C) sound waves
D) microwaves EM

mechanical waves require a medium

225. Transverse waves are to radio waves as longitudinal waves are to

A) light waves
B) microwaves
C) ultraviolet waves
D) sound waves

226. The diagram below represents the wave fronts produced by a point source moving to the right in a uniform medium. Observers are located at points *A* and *B*.



A	B
further away	closer
$f\downarrow$	$f\uparrow$
$\lambda\uparrow$	$\lambda\downarrow$

Compared to the wave frequency and wavelength observed at point *A*, the wave observed at point *B* has a

A) higher frequency and a shorter wavelength
B) higher frequency and a longer wavelength
C) lower frequency and a shorter wavelength
D) lower frequency and a longer wavelength

227. **Note that the question below has only three choices.**
If the amplitude of a wave is increased, the frequency of the wave will

A) decrease
B) increase
C) remain the same

Amplitude not related to any other variables

228. A stationary police officer directs radio waves emitted by a radar gun at a vehicle moving toward the officer. Compared to the emitted radio waves, the radio waves reflected from the vehicle and received by the radar gun have a

A) longer wavelength
B) higher speed
C) longer period
D) higher frequency

229. **Note the question below has only three choices.**
As viewed from Earth, the light from a star has lower frequencies than the light emitted by the star because the star is

A) moving toward Earth
B) moving away from Earth
C) stationary

230. Which statement describes a characteristics common to all electromagnetic waves and mechanical waves?

A) Both types of waves travel at the same speed.
B) Both types of waves require a material medium for propagation.
C) Both types of waves propagate in a vacuum.
D) Both types of waves transfer energy.

231. Which formula represents a constant for light waves of different frequencies in a vacuum?

A) $f\lambda$
B) $\frac{f}{\lambda}$
C) $\frac{\lambda}{f}$
D) $f + \lambda$

$v = f\lambda$

232. When x-ray radiation and infrared radiation are traveling in a vacuum, they have the same

A) speed
B) frequency
C) wavelength
D) energy per photon

233. Which phenomenon provides evidence that light has a wave nature?

A) emission of light from an energy-level transition in a hydrogen atom
B) diffraction of light passing through a narrow opening
C) absorption of light by a black sheet of paper
D) reflection of light from a mirror

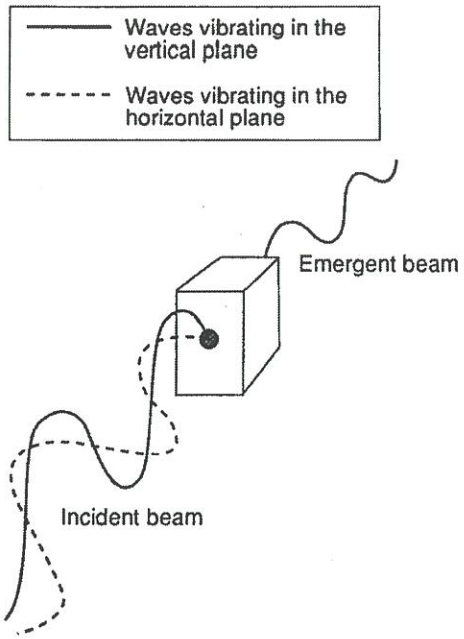
234. Only the wave theory of light offers an explanation for the ability of light to exhibit

A) interference
B) reflection
C) photoelectric emission
D) intensity of radiation

235. Which phenomenon can *not* be exhibited by longitudinal waves?

A) reflection
B) refraction
C) diffraction
D) polarization

236. The diagram below shows a beam of light entering and leaving a "black box."



The box most likely contains a

A) prism
B) converging lens
C) double slit
D) polarizer

237. A gamma ray photon and a microwave photon are traveling in a vacuum. Compared to the wavelength and energy of the gamma ray photon, the microwave photon has a

A) shorter wavelength and less energy
B) shorter wavelength and more energy
C) longer wavelength and less energy
D) longer wavelength and more energy

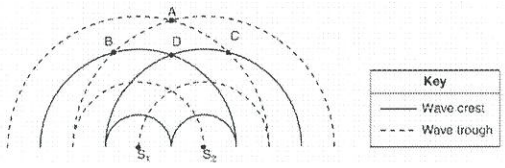
238. Which type of oscillation would most likely produce an electromagnetic wave? created by moving charged particle

A) a vibrating tuning fork
B) a washing machine agitator at work
C) a swinging pendulum
D) an electron traveling back and forth in a wire

239. The effect produced when two or more sound waves pass through the same point simultaneously is called

A) interference
B) diffraction
C) refraction
D) resonance

240. Two speakers, S_1 and S_2, operating in phase in the same medium produce the circular wave patterns shown in the diagram below.



At which two points is constructive interference occurring? 2 of the same

A) *A* and *B*
B) *A* and *D*
C) *B* and *C*
D) *B* and *D*

241. The diagram below shows a light ray striking a plane mirror.

Between ray and normal

$\theta_i = \theta_r$

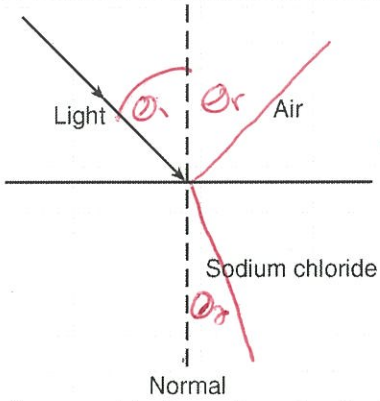
What is the angle of reflection?

A) 30 °
B) 60°
C) 90°
D) 120°

242. A wave passes through an opening in a barrier. The amount of diffraction experienced by the wave depends on the size of the opening and the wave's

A) amplitude
B) wavelength
C) velocity
D) phase

243. A ray of monochromatic light is incident on an air-sodium chloride boundary as shown in the diagram below. At the boundary, part of the ray is reflected back into the air and part is refracted as it enters the sodium chloride.



$n_1 = 1$
$n_2 = 1.54$

Compared to the ray's angle of refraction in the sodium chloride, the ray's angle of reflection in the air is

A) smaller
B) larger
C) the same

$\theta_2 < \theta_r$

244. As a monochromatic light ray passes from air into water, two characteristics of the ray that will *not* change are

A) wavelength and period
B) frequency and period
C) wavelength and speed
D) frequency and speed

Frequency does not change
Period is the inverse of f so it is also fixed

245. The absolute index of refraction of medium *Y* is twice as great as the absolute index of refraction of medium *X*. As a light ray travels from medium *X* into medium *Y*, the speed of the light ray is

A) halved
B) doubled
C) quartered
D) quadrupled

$\frac{n_2}{n_1} = \frac{v_1}{v_2}$

y	x
2n	n

246. A beam of light crosses a boundary between two different media. Refraction can occur if

A) the angle of incidence is 0°
B) there is no change in the speed of the wave
C) the media have different indices of refraction
D) all of the light is reflected

247. Which quantity is equivalent to the product of the absolute index of refraction of water and the speed of light in water? c=nv

A) wavelength of light in a vacuum
B) frequency of light in water
C) sine of the angle of incidence
D) speed of light in a vacuum

248. Glass may shatter when exposed to sound of a particular frequency. This phenomenon is an example of

A) refraction
B) diffraction
C) resonance
D) the Doppler effect

249. Moving electrons are found to exhibit properties of

A) particles, only
B) waves, only
C) both particles and waves
D) neither particles nor waves

250. Which phenomenon best supports the theory that matter has a wave nature?

A) electron momentum
B) electron diffraction (matter, wave)
C) photon momentum
D) photon diffraction

251. During a collision between a photon and an electron, there is conservation of

A) energy, only
B) momentum, only
C) both energy and momentum
D) neither energy nor momentum

252. According to the Standard Model of Particle Physics, a neutrino is a type of

A) lepton B) photon
C) meson D) baryon

253. The particles in a nucleus are held together primarily by the

A) strong force
B) gravitational force
C) electrostatic force
D) magnetic force

254. What is the total number of quarks in a helium nucleus consisting of 2 protons and 2 neutrons? 4 baryons 3 quarks each

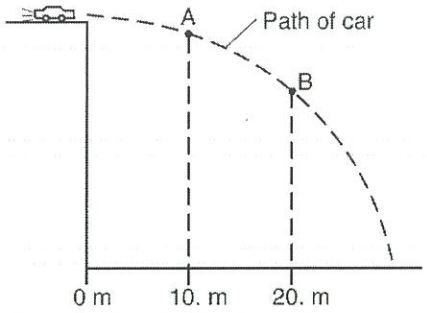
A) 16 B) 12 C) 8 D) 4

255. A particle that is composed of two up quarks and one down quark is a uud

A) meson B) neutron
C) proton D) positron

256. **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

257. A baseball player throws a ball horizontally. Which statement best describes the ball's motion after it is thrown? [Neglect the effect of friction.]

A) Its vertical speed remains the same, and its horizontal speed increases.
B) Its vertical speed remains the same, and its horizontal speed remains the same.
C) Its vertical speed increases, and its horizontal speed increases.
D) Its vertical speed increases, and its horizontal speed remains the same.

horizontal axis in equilibrium
Vertical axis experiences net force = to Fg

258. A 0.2-kilogram red ball is thrown horizontally at a speed of 4 meters per second from a height of 3 meters. A 0.4-kilogram green ball is thrown horizontally from the same height at a speed of 8 meters per second. Compared to the time it takes the red ball to reach the ground, the time it takes the green ball to reach the ground is

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

red | green
.2kg | .4kg
4m/s | 8m/s
3m | 3m

dy determines time of fall

259. A golf ball is hit at an angle of 45° above the horizontal. What is the acceleration of the golf ball at the highest point in its trajectory? [Neglect friction.]

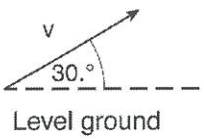
A) 9.8 m/s^2 upward
B) 9.8 m/s^2 downward
C) 6.9 m/s^2 horizontal
D) 0.0 m/s^2

260. A vector makes an angle, θ, with the horizontal. The horizontal and vertical components of the vector will be equal in magnitude if angle θ is

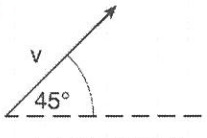
A) 30° B) 45° C) 60° D) 90°

261. Four identical projectiles are launched with the same initial speed, v, but at various angles above the level ground. Which diagram represents the initial velocity of the projectile that will have the largest total horizontal displacement? [Neglect air resistance.]

A)

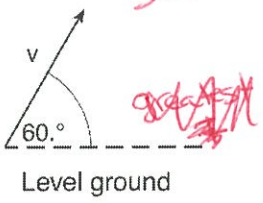


B)



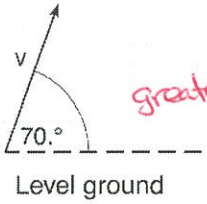
greatest dx

C)



same dx

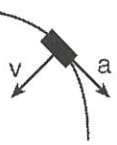
D)



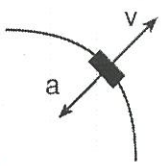
greatest t

262. A car rounds a horizontal curve of constant radius at a constant speed. Which diagram best represents the directions of both the car's velocity, v, and acceleration, a?

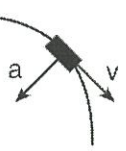
A)



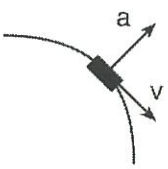
B)



C)



D)

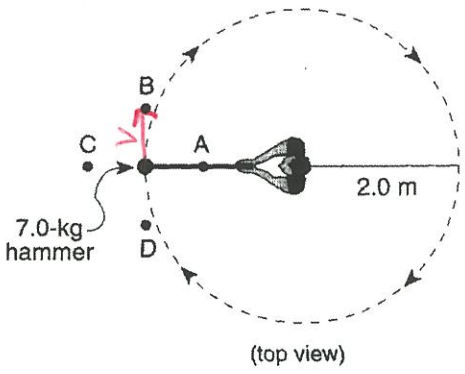


Velocity is tangent

a_c and F_{net_c} are directed to center

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

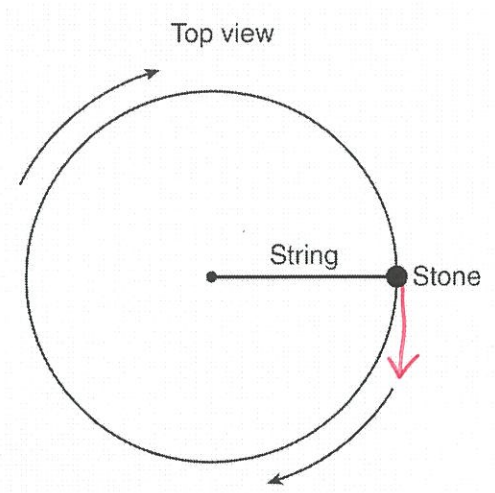
An athlete in a hammer-throw event swings a 7.0-kilogram hammer in a horizontal circle at a constant speed of 12 meter per second. The radius of the hammer's path is 2.0 meters



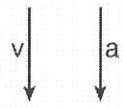
If the hammer is released at the position shown, it will travel toward point

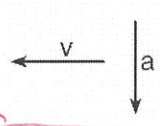
A) *A* B) *B* C) *C* D) *D*

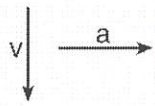
264. A stone on the end of a string is whirled clockwise at constant speed in a horizontal circle as shown in the diagram below.

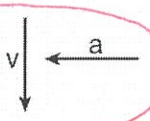


Which pair of arrows best represents the directions of the stone's velocity, *v*, and acceleration, *a*, at the position shown?

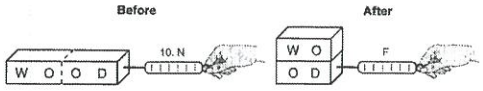
A) 

B) 

C) 

D) 

265. The diagram below shows a student applying a 10.-newton force to slide a piece of wood at constant speed across a horizontal surface. After the wood is cut in half, one piece is placed on top of the other, as shown.



What is the magnitude of the force, *F*, required to slide the stacked wood at constant speed across the surface?

A) 40 N B) 20 N
C) 10 N D) 5.0 N

Surface area does not influence F_N or F_f

266. A student on an amusement park ride moves in a circular path with a radius of 3.5 meters once every 8.9 seconds. The student moves at an average speed of

A) 0.39 m/s B) 1.2 m/s
C) 2.5 m/s D) 4.3 m/s

$r = 3.5\text{m}$
$t = 8.9\text{s}$
$v = \frac{C}{t} = \frac{2\pi r}{t}$

267. A baseball player runs 27.4 meters from the batter's box to first base, overruns first base by 3.0 meters, and then returns to first base. Compared to the total distance traveled by the player, the magnitude of the player's total displacement from the batter's box is

A) 3.0 m shorter B) 6.0 m shorter
C) 3.0 m longer D) 6.0 m longer

distance	displacement
27.4m	27.4m
+3m	
+3m	
33.4m	27.4m

268. An object dropped from rest will have a velocity of approximately 30. meters per second at the end of

A) 1.0 s B) 2.0 s
C) 3.0 s D) 4.0 s

$v_i = 0$
$v_f = 30\text{m/s}$
$a = 9.8\text{m/s}^2$ (or 10m/s^2)
$t = ?$

$v_f = v_i + at$
$30\text{m/s} = 0 + (10\text{m/s}^2)t$
$t = 3\text{s}$

269. A ball is thrown vertically upward with an initial velocity of 29.4 meters per second. What is the maximum height reached by the ball? [Neglect friction.]

A) 14.7 m B) 29.4 m
C) 44.1 m D) 88.1 m

$V_i = 29.4\ m/s$, $d_y = ?$, $a = 10\ m/s^2$, $V_f = 0$

$V_f^2 = V_i^2 + 2ad$

$0 = (29.4\ m/s)^2 + 2(10\ m/s^2)d$

270. A 25-newton weight falls freely from rest from the roof of a building. What is the total distance the weight falls in the first 1.0 second?

A) 19.6 m B) 9.8 m
C) 4.9 m D) 2.5 m

$d_y = ?$, $t = 1s$, $a = 9.8\ m/s^2$, $V_i = 0$

$d = \frac{1}{2}at^2 = \frac{1}{2}(9.8\ m/s^2)(1s)^2$

271. Which situation will produce the greatest change of momentum for a 1.0-kilogram cart?

$Ft = J = p = m\Delta v = 3\ kg\ m/s$

A) accelerating it from rest to 3.0 m/s
B) accelerating it from 2.0 m/s to 4.0 m/s $2\ kg\ m/s$
C) applying a net force of 5.0 N for 2.0 s $Ft = 10\ Ns$
D) applying a net force of 10.0 N for 0.5 s $5\ Ns$

272. At a certain location, a gravitational force with a magnitude of 420 newtons acts on a 70.-kilogram astronaut. What is the magnitude of the gravitational field strength at this location?

A) 0.17 N/kg B) 6.0 N/kg
C) 9.8 m/s^2 D) 25 000 N/kg

$g = \frac{F_g}{m} = \frac{420\ N}{70\ kg} = 6\ N/kg$

273. A 100.-kilogram cart accelerates at 0.50 meter per second squared west as a horse exerts a force of 60. newtons west on the cart. What is the magnitude of the force that the cart exerts on the horse?

A) 10. N B) 50. N
C) 60. N D) 110 N

$m = 100\ kg$, $a = 5\ m/s^2$, $F = 60\ N$

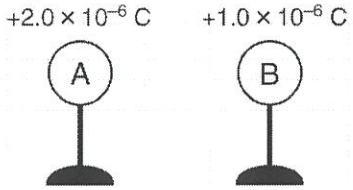
Newton's 3rd Law

274. A 400-newton girl standing on a dock exerts a force of 100 newtons on a 10 000-newton sailboat as she pushes it away from the dock. How much force does the sailboat exert on the girl?

A) 25 N B) 100 N
C) 400 N D) 10 000 N

3rd Law

275. Two similar metal spheres, *A* and *B*, have charges of $+2.0 \times 10^{-6}$ coulomb and $+1.0 \times 10^{-6}$ coulomb, respectively, as shown in the diagram below.

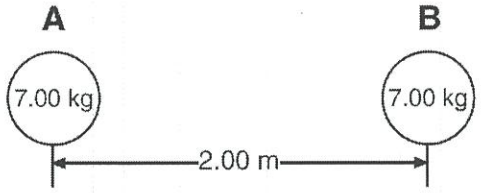


The magnitude of the electrostatic force on *A* due to *B* is 2.4 newtons. What is the magnitude of the electrostatic force on *B* due to *A*?

A) 1.2 N B) 2.4 N
C) 4.8 N D) 9.6 N

Newton's Law

276. The diagram shows two bowling balls, *A* and *B*, each having a mass of 7.00 kilograms, placed 2.00 meters apart.



What is the magnitude of the gravitational force exerted by ball *A* on ball *B*?

A) 8.17×10^{-9} N B) 1.63×10^{-9} N
C) 8.17×10^{-10} N D) 1.17×10^{-10} N

$F_g = \frac{Gm_1m_2}{r^2}$

$= \frac{(6.67 \times 10^{-11}\ N\ m^2/kg^2)(7kg)(7kg)}{4m^2}$

$81.7 \times 10^{-11}\ N$

277. The centers of two 15.0-kilogram spheres are separated by 3.00 meters. The magnitude of the gravitational force between the two spheres is approximately

A) 1.11×10^{-10} N B) 3.34×10^{-10} N
C) 1.67×10^{-9} N D) 5.00×10^{-9} N

$F_g = \frac{G m_1 m_2}{r^2} = \frac{6.67\times10^{-11}\ N\cdot m^2/kg^2 \times (15kg)(15kg)}{9\ m^2}$

278. On the surface of Earth, a spacecraft has a mass of 2.00×10^4 kilograms. What is the mass of the spacecraft at a distance of one Earth radius above Earth's surface?

A) 5.00×10^3 kg B) 2.00×10^4 kg
C) 4.90×10^4 kg D) 1.96×10^5 kg

mass doesn't change

279. The acceleration due to gravity on the surface of planet X is 19.6 meters per second^2. If an object on the surface of this planet weighs 980. newtons, the mass of the object is

$F_g = 980N$
$g = 19.6 m/s^2$
$m = ?$

A) 50.0 kg B) 100. kg
C) 490. N D) 908 N

$m = \frac{F_g}{g} = \frac{980N}{19.6 m/s^2}$

280. A rubber block weighing 60. newtons is resting on a horizontal surface of dry asphalt. What is magnitude of the minimum force needed to start the rubber block moving across the dry asphalt?

$\mu_s = .85$

A) 32 N B) 40 N
C) 51 N D) 60 N

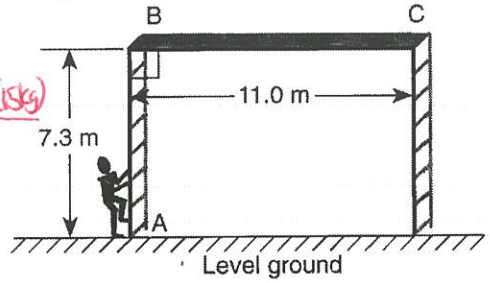
$F_g = 60N$
$F_N = 60N$
$F_f = \mu F_N$
$.85(60N)$

281. A 0.50-kilogram puck sliding on a horizontal shuffleboard court is slowed to rest by a frictional force of 1.2 newtons. What is the coefficient of kinetic friction between the puck and the surface of the shuffleboard court?

A) 0.24 B) 0.42
C) 0.60 D) 4.1

$m = .5kg$
$F_f = 1.2N$
$\mu = ?$
$F_N = F_g = mg$
$F_N = 4.9N$
$\mu = \frac{F_f}{F_N}$

282. As shown in the diagram below, a painter climbs 7.3 meters up a vertical scaffold A to B and then walks 11.0 meters from B to C along a level platform



$dx = 11m$
$dy = 7.3m$

What is the angle of the painter's displacement relative to the horizontal as they move from A to C?

A) 13.2 degrees B) 33.6 degrees
C) 56.4 degrees D) 18.3 degrees

283. While riding a chairlift, a 55-kilogram skier is raised a vertical distance of 370 meters. What is the total change in the skier's gravitational potential energy?

$PE = mgh$
$PE = (55kg)(9.8 m/s^2)(370m)$
199430
≈ 200000

A) $5.4 \cdot 10^1$ J B) $5.4 \cdot 10^2$ J
C) $2.0 \cdot 10^4$ J D) $2.0 \cdot 10^5$ J

284. A motor does a total of 480 joules of work in 5.0 seconds to lift a 12-kilogram block to the top of a ramp. The average power developed by the motor is

$W = 480J$
$t = 5s$
$m = 12kg$
$P = \frac{W}{t} = \frac{480J}{5s}$

A) 8.0 W B) 40. W
C) 96 W D) 2400 W

285. A 40.-kilogram student runs up a staircase to a floor that is 5.0 meters higher than her starting point in 7.0 seconds. The student's power output is

$P = \frac{W}{t} = \frac{mgh}{t}$
$P = \frac{(40kg)(9.81 m/s^2)(5m)}{7s}$

A) 29 W B) 280 W
C) 1.4×10^3 W D) 1.4×10^4 W

286. A 5.8 x 10^4-watt elevator motor can lift a total weight of 2.1 x 10^4 newtons with a maximum constant speed of

A) 0.28 m/s B) 0.36 m/s
C) 2.8 m/s D) 3.6 m/s

$P = 5.8 \times 10^4$ W $F = 2.1 \times 10^4$ N $v = ?$

$P = Fv$ or $v = P/F = \frac{5.8 \times 10^4 \text{ W}}{2.1 \times 10^4 \text{ N}}$

287. A particle could have a charge of

A) 0.8×10^{-19} C B) 1.2×10^{-19} C
C) 3.2×10^{-19} C D) 4.1×10^{-19} C

must be a multiple of 1.6×10^{-19} C

288. What is the approximate electrostatic force between two protons separated by a distance of 1.0×10^{-6} meter?

A) 2.3×10^{-16} N and repulsive
B) 2.3×10^{-16} N and attractive
C) 9.0×10^{21} N and repulsive
D) 9.0×10^{21} N and attractive

$F_e = k\frac{q_1 q_2}{r^2}$ $k = 8.99 \times 10^9 \text{ N m}^2/\text{C}^2$ $q_1 = q_2 = 1.6 \times 10^{-19}$ C

289. An electric field exerts an electrostatic force of magnitude 1.5 x 10^{-14} newton on an electron within the field. What is the magnitude of the electric field strength at the location of the electron?

$q = 1.6 \times 10^{-19}$ C

A) 2.4 x 10^{-33} N/C B) 1.1 x 10^{-5} N/C
C) 9.4 x 10^4 N/C D) 1.6 x 10^{16} N/C

$E = \frac{F_e}{q} = \frac{1.5 \times 10^{-14} \text{ N}}{1.6 \times 10^{-19} \text{ C}}$

290. What is the total amount of work required to move a proton through a potential difference of 100. volts?

A) 1.60×10^{-21} J B) 1.60×10^{-17} J
C) 1.00×10^2 J D) 6.25×10^{20} J

$V = 100$ V $q = 1.6 \times 10^{-19}$ C $W = ?$ $W = Vq$

291. Charge flowing at the rate of 2.50×10^{16} elementary charges per second is equivalent to a current of

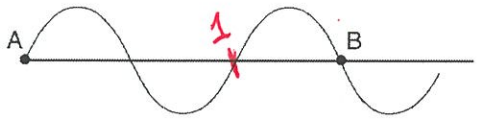
A) 2.50×10^{13} A B) 6.25×10^5 A
C) 4.00×10^{-3} A D) 2.50×10^{-3} A

292. What is the resistance at 20.°C of a 2.0-meter length of tungsten wire with a cross-sectional area of 7.9 $\times 10^{-7}$ meter^2?

A) $5.7 \times 10^{-1}\ \Omega$ B) $1.4 \times 10^{-1}\ \Omega$
C) $7.1 \times 10^{-2}\ \Omega$ D) $4.0 \times 10^{-2}\ \Omega$

$\rho = 5.6 \times 10^{-8}\ \Omega\text{m}$ $A = 7.9 \times 10^{-7}\ \text{m}^2$ $L = 2\text{m}$ $R = \frac{\rho L}{A}$

293. The diagram below shows two points, *A* and *B*, on a wave train.



How many wavelengths separate point *A* and point *B*?

A) 1.0 B) 1.5
C) 3.0 D) 0.75

294. A beam of light has a wavelength of 4.5×10^{-7} meter in a vacuum. The frequency of this light is

A) 1.5×10^{-15} Hz B) 4.5×10^{-7} Hz
C) 1.4×10^2 Hz D) 6.7×10^{14} Hz

$v = c = 3 \times 10^8$ m/s $\lambda = 4.5 \times 10^{-7}$ m $f = \frac{c}{\lambda} = \frac{3 \times 10^8 \text{ m/s}}{4.5 \times 10^{-7} \text{ m}}$

295. 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

$v = ?$ $\lambda = 1 \times 10^{-2}$ m $T = 4 \times 10^{-1}$ s $v = \frac{\lambda}{T} = \frac{1 \times 10^{-2} \text{ m}}{4 \times 10^{-1} \text{ s}}$

$= .25 \times 10^{-3}$ m/s $= 2.5 \times 10^{-2}$ m/s

296. Approximately how much time does it take light to travel from the Sun to Earth?

A) 2.00×10^{-3} s B) 1.28×10^0 s
C) 5.00×10^2 s D) 4.50×10^{19} s

$d = 1.5 \times 10^{11}$ m (PRT) $v = c = 3.0 \times 10^8$ m/s $v = \frac{d}{t}$

$t = \frac{d}{v} = \frac{1.5 \times 10^{11} \text{ m}}{3 \times 10^8 \text{ m/s}} = .5 \times 10^3$ 5×10^2 s

$I = \frac{q}{t} =$

q must be in Coulombs

$2.5 \times 10^6 \text{ e} \times \frac{1.6 \times 10^{-19} \text{ C}}{1 \text{ e}} = 4 \times 10^{-3}$ A $.004$ A

297. How much time does it take light from a flash camera to reach a subject 6.0 meters across a room?

A) 5.0×10^{-9} s B) 2.0×10^{-8} s
C) 5.0×10^{-8} s D) 2.0×10^{-7} s

$c = 3 \times 10^8$ m/s $v = \frac{d}{t}$ $t = \frac{d}{v} = \frac{6m}{3 \times 10^8 m/s}$
$d = 6$ m

298. A ray of light ($f = 5.09 \times 10^{14}$ Hz) traveling in air strikes a block of sodium chloride at an angle of incidence of 30.°. What is the angle of refraction for the light ray in the sodium chloride?

A) 19° B) 25° C) 40.° D) 49°

$n_1 \sin\theta_1 = n_2 \sin\theta_2$
$1 \sin 30° = 1.54 \sin\theta_2$

299. A singer demonstrated that she could shatter a crystal glass by singing a note with a wavelength of 0.320 meter in air at STP. What was the natural frequency of the glass?

A) 9.67×10^{-4} Hz B) 1.05×10^{2} Hz
C) 1.03×10^{3} Hz D) 9.38×10^{8} Hz

$v_{sound} = 331$ m/s
$\lambda = .320$ m $f = \frac{v}{\lambda} = \frac{331 m/s}{.320 m} =$

300. A plane flying horizontally above Earth's surface at 100. meters per second drops a crate. The crate strikes the ground 30.0 seconds later. What is the magnitude of the horizontal component of the crate's velocity just before it strikes the ground? [Neglect friction.]

A) 0 m/s B) 100. m/s
C) 294 m/s D) 394 m/s

$v_x = 100$ m/s v_x does not change

Base your answers to questions **301** and **302** on the information below.

Projectile *A* is launched horizontally at a speed of 20. meters per second from the top of a cliff and strikes a level surface below, 3.0 seconds later. Projectile *B* is launched horizontally from the same location at a speed of 30. meters per second.

A	B
$v_x = 20$ m/s	$v_x = 30$ m/s
$t = 3$ s	$t = 3$ s
same	height same
$d_y = ?$	d_y

301. Approximately how high is the cliff?

A) 29 m B) 44 m
C) 60. m D) 104 m

$d_y = \frac{1}{2} a t^2$
$d_y = \frac{1}{2}(9.8 m/s^2)(3s)^2$
$d = 44$ m

302. The time it takes projectile *B* to reach the level surface is

A) 4.5 s B) 2.0 s
C) 3.0 s D) 10. s

303. A baseball is thrown at an angle of 40.0° above the horizontal. The horizontal component of the baseball's initial velocity is 12.0 meters per second. What is the magnitude of the ball's initial velocity?

A) 7.71 m/s B) 9.20 m/s
C) 15.7 m/s D) 18.7 m/s

$v_x = 12$ m/s
$\theta = 40°$
$v = ?$
$v_x = v \cos\theta$
$\frac{12 m/s}{\cos 40°} = v$
15.7 m/s

304. A ball is hit straight up with an initial speed of 28 meters per second. What is the speed of the ball 2.2 seconds after it is hit? [Neglect friction.]

A) 4.3 m/s B) 6.4 m/s
C) 22 m/s D) 28 m/s

$v_i = 28$ m/s
$v_f = ?$
$a = -9.8$ m/s^2
$t = 2.2$ s

$v_f = v_i + at$
$v_f = 28 m/s + (-9.8 m/s^2)(2.2 s)$

$v_f^2 = v_i^2 + 2ad$ ($v_f = 0$) $\quad d = \frac{-v_i^2}{2a}$

$v_i^2 = 2ad$

305. A nerf dart launched upward from speed "v" reaches a height of 20m. What is the max height of a nerf dart launched upward from a speed of "1/2v"?

A) 5m B) 10m
C) 20m D) 40m

306. The force between two masses is 40N when separated by a distance r. The masses are then moved and experience a force of 10N. What is the new distance between them?

$F_g = \frac{G m_1 m_2}{r^2}$ $\quad r = \sqrt{\frac{G m_1 m_2}{F_g}}$

A) 4r B) 1/2r C) 2r D) 1/4r

307. An object dropped on planet X falls 20m in 4 second. How much time will it take to fall 5m?

$t = \sqrt{\frac{2d}{a}}$ $\quad \frac{1}{2}$ $\quad \frac{1}{4}$

A) 1 second B) 0.5 seconds
C) 4 seconds D) 2 seconds

308. What is the current in a 100.-ohm resistor connected to a 0.40-volt source of potential difference?

$I = \frac{V}{R} = \frac{4V}{100\Omega}$

A) 250 mA B) 40. mA
C) 2.5 mA D) 4.0 mA

309. If an object has a net negative charge of 4.0 coulombs, the object possesses

A) 6.3×10^{18} more electrons than protons
B) 2.5×10^{19} more electrons than protons
C) 6.3×10^{18} more protons than electrons
D) 2.5×10^{19} more protons than electrons

310. A sphere has a negative charge of 6.4×10^{-7} coulomb. Approximately how many electrons must be removed to make the sphere neutral?

$6.4\times10^{-7}\,C \times \frac{1e}{1.6\times10^{-19}\,C}$

A) 1.6×10^{-8} B) 9.8×10^{5}
C) 6.4×10^{26} D) 4.0×10^{12}

311. The current in a wire is 4.0 amperes. The time required for 2.5×10^{19} electrons to pass a certain point in the wire is

$I = 4A$
$t = ?$
$q = 2.5\times10^{19}\,e \times \frac{1.6\times10^{-19}\,C}{1e} = 4C$

A) 1.0 s B) 0.25 s
C) 0.50 s D) 4.0 s

$I = \frac{q}{t}$

$t = \frac{q}{I} = \frac{4C}{4A} = 1s$

312. In a television set, an electron beam with a current of 5.0×10^{-6} ampere is directed at the screen. Approximately how many electrons are transferred to the screen in 60. seconds?

$I = 5\times10^{-6}\,A$
$t = 60s$
$q = It = 3\times10^{-4}\,C$
$3\times10^{-4}\,C \times \frac{1e}{1.6\times10^{-19}\,C}$

A) 1.2×10^{7} B) 5.3×10^{11}
C) 1.9×10^{15} D) 6.3×10^{18}

313. A 0.45-kilogram football traveling at a speed of 22 meters per second is caught by an 84-kilogram stationary receiver. If the football comes to rest in the receiver's arms, the magnitude of the impulse imparted to the receiver by the ball is

$m = .45kg$ $\quad v = 22 m/s$ $\quad p = 9.9 kg\,m/s$

$J = \Delta p$

A) 1800 N•s B) 9.9 N•s
C) 4.4 N•s D) 3.8 N•s

$4C \times \frac{1e}{1.6\times10^{-19}\,C} = 2.5\times10^{19}\,e$