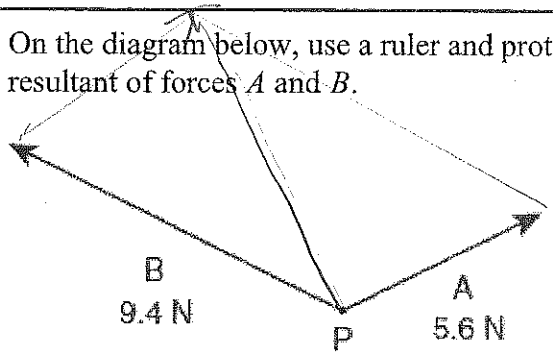
Skills 20-27 Review
Long Answer Questions

248. On the diagram below, use a ruler and protractor to construct a vector representing the resultant of forces *A* and *B*.



Parallelogram method or head to tail Skill 21

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

A 1200-kilogram car moving at 12 meters per second collides with a 2300-kilogram car that is waiting at rest at a traffic light. After the collision, the cars lock together and slide. Eventually, the combined cars are brought to rest by a force of kinetic friction as the rubber tires slide across the dry, level, asphalt road surface.

Skill 27 Inelastic Collision

Calculate the speed of the locked-together cars immediately after the collision. [Show all work, including the equation and substitution with units.]

250. Calculate the magnitude of the impulse applied to a 0.75-kilogram cart to change its velocity from 0.50 meter per second east to 2.00 meters per second east. [Show all work, including the equation and substitution with units.]

Skill 20 Newton's 2nd Law

Remember to read through all parts → not necessarily in order

Skills 20-27 Review

251. A 10.-kilogram rubber block is pulled horizontally at constant velocity across a sheet of ice. Calculate the magnitude of the force of friction acting on the block. [Show all work, including the equation and substitution with units.]

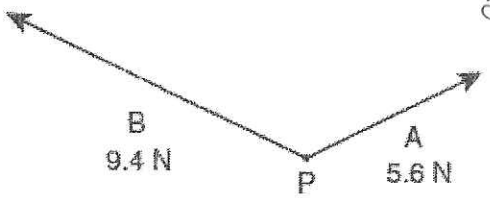
Skill 22

horizontal axis

Base your answers to questions **252** and **253** on the information and diagram below.

Force *A* with a magnitude of 5.6 newtons and force *B* with a magnitude of 9.4 newtons act concurrently on point *P*.

Similar to 246 measure

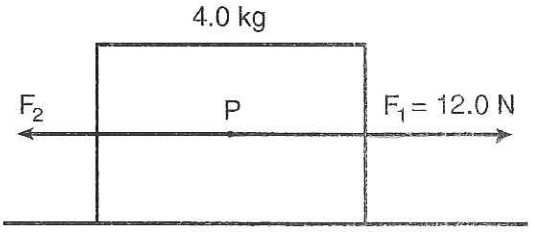


252. Determine the magnitude of the resultant force.

Base your answers to questions **253** through **255** on the information and diagram below.

In the scaled diagram, two forces, F_1 and F_2, act on a 4.0-kilogram block at point *P*. Force F_1 has a magnitude of 12.0 newtons, and is directed toward the right.

Skill 22



(Drawn to scale)

253. Calculate the magnitude of the acceleration of the block. (3rd)

254. Determine the magnitude of the net force acting on the block. (2nd)

255. Using a ruler and the scaled diagram, determine the magnitude of F_2 in newtons. (P)

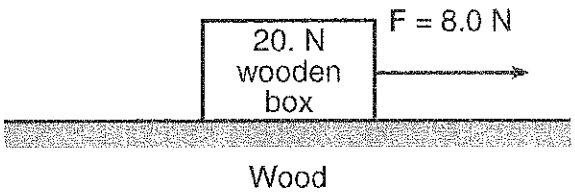
Skills 20-27 Review

Base your answers to questions **256** through **258** on the information below.

A horizontal force of 8.0 newtons is used to pull a 20.-newton wooden box moving toward the right along a horizontal, wood surface, as shown.

Skill 23

Skill 22



256. Calculate the magnitude of the acceleration of the box. [Show all work, including the equation and substitution with units.]

(3)

257. Determine the mass of the box.

(1)

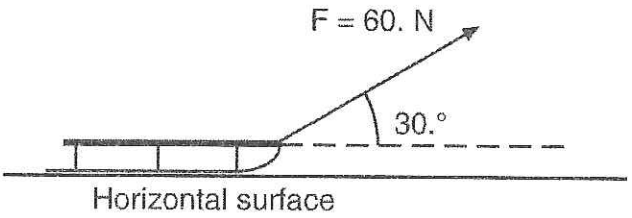
258. Determine the magnitude of the net force acting on the box.

(2)

Base your answers to questions **259** and **260** on the information below.

A force of 60. newtons is applied to a rope to pull a sled across a horizontal surface at a constant velocity. The rope is at an angle of 30. degrees above the horizontal.

Skills 21 & 22



259. Determine the magnitude of the frictional force acting on the sled.

(2)

260. Calculate the magnitude of the component of the 60.-newton force that is parallel to the horizontal surface. [Show all work, including the equation and substitution with units.]

(1)

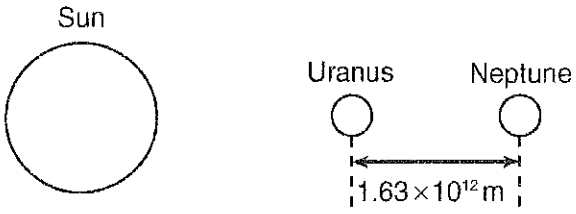
Base your answers to questions **261** and **262** on the passage and data table below.

The net force on a planet is due primarily to the other planets and the Sun. By taking into account all the forces acting on a planet, investigators calculated the orbit of each planet. A small discrepancy between the calculated orbit and the observed orbit of the planet Uranus was noted. It appeared that the sum of the forces on Uranus did not equal its mass times its acceleration, unless there was another force on the planet that was not included in the calculation. Assuming that this force was exerted by an unobserved planet, two scientists working independently calculated where this unknown planet must be in order to account for the discrepancy. Astronomers pointed their telescopes in the predicted direction and found the planet we now call Neptune.

Skill 26

Data Table

Mass of the Sun	1.99×10^{30} kg
Mass of Uranus	8.73×10^{25} kg
Mass of Neptune	1.03×10^{26} kg
Mean distance of Uranus to the Sun	2.87×10^{12} m
Mean distance of Neptune to the Sun	4.50×10^{12} m



(Not drawn to scale)

261. The magnitude of the force the Sun exerts on Uranus is 1.41×10^{21} newtons. Explain how it is possible for the Sun to exert a greater force on Uranus than Neptune exerts on Uranus.

Skills 20-27 Review

262. The diagram represents Neptune, Uranus, and the Sun in a straight line. Neptune is 1.63×10^{12} meters from Uranus.

Calculate the magnitude of the interplanetary force of attraction between Uranus and Neptune at this point. [Show all work, including the equation and substitution with units.]

Skill 26

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

A manufacturer's advertisement claims that their 1,250-kilogram (12,300-newton) sports car can accelerate on a level road from 0 to 60.0 miles per hour (0 to 26.8 meters per second) in 3.75 seconds.

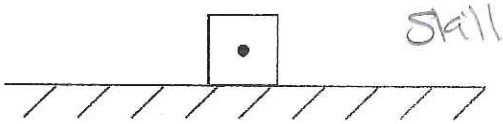
Calculate the net force required to give the car the acceleration claimed in the advertisement. [Show all work, including the equation and substitution with units.]

Skill 20

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

A force of 10. Newtons toward the right is exerted on a wooden crate initially moving to the right on a horizontal wooden floor. The crate weighs 25 Newtons.

Skill 23



a Calculate the magnitude of the force of friction between the crate and the floor. (1)

b On the diagram, draw and label all vertical forces acting on the crate. (2)

c On the diagram, draw and label all horizontal forces acting on the crate. (3)

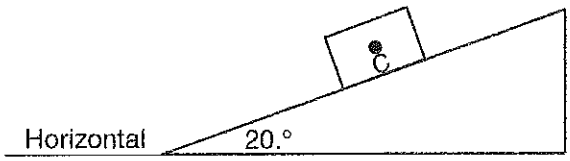
d What is the magnitude of the net force acting on the crate? (4)

e Is the crate accelerating? Explain your answer. (5)

Base your answers to questions **265** through **267** on the information and diagram below.

The following diagram is provided for practice purposes only. A 10.0-kilogram block slides at constant speed down a plane inclined at 20.° to the horizontal, as shown.

Skill 22
inclined planes



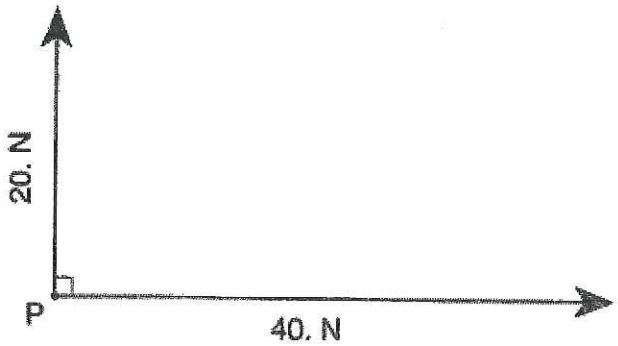
265. In one or more complete sentences, describe the change in the motion of the block as the angle of inclination is increased to 30.°.

266. Determine the weight of the block. [Show all calculations, including the equation and substitution with units.]

267. On the diagram above, draw an arrow to represent and identify the direction of each of the three forces (weight, friction, normal force) acting on the block. Begin each arrow at point *C* and label each arrow with the force that it represents.

Base your answers to questions **268** through **271** on the information and vector diagram below.

Skill 21
Skill 20



268. Calculate the magnitude of the acceleration of the object. [Show all calculations, including the equation and substitution with units.]

269. What is the measure of the angle (in degrees) between east and the resultant force?

270. What is the magnitude of the resultant force? → other page

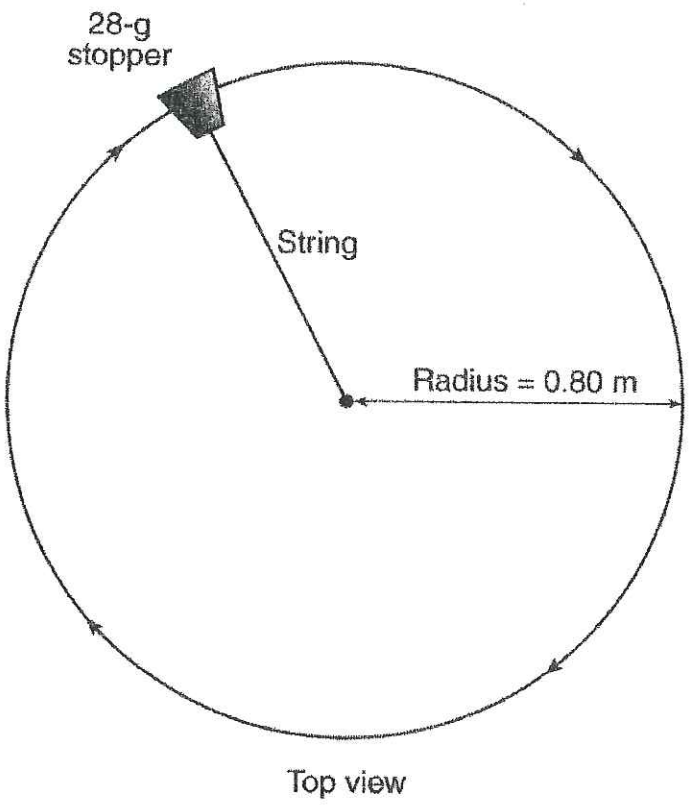
271. On the vector diagram above, use a ruler and protractor to construct the vector that represents the resultant force.

2

Base your answers to questions **272** and **273** on the information below.

A 28-gram rubber stopper is attached to a string and whirled clockwise in a horizontal circle with a radius of 0.80 meter. The diagram below represents the motion of the rubber stopper. The stopper maintains a constant speed of 2.5 meters per second.

Skills



Top view

272. On the diagram above, draw an arrow showing the direction of the centripetal force acting on the stopper when it is at the position shown.

273. Calculate the magnitude of the centripetal acceleration of the stopper. [Show all work, including the equation and substitution with units.]

Skill 25

Unit 3 Practice Test - 2 pt questions

274. Which is a unit of momentum? Skill 20

A) N-m/s^2 B) kg-m/s^2
C) N-m/s D) kg-m/s

275. Which quantity has both a magnitude and a direction? (Skill 21 & Skill 5)

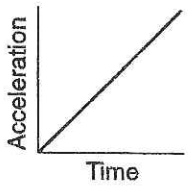
A) inertia B) impulse
C) speed D) time

276. A rocket engine acquires motion by ejecting hot gases in the opposite direction. This is an example of the law of (Skill 27)

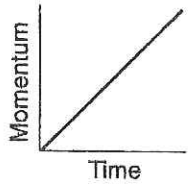
A) conservation of heat
B) conservation of energy
C) conservation of momentum
D) conservation of mass

277. Which graph best represents the motion of an object that has *no* unbalanced force acting on it? Skill 20 (#12)

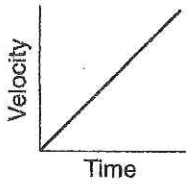
A)



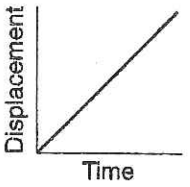
B)



C)

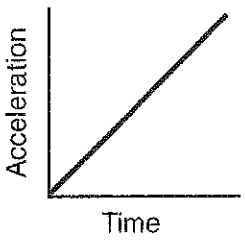


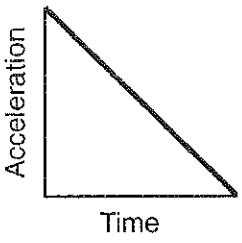
D)

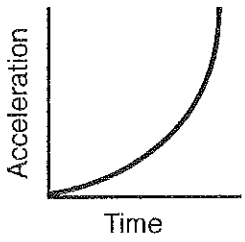


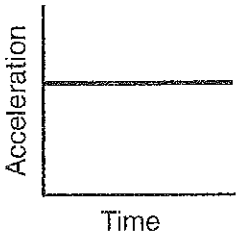
Unit 3 Practice Test - 2 pt questions

278. A constant unbalanced force is applied to an object for a period of time. Which graph best represents the acceleration of the object as a function of elapsed time? Skill 20(5)(2)

A)


B)


C)


D)


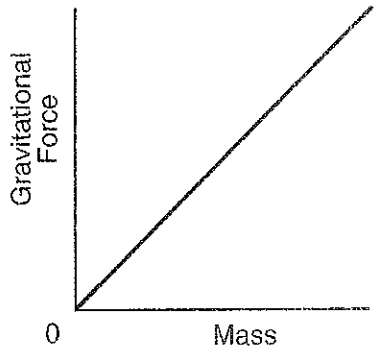
279. A man weighs 900 Newtons standing on a scale in a stationary elevator. If some time later the reading on the scale is 1200 Newtons, the elevator must be moving with Skill 22 Yaris

A) constant acceleration downward
B) constant speed downward
C) constant acceleration upward
D) constant speed upward

280. A cart is uniformly accelerating from rest. The net force acting on the cart is Skill 20

A) decreasing B) zero
C) constant D) increasing

281. Base your answer to the following question on The graph below represents the relationship between gravitational force and mass for objects near the surface of Earth. Skill 22



The slope of the graph represents the

A) gravitational field strength
B) universal gravitational constant
C) momentum of objects
D) weight of objects

282. The diagram below represents two concurrent forces.

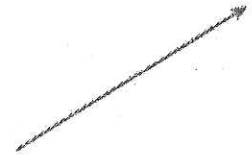
Skill 21

Which vector represents the force that will produce equilibrium with these two forces?

equilibrant

A)

B)

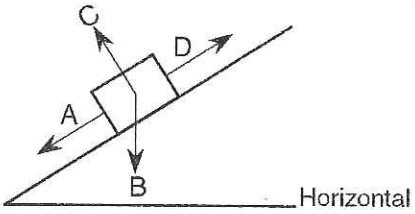


C)

D)

283. In the diagram below, a box is at rest on an inclined plane.

Skill 22

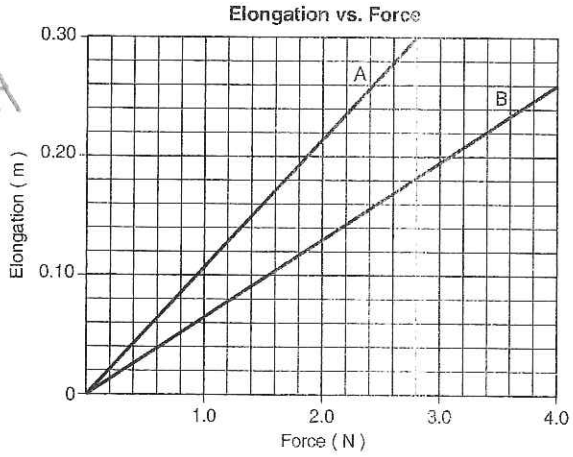


Which vector best represents the direction of the normal force acting on the box?

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

284. The graph below shows elongation as a function of the applied force for two springs, *A* and *B*.

Skill 24



Compared to the spring constant for spring *A*, the spring constant for spring *B* is

A) smaller B) larger
C) the same

285. A ball of mass *M* at the end of a string is swinging in a horizontal circular path of radius *R* at constant speed *V*. Which combination of changes would require the greatest increase in the centripetal force acting on the ball?

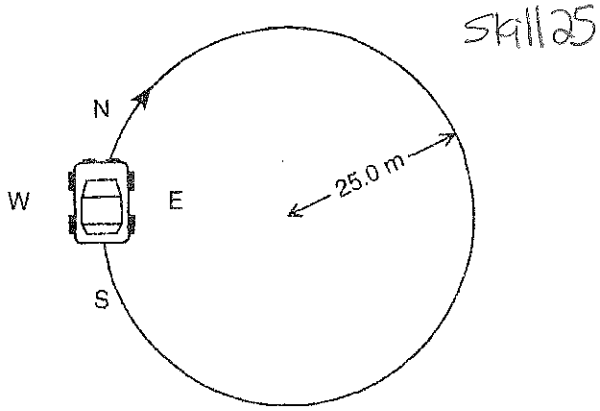
Skill 25

A) doubling *V* and doubling *R*
B) doubling *V* and halving *R*
C) halving *V* and doubling *R*
D) halving *V* and halving *R*

286. 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.

Skill 25



If the circular track were to suddenly become frictionless at the instant shown in the diagram, the car's direction of travel would be

A) toward *E*
B) toward *N*
C) toward *W*
D) a clockwise spiral

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

A 2.0×10^3-kilogram car travels at a constant speed of 12 meters per second around a circular curve of radius 30. meters.

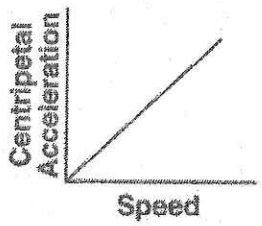
Skill 25

As the car goes around the curve, the centripetal force is directed

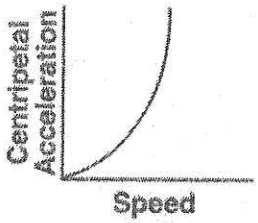
A) toward the center of the circular curve
B) away from the center of the circular curve
C) tangent to the curve in the direction of motion
D) tangent to the curve opposite the direction of motion

288. Which graph best represents the relationship between the magnitude of the centripetal acceleration and the speed of an object moving in a circle of constant radius?

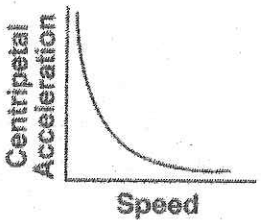
A)



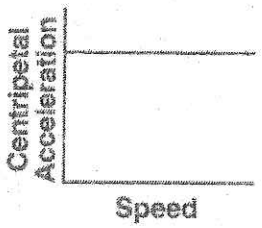
B)



C)



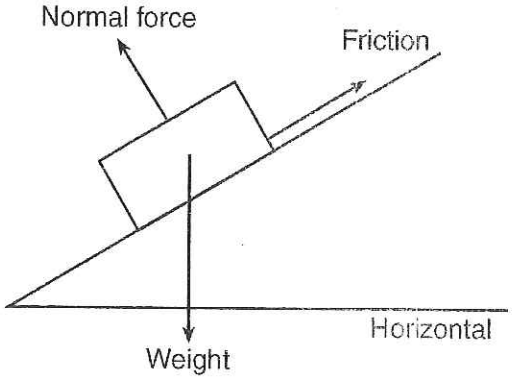
D)



289. Which object has the greatest inertia?

A) a 0.010-kg bullet traveling at 90. m/s
B) a 30.-kg child traveling at 10. m/s on her bike
C) a 490-kg elephant walking with a speed of 1.0 m/s
D) a 1500-kg car at rest in a parking lot

290. Three forces act on a box on an inclined plane as shown in the diagram below. [Vectors are not drawn to scale.]



If the box is at rest, the net force acting on it is equal to

A) the weight
B) the normal force
C) friction
D) zero

291. If the sum of all the forces acting on a moving object is zero, the object will

A) slow down and stop
B) change the direction of its motion
C) accelerate uniformly
D) continue moving with constant velocity

292. A rocket in space can travel without engine power at constant speed in the same direction. This condition is best explained by the concept of

A) gravitation
B) action-reaction
C) acceleration
D) inertia

293. Which of the following is an acceptable unit for a spring constant? Skill 24

A) Nm B) N/s
C) N/m D) kg m/s^2

294. An object is brought to rest by a constant force. Which factor other than the mass and velocity of the object must be known in order to determine the magnitude of the force required to stop the object? Skill 20

A) the time that the force acts on the object
B) the gravitational potential energy of the object
C) the density of the object
D) the weight of the object

295. The direction of an object's momentum is always the same as the direction of the object's

Skill 20

A) inertia B) potential energy
C) velocity D) weight

296. 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 Skill 27

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

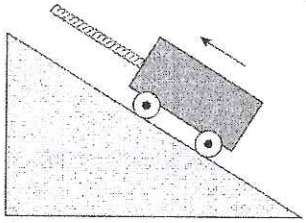
297. A woman with horizontal velocity v_1 jumps off a dock into a stationary boat. After landing in the boat, the woman and the boat move with velocity v_2. Compared to velocity v_1, velocity v_2 has Skill 27

A) the same magnitude and the same direction
B) the same magnitude and opposite direction
C) smaller magnitude and the same direction
D) larger magnitude and the same direction

298. A 2,400-kilogram car is traveling at a speed of 20. meters per second. Compared to the magnitude of the force required to stop the car in 12 seconds, the magnitude of the force required to stop the car in 6.0 seconds is Skill 20, 27 (& Skill 19)

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

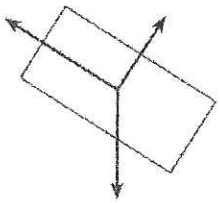
299. A cart is held at equilibrium on an inclined plane (frictionless surface).



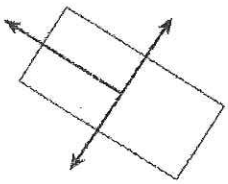
Which of the following correctly represents the forces that act on the cart?

Skill 22

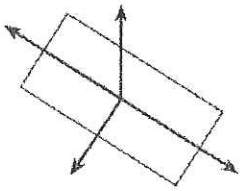
A)



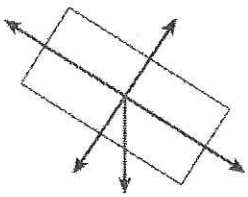
B)



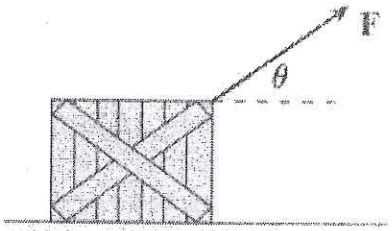
C)



D)



300. The diagram below shows a force of magnitude F applied to a crate at an angle θ relative to a horizontal frictionless surface.



Skill 22

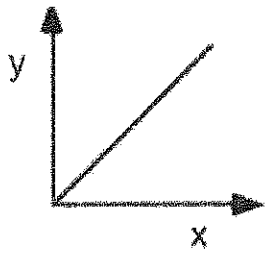
As the angle θ is increased, the horizontal acceleration of the mass

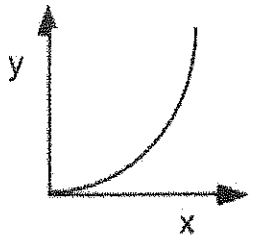
A) increases
B) decreases
C) remains the same

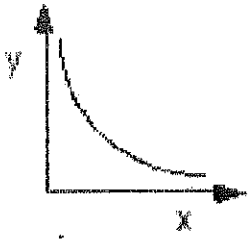
Unit 3 Practice Test - 2 pt questions

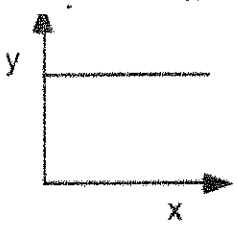
301. In a lab investigation, a student applies a constant net force to a cart and measures the acceleration of the cart in response to an increasing mass. Which of the following graphs shows the correct relationship between the dependent and independent variable in this experiment.

Skill 20 (& skill 19)

A) 

B) 

C) 

D) 

302. Two eggs, A and B, each with a mass of 0.1kg, are dropped for the same distance. If egg A is brought to a rest by the floor in 0.5 seconds and egg B is brought to a rest by a cushion in 1 second, Egg A experiences

Skill 20

A) a greater change in momentum
B) a greater impulse
C) a greater net force
D) a smaller impulse

303. If the Earth were twice as massive as it is now, then the gravitational force between it and the Sun would be

Skill 26

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

304. The gravitational force of attraction between two objects would be increased by

Skill 26

A) doubling the mass of both objects, only
B) doubling the distance between the objects, only
C) doubling the mass of both objects and doubling the distance between the objects
D) doubling the mass of one object and doubling the distance between the objects

305. Two objects of equal mass are a fixed distance apart. If the mass of each object could be tripled, the gravitational force between the objects would

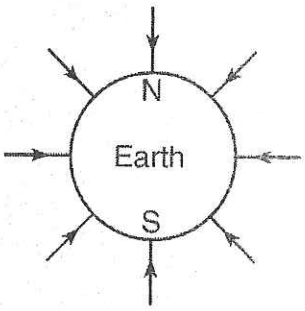
Skill26

A) decrease by one-third
B) triple
C) decrease by one-ninth
D) increase 9 times

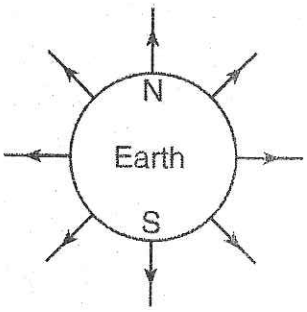
306. In which diagram do the field lines best represent the gravitational field around Earth?

Skill26

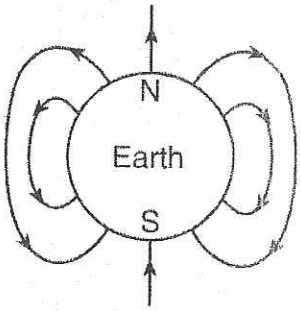
A)



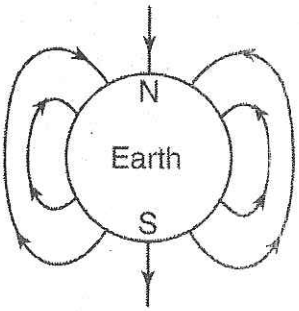
B)



C)



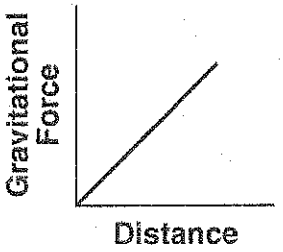
D)



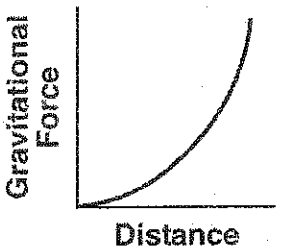
307. Which graph represents the relationship between the magnitude of the gravitational force exerted by Earth on a spacecraft and the distance between the center of the spacecraft and center of Earth? [Assume constant mass for the spacecraft.]

Skill 26

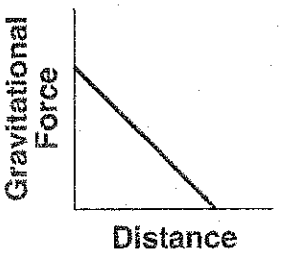
A)



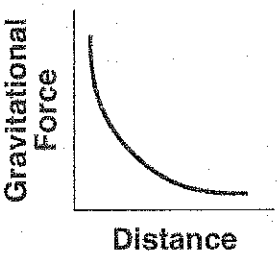
B)



C)



D)



308. Net Force can be defined as

Skill 20

A) the rate of change in position
B) the rate of change in acceleration
C) the rate of change in momentum
D) the rate of change in velocity

Unit 3 Practice Test - 3 pt questions

309. What is the speed of a 1.5×10^3-kilogram car that has a momentum of 3.0×10^5 kilogram • meters per second east?

Skill 20

A) 5.0×10^{-3} m/s B) 2.0×10^2 m/s
C) 4.5×10^8 m/s D) 2.0×10^7 m/s

310. A 20kg object accelerates down a frictionless ramp at 7 m/s^2. What is the approximate angle of the ramp?

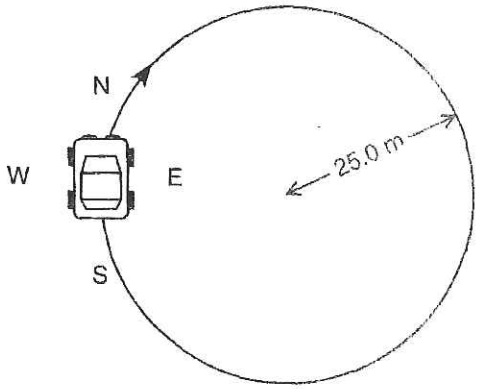
Skill 22

A) 45 degrees B) 2.9 degrees
C) 30 degrees D) 20.5 degrees

311. 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 10.00 meters per second.

Skill 23 & 26



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) 4.00×10^2 N D) 4.00×10^3 N

312. A mass of 50 kg is lifted vertically from rest to a velocity of 1 m/s over a time of 0.2 seconds. What is the upward force applied to the cause the acceleration?

Skill 22

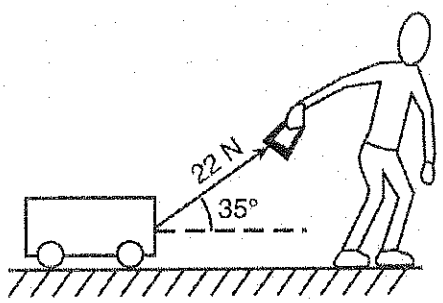
A) 250N B) 200N
C) 740N D) 10N

313. A 20-kilogram cart traveling east with a speed of 6 meters per second collides with a 30-kilogram cart traveling west. If both carts come to rest immediately after the collision, what was the speed of the westbound cart before the collision?

Skill 27

A) 6 m/s B) 2 m/s
C) 3 m/s D) 4 m/s

314. A child pulls a wagon at a constant velocity along a level sidewalk. The child does this by applying a 22-newton force to the wagon handle, which is inclined at 35° to the sidewalk as shown below.



Level sidewalk

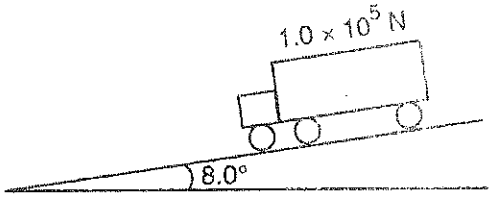
What is the magnitude of the force of friction on the wagon?

Skill 21 & 22

A) 11 N B) 13 N
C) 18 N D) 22 N

315. The diagram below shows a 1.0×10^5-newton truck at rest on a hill that makes an angle of 8.0° with the horizontal.

Skill 22 inclines



Horizontal

What is the component of the truck's weight parallel to the hill?

A) 1.4×10^3 N B) 1.0×10^4 N
C) 1.4×10^4 N D) 9.9×10^4 N

316. A 60 kg passenger traveling in a car experiences an average net force of 1600N when a car is brought to a quick stop in 1s. What would be the force experienced by the passenger if the amount of time to bring the car to rest were increased to 4s while all other factors remain constant?

Skill 20 2nd Law

A) 400N B) 6400 N
C) 28N D) 7N

317. A person kicks a 4.0-kilogram door with a 48-newton force causing the door to accelerate at 12 meters per seconds. What is the magnitude of the force exerted by the door on the person?

Skill 20

A) 48 N B) 24 N
C) 12 N D) 4.0 N

Unit 3 Practice Test - 3 pt questions

318. A force of 6.0 newtons changes the momentum of a moving object by 1.5 kilogram•meters per second. How long did the force act on the mass?

Skill 20

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

319. 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?

Skill 20

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

320. An apple weighing 1 Newton on the surface of Earth has a mass of approximately

Skill 22

A) 1×10^{-1} kg B) 1×10^0 kg
C) 1×10^1 kg D) 1×10^2 kg

321. A 60.-kilogram astronaut weighs 96 Newtons on the surface of the Moon. The acceleration due to gravity on the Moon is

Skill 22

A) 0.0 m/s^2 B) 1.6 m/s^2
C) 4.9 m/s^2 D) 9.8 m/s^2

322. A 50-kilogram woman wearing a seat belt is traveling in a car that is moving with a velocity of 10 meters per second. In an emergency, the car is brought to a stop in 0.5 second. What force does the seat belt exert on the woman so that she remains in her seat?

Skill 20

A) 1000N B) 500N
C) 50N D) 25N

323. A 200 kg crate is lifted by a crane. Determine the force of tension needed to accelerate the crate upward at 0.5m/s^2.

Skill 22 Vertical

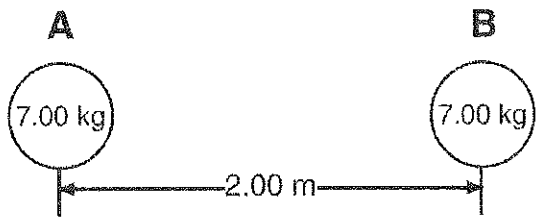
A) 2060N B) 100N
C) 1860N D) 1960N

324. A 1.5 kg ball is kicked into the air at an angle of 30 degrees. While the ball is in the air the magnitude of the net force acting on the ball is equal to

Skill 22

A) 7.4 N B) 0N
C) 1.5 N D) 14.7N

325. 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

326. Two bodies attract each other with a gravitational force of 10.0 Newtons. What will be the force of attraction if the mass of each body is doubled?

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

327. An astronaut weighs 8.00×10^2 newtons on the surface of Earth. What is the weight of the astronaut 6.37×10^6 meters above the surface of Earth?

A) 0.00 N B) 2.00×10^2N
C) 1.60×10^3 N D) 3.20×10^3 N

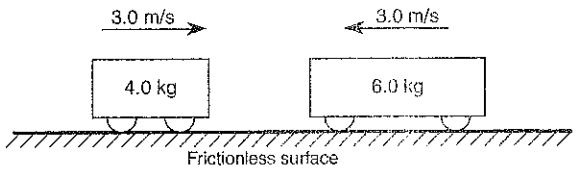
328. A 2.0-kilogram ball traveling north at 4.0 meters per second collides head on with a 1.0-kilogram ball traveling south at 8.0 meters per second. What is the magnitude of the total momentum of the two balls after collision?

A) 0 kg-m/s B) 8.0 kg-m/s
C) 16 kg-m/s D) 32 kg-m/s

329. A 3.1 kilogram gun initially at rest is free to move. When a 0.015-kilogram bullet leaves the gun with a speed of 500. meters per second, what is the speed of the gun?

A) 0.0 m/s B) 2.4 m/s
C) 7.5 m/s D) 500. m/s

330. The diagram below shows a 4.0-kilogram cart moving to the right and a 6.0-kilogram cart moving to the left on a horizontal frictionless surface.



When the two carts collide they lock together. The magnitude of the total momentum of the two-cart system after the collision is

A) 0.0 kg•m/s B) 6.0 kg•m/s
C) 15 kg•m/s D) 30. kg•m/s

331. A 5.0-newton force and a 7.0-newton force act concurrently on a point. As the angle between the forces is increased from 0° to 180°, the magnitude of the resultant of the two forces changes from

Skill 2.1

A) 0.0 N to 12.0 N B) 2.0 N to 12.0 N
C) 12.0 N to 2.0 N D) 12.0 N to 0.0 N

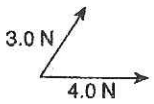
332. Which combination of three concurrent forces acting on a body could *not* produce equilibrium?

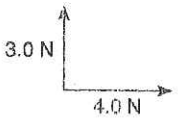
Skill 2.1

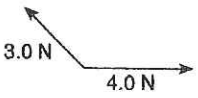
A) 1 N, 3 N, 5 N B) 2 N, 2 N, 2 N
C) 3 N, 4 N, 5 N D) 4 N, 4 N, 5 N

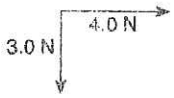
333. A 3.0-newton force and a 4.0-newton force act concurrently on a point. In which diagram below would the orientation of these forces produce the greatest net force on the point?

Skill 2.1

A) 

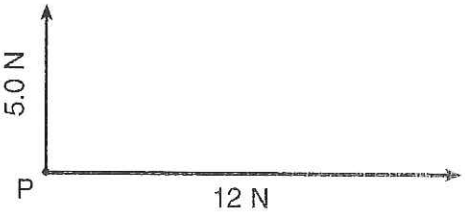
B) 

C) 

D) 

334. The diagram below represents a 5.0-newton force and a 12-newton force acting on point P.

Skill 2.1



The resultant of the two forces has a magnitude of

A) 5.0 N B) 7.0 N
C) 12 N D) 13 N