FINAL REVIEW: MULTIPLE CHOICE

1. What is the magnitude of the velocity after 1.5 seconds of a ball thrown upward from a height of 5m at 40m/s?
   a. 15m/s **b.** 20m/s **c.** 25m/s **d.** 30m/s **e.** 35m/s

2. An object released from rest at time t=0 slides down a frictionless incline a distance of 1 meter during the first second. The distance traveled by the object during the time interval from t=1s to t=2s is…
   a. 1m **b.** 2m **c.** 3m **d.** 4m **e.** 5m

3. An object is thrown with a horizontal velocity of 20m/s from a cliff that is 125m above ground level. If air resistance is negligible, the time that it takes the object to fall to the ground from the cliff is most nearly…
   a. 3s **b.** 5s **c.** 6s **d.** 12s **e.** 25s

4. The rate of change of velocity is the…
   a. displacement
   b. velocity
   c. derivative of position
   d. acceleration
   e. integral of acceleration

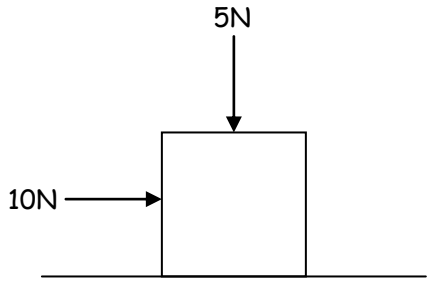
5. A child has a toy tied to the end of a string and whirls the toy above his head at a constant speed in a horizontal circular path of radius R. The toy completes each revolution of its motion in a time period T. What is the magnitude of the acceleration of the toy?
   a. Zero **b.** $\frac{4\pi^2 R}{T^2}$ **c.** $\frac{\pi R}{T^2}$ **d.** g **e.** $2\pi g$

6. Three balls are projected from the edge of a cliff. Ball I is fired horizontally, ball II is fired at an angle of 30° above the horizontal with the same speed as ball I, and ball III is released from rest. Which one of the following is true?
   a. I and II hit at the same time, and III hits later.
   b. I and II hit at the same time, and III hits earlier.
   c. I and III hit at the same time, and II hits later.
   d. I and III hit at the same time, and II hits earlier.
   e. All three balls hit at the same time.

7. A rope of negligible mass supports a block that weighs 30N. The breaking strength of the rope is 50N. The largest acceleration that can be given to the block by pulling up on it with the rope without breaking the rope is most nearly...

a. $6m/s^2$ **b.** $6.7m/s^2$ **c.** $10m/s^2$ **d.** $15m/s^2$ **e.** $16.7m/s^2$

8. A 2kg block slides with constant velocity along a horizontal tabletop. A horizontal applied force of 10N and a downward applied force of 5N act on the block, as shown. The coefficient of friction between the block and tabletop is most nearly...



a. 0.3 **b.** 0.4 **c.** 0.5 **d.** 0.75 **e.** 1

9. Three forces act on an object. If the object is in translational equilibrium, which of the following must be true?

I. The vector sum of the three forces must equal zero.
II. The magnitudes of the three forces must all be equal.
III. All three forces must be parallel.

a. I only
b. II only
c. I and III only
d. II and III only
e. I, II, and III

10. A solid metal ball and a hollow plastic ball of the same external radius are released from rest in a large vacuum chamber. When each has fallen 1m, they both have the same…

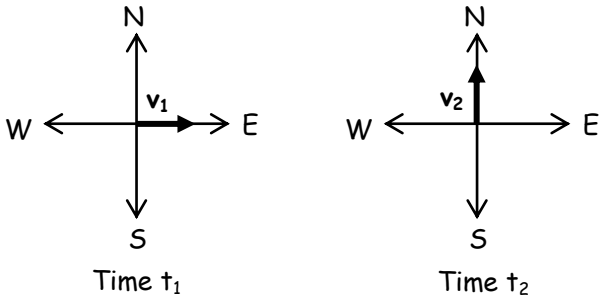
a. inertia
b. momentum
c. change in potential energy
d. speed
e. kinetic energy

11. A 2kg object's velocity is initially $(4\hat{i})m/s$ and its final velocity is $(3\hat{j})m/s$. What is the object's change in momentum, in unit-vector notation?

a. $(8\hat{i} - 6\hat{j})kgm/s$
b. $(8\hat{i} + 6\hat{j})kgm/s$
c. $(-8\hat{i} + 6\hat{j})kgm/s$
d. $(10\hat{i})kgm/s$
e. $(10\hat{j})kgm/s$

12. Vectors $\mathbf{v_1}$ and $\mathbf{v_2}$ shown below have equal magnitudes. The vectors represent the velocities of an object at times t_1 and t_2, respectively. The average acceleration of the object between time t_1 and t_2 was…

a. zero.
b. directed north.
c. directed west.
d. directed north of east.
e. directed north of west.



13. A particle moves along the x-axis with a non-constant acceleration described by $a=12t$, where a is in m/s^2. If the particle starts from rest so that its speed v and position x are zero when t=0, where is it located when t=2 seconds?

a. x=12m **b.** x=16m **c.** x=24m **d.** x=32m **e.** x=48m

14. An object is thrown straight upward. Which of the following are the correct signs of the velocity and acceleration vectors at the moment the object is at its highest point?

	Velocity	Acceleration
a.	+	-
b.	+	0
c.	-	0
d.	0	-
e.	0	0

15. A particle moves in the xy plane with a constant velocity of $-5\hat{i} + 3\hat{j}$. Which one of the following is closest to the angle at which the particle is moving, relative to the positive x-axis?

a. 30° **b.** 120° **c.** 150° **d.** 300° **e.** 330°

16. A force given by $\vec{F}=(3N)\hat{i}+(4N)\hat{j}$ acts on an object as it moves with a velocity of $(2m/s)\hat{j}$. What is the power generated by this force?

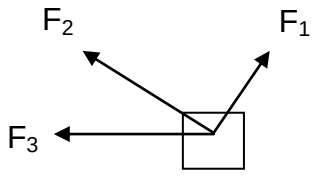
a. 5W **b.** 6W **c.** 8W **d.** 10W **e.** 14W

17. A rock is thrown upward at an angle from ground level with an initial kinetic energy of 100J. By the time the rock has reached its highest point, its potential energy has increased by 60J, while air resistance has converted 10J of energy into heat. How much kinetic energy does the rock have when it has reached its highest point?

a. 0 J **b.** 30J **c.** 50J **d.** 150J **e.** 170J

18. The object in the diagram is moving directly to the right, under the influence of all of the forces shown. Which force (or forces) is doing positive work on the object during its motion?

a. F_1 only
b. F_2 only
c. Both F_1 and F_2
d. Both F_1 and F_3
e. All three forces do positive work.



19. According to the work-kinetic energy theorem, what must be true about an object if the net work done on it during some time interval is equal to zero?

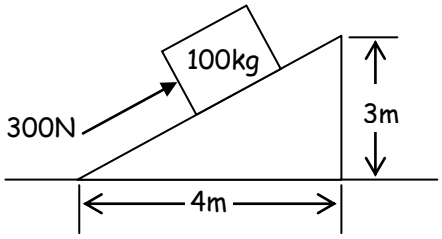
a. The object is sitting still.
b. The object is not accelerating.
c. The object is slowing down.
d. The object is speeding up.

20. A weight lifter lifts a mass *m* at constant speed to a height *h* in time *t*. How much work is done by the weight lifter?

a. *mg*
b. *mh*
c. *mgh*
d. *mght*
e. *mgh/t*

21. A constant force of 300N pushes a 100kg mass up the inclined plane shown in the diagram at a constant speed of 4m/s. The work done by the 300N force in pushing the mass from the bottom of the incline all the way to the top of the incline is most nearly…

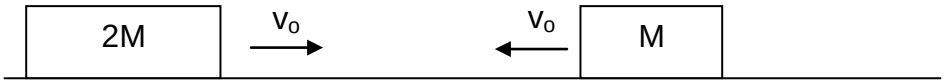
a. 0J
b. 900J
c. 1000J
d. 1500J
e. 3000J



22. A child pushes horizontally on a box of mass m which moves with constant speed v across a horizontal floor. The coefficient of kinetic friction between the box and floor is μ. At what rate does the child do work on the box?

a. μmgv **b.** $\frac{\mu mg}{v}$ **c.** mgv **d.** μmv^2 **e.** $\frac{v}{\mu mg}$

23. The two blocks of masses M and 2M shown above initially travel at the same speed v_o but in opposite directions. They collide and stick together. What is their velocity after the collision?



a. zero

b. $\frac{1}{3}v_o$ to the right

c. $\frac{1}{3}v_o$ to the left

d. v_o to the right

e. v_o to the left

24. A 3kg ball approaches a wall at a speed of 20m/s. It then bounces off of the wall in the opposite direction at the same speed. What is the magnitude of the average force exerted on the ball if it is in contact with the wall for 0.1s?

a. 0N **b.** 40N **c.** 60N **d.** 600N **e.** 1200N

25. A new planet is discovered that has twice the Earth's mass and twice the Earth's radius. On the surface of this new planet, a person who weighs 500N on Earth would experience a gravitational force of…

a. 125N **b.** 250N **c.** 500N **d.** 1000N **e.** 2000N

26. What is the orbital speed of a satellite of mass m orbiting the earth at a distance r from the center of the Earth? (Assume that G stands for the gravitational constant and M stands for the Earth's mass.)

a. $\frac{GM}{r}$ **b.** $\sqrt{\frac{2GM}{r}}$ **c.** $\frac{2Gm}{r}$ **d.** $\sqrt{\frac{2Gm}{r}}$ **e.** $\sqrt{\frac{GM}{r}}$

27. Which one of the following would be the correct value for the escape speed for a 2kg object from a 20,000kg asteroid of radius 100m? (All answers are in meters per second.)

a. $20G$ **b.** $400G$ **c.** $2\sqrt{G}$ **d.** $20\sqrt{G}$ **e.** $\sqrt{50G}$

28. A 5kg ball approaches a wall at a speed of 4m/s. It then bounces off of the wall in the opposite direction at the same speed. What is the magnitude of the average force exerted on the ball if it is in contact with the wall for 0.1s?

a. 0N **b.** 100N **c.** 200N **d.** 400N **e.** 500N

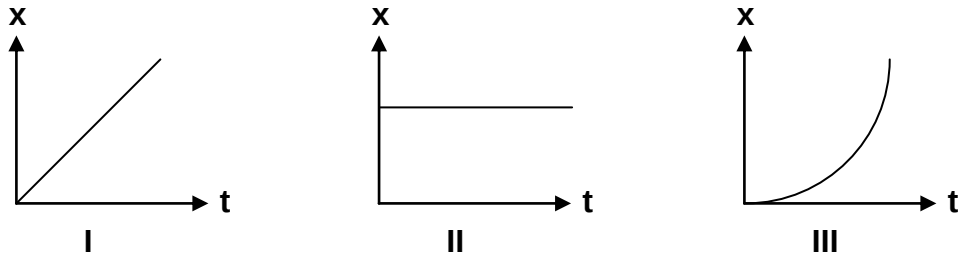
29. A certain object moving in a straight line accelerates at a rate of $4m/s^2$ for 3s. What is the object's final speed, if it was initially moving at 10m/s?

a. 4m/s **b.** 12m/s **c.** 14m/s **d.** 22m/s **e.** 24m/s

30. A physics teacher explains to his class why an egg dropped on a pillow doesn't break, though an egg dropped from the same height onto a hard floor does break. In his explanation, which of the following ideas is the most helpful?

a. conservation of momentum
b. impulse and momentum
c. conservation of energy
d. power
e. work done by non-conservative forces

31. Three objects can only move along a straight, level path. The graphs below show the position **x** of the objects plotted as a function of time **t**. The object's velocity is changing in which of the cases?



a. I only
b. III only
c. I and II only
d. I and III only
e. I, II, and III

32. In a traditional coordinate system, if an object in one-dimensional motion is slowing down while moving to the left, it is said to have _____ acceleration and _____ velocity.

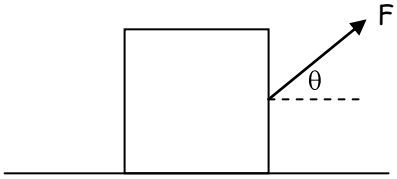
a. positive, positive
b. negative, positive
c. positive, negative
d. negative, negative
e. zero, negative

33. Two objects of weights W and 2W are connected by a lightweight cord that hangs over a frictionless pulley. The objects are hung freely from the pulley, and released from rest. How does the tension (F_T) in the cord compare to the weight of each object?

a. $W < F_T = 2W$
b. $W < F_T < 2W$
c. $W = F_T = 2W$
d. $W = F_T < 2W$
e. $W > F_T > 2W$

34. An object is pulled across a horizontal surface by a force F at an angle θ above the horizontal. If F is increased slightly, then the normal force _____. If θ is increased slightly, then the normal force _____.

a. increases, increases
b. increases, decreases
c. increases, remains constant
d. decreases, decreases
e. decreases, increases



35. An object of mass M is released to slide down a frictionless plane that is inclined at an angle θ. Which one of the following is the rate at which the object accelerates?

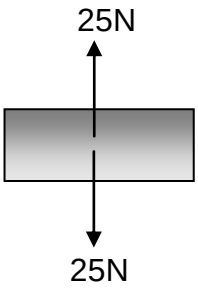
a. $Mg\cos\theta$
b. $Mg\sin\theta$
c. $g\sin\theta$
d. $g\cos\theta$
e. $g\tan\theta$

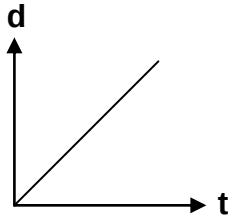
36. Which of the following objects is in equilibrium?

I. A free-fall object at its maximum height.
II. An object moving in a circular path at a constant speed.
III. An object at rest on a tabletop.

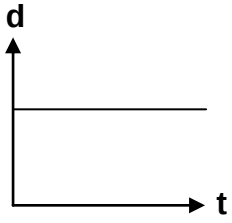
a. I only
b. II only
c. III only
d. I and III only
e. I, II, and III

37. Which one of the graphs shown below could be a distance-time graph corresponding to the object shown in the diagram to the right, with no forces acting on it than the two vertical forces that are shown?

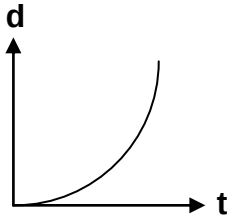




Graph 1



Graph 2



Graph 3

a. Graph 1 only
b. Graph 2 only
c. Graph 3 only
d. Graphs 1 and 2
e. All 3 graphs

38. Vector **A** = $3\hat{i} - 3\hat{j}$ and vector **B** = $9\hat{i} + 5\hat{j}$. The magnitude of **B** − **A** is closest to which of the following?

a. 8 units **c.** 12 units **e.** 16 units
b. 10 units **d.** 14 units

39. A ball is dropped from a height of 45m. The amount of time required for the ball to strike the ground is closest to which of the following?

a. 2 seconds **c.** 5 seconds **e.** 15 seconds
b. 3 seconds **d.** 9 seconds

40. At the highest point of its trajectory, a projectile fired at 30° above the horizontal from a starting height of 20m...

a. is instantaneously at rest.
b. has traveled half the distance to its impact point.
c. has 0 acceleration.
d. has a horizontal velocity component equal to its initial value.
e. has more than one of the above properties.

41. A particle moving with counterclockwise uniform circular motion has a velocity of $4\hat{i} + 3\hat{j}$ at time t_1=2s, and then has a velocity of $-3\hat{i} + 4\hat{j}$ at time t_2=5s. Assuming that the particle has completed less than a complete revolution between t_1 and t_2, what is the period of motion of the particle?

a. 3s **b.** 4s **c.** 6s **d.** 12s **e.** 15s

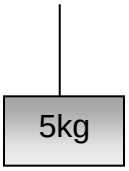
42. A particle moves along the x-axis with position described by the following function: $x(t) = 5t^2 - 4t^3$. The particle's speed at time t=2 seconds is closest to which one of the following?

a. 38m/s **b.** 28m/s **c.** 12m/s **d.** 3m/s **e.** 0m/s

43. The drag force acting on an object falling through the air does not depend at all on which one of the following?

a. mass of the object
b. density of the air
c. shape of the object
d. speed of the object
e. size of the object

44. The 5kg block shown in the diagram is supported by a rope of negligible mass. What tension force in the rope would be necessary to give the block an upward acceleration of $2m/s^2$?

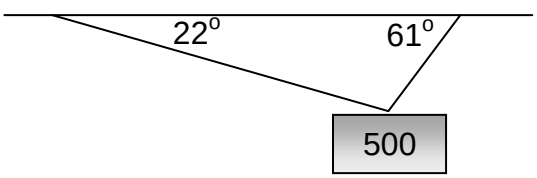


a. 2N **b.** 10N **c.** 15N **d.** 50N **e.** 60N

45. A 3kg mass moving at 6m/s is brought to rest in 2 seconds. The magnitude of the net force acting on the mass is closest to which of the following?

a. 6N **b.** 9N **c.** 12N **d.** 18N **e.** 36N

46. An AP Physics student is working a problem wherein a 500N block is suspended in equilibrium from two cords, as shown in the diagram. The tension in the right cord is 400N. Which one of the following is a <u>correct</u> equation that will help the student solve to find the tension F_T in the left cord?



a. $F_T + 400\sin 61^\circ = 500$

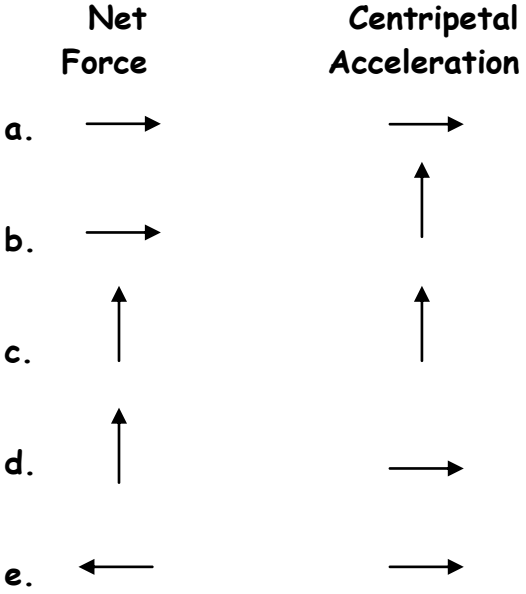
b. $F_T + 400\cos 61^\circ = 500$

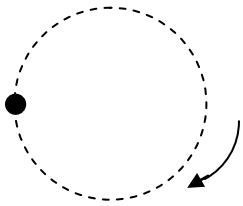
c. $F_T\cos 22^\circ = 400\cos 61^\circ$

d. $F_T\sin 22^\circ = 400\sin 61^\circ$

e. $F_T\cos 22^\circ + 400\sin 61^\circ = 500$

47. An object is shown moving clockwise around a circular horizontal path. What are the directions of the object's net force vector and centripetal acceleration vector at the moment the object is in the location indicated?





48. The force acting on a 5kg mass over a 2 second interval is given by $F(t)=3t^2$. Calculate the total impulse acting on the object over the 2 second interval.

a. 1.6Ns **b.** 8Ns **c.** 12Ns **d.** 40Ns **e.** 60Ns

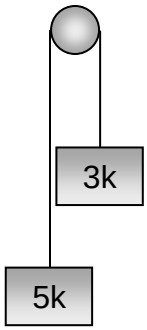
49. Two objects, A and B, initially at rest, are "exploded" apart by the release of a coiled spring that was compressed between them. As they move apart, the velocity of object A is 5m/s and the velocity of object B is -2m/s. The ratio of the mass of A to the mass of M, m_A/m_B, is…

a. 4/25 **b.** 2/5 **c.** 1/1 **d.** 5/2 **e.** 25/4

50. If one knows only the constant resultant force acting on an object and the time during which this force acts, one can determine the…

a. change in momentum of the object.
b. change in velocity of the object.
c. change in kinetic energy of the object.
d. mass of the object.
e. acceleration of the object.

51. The frictionless pulley system shown in the diagram is released from rest. Which one of the following is closest to the acceleration of the 3kg block?



a. 2.5 m/s^2
b. 4 m/s^2
c. 6.25 m/s^2
d. 6.5 m/s^2
e. 10 m/s^2

52. An object of mass M is sliding down a ramp of inclined at an angle θ from the horizontal. What must be the coefficient of kinetic friction between the block and incline, if the block is sliding down the incline at a constant speed?

a. $Mg\sin\theta$
b. $Mg\dfrac{\cos\theta}{\sin\theta}$
c. $Mg\dfrac{\sin\theta}{\cos\theta}$
d. $\dfrac{\sin\theta}{\cos\theta}$
e. $\dfrac{\cos\theta}{\sin\theta}$

53. A mass is attached to an ideal spring on a smooth horizontal surface. It is displaced an amount A from equilibrium, and then released. Which of the following is true?

I. Kinetic energy is largest when the mass passes through equilibrium.
II. Potential energy is largest when the mass is at ±A.
III. The total energy is largest when the mass at equilibrium.

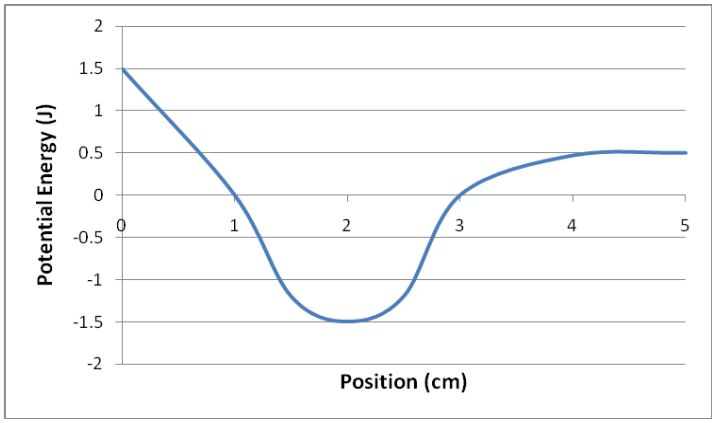
a. I only **b.** II only **c.** III only **d.** I and II only **e.** I and III only

54. A rock of mass m is thrown horizontally off a building from a height h_o. The speed of the rock as it leaves the thrower's hand at the edge of the building is v_o. Disregarding air resistance, what is the kinetic energy of the rock just before it hits the ground?

a. mgh_o
b. $\frac{1}{2}mv_o^2$
c. $mgh_o - \frac{1}{2}mv_o^2$
d. $\frac{1}{2}mv_o^2 - mgh_o$
e. $\frac{1}{2}mv_o^2 + mgh_o$

55. A conservative force has the potential energy function U(x), shown by the given graph. A particle moving along the x-axis has kinetic energy equal to 1.0J when it is at position x=2cm. Which of the following is a correct statement about the motion of the particle?

a. It oscillates between x=1cm and 3cm.
b. It moves to the right of x=4cm and does not return.
c. It moves to the left of x=1cm and does not return.
d. It comes to rest at x=1cm and 3cm.
e. It cannot reach either x=1cm or 3cm.

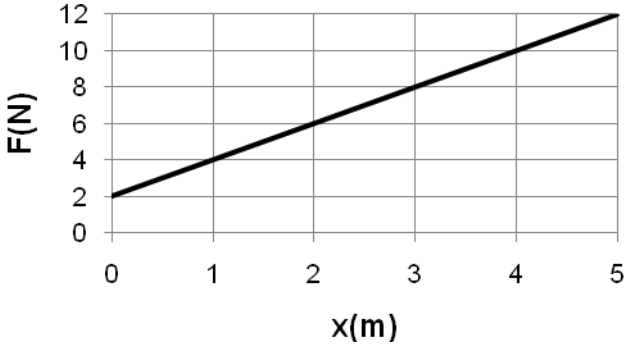


56. An object of mass *m* is accelerated from rest to a speed *v* over the course of a time interval *t*. At what rate is work done on this object during this time interval?

a. mv
b. $\frac{1}{2}mv$
c. $\frac{1}{2}mv^2$
d. $\frac{\frac{1}{2}mv^2}{t}$
e. $\frac{mv}{t}$

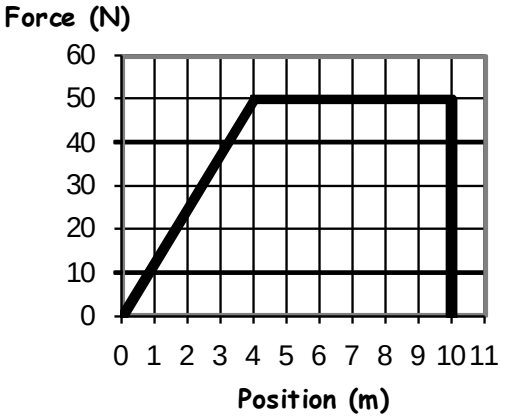
57. A force acts on an object according to the graph shown below. Calculate the magnitude of the work done during the interval from 0 to 5 seconds.

a. 1J
b. 2J
c. 17.5J
d. 30J
e. 35J



58. The only force acting on an 8kg object varies as shown in the given graph. Determine the work done by this force to move the object from x=0m to x=10m.

a. zero
b. 50J
c. 300J
d. 400J
e. 500J

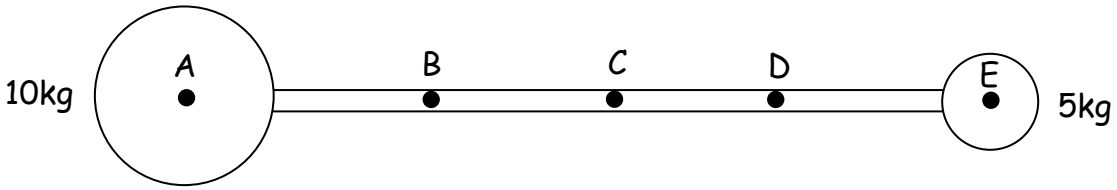


59. Assuming it started from rest at position 0m, the speed of the 8kg object in problem #8 at the end of the 10m displacement is closest to which one of the following?

a. zero **b.** 2m/s **c.** 5m/s **d.** 7.1m/s **e.** 10m/s

60. An object of mass M is moving to the right at a speed v when it explodes into two parts of equal size. How quickly is the center of mass of the 2-object system moving after the collision?

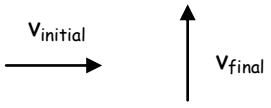
a. It is moving faster than speed v.
b. It is moving slower than speed v.
c. It is still moving at speed v.
d. This answer depends on the precise value of the speed v.
e. This answer depends on the precise value of the mass M.



61. A 5kg sphere is connected to a 10kg sphere by a rigid rod of negligible mass, as shown in the above diagram. Which of the five lettered points best represents the center of mass of the sphere-rod combination?

a. A **b.** B **c.** C **d.** D **e.** E

62. An object has some initial velocity, and then has a different final velocity after being acted on by an impulse. If the initial and final velocity vectors are as shown to the right, what is the direction of the impulse that acts on the object?



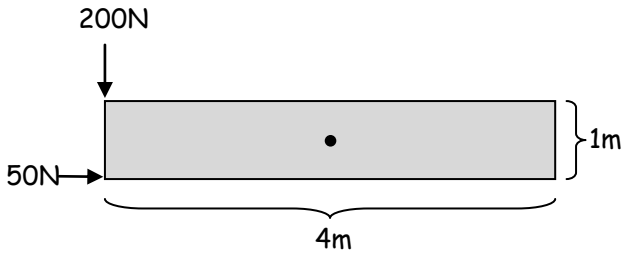
a.  **b.**  **c.**  **d.**  **e.** 

63. Two particles of different masses are located at positions on an xy plane as indicated in the given table. What is the x-coordinate of the center of mass of the two-particle system?

	Particle 1	Particle 2
Mass (kg)	2	8
Position (cm, cm)	(0, 0)	(2, 5)

a. 0.2 cm
b. 1 cm
c. 1.2 cm
d. 1.6 cm
e. 2 cm

64. Calculate the net torque acting on the 5kg object, about an axis perpendicular to the page passing through its center.



a. 200Nm
b. 300Nm
c. 350Nm
d. 375Nm
e. 425Nm

65. A 5m-radius disk starts from rest at t=0s and begins to rotate about its central axis with a rotational acceleration of 5rad/s^2. How many radians has it passed through by the time t=4s?

a. 10 **b.** 20 **c.** 40 **d.** 80 **e.** 160

66. For the situation described in #2, what is the linear velocity, in meters per second, of a point on the disk's edge at time t=4s?

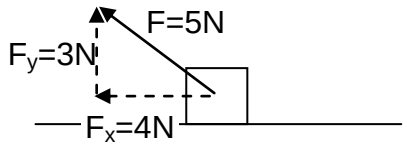
a. 4 **b.** 20 **c.** 25 **d.** 50 **e.** 100

67. A circular hoop of mass M and radius R rolls down an incline without slipping, from an initial height H. Its translational kinetic energy at the bottom of the incline is which one of the following?

a. MgH
b. greater than MgH
c. less than MgH
d. $\frac{1}{2}MR^2$
e. $\frac{1}{4}MR^2$

68. A 10kg block is sliding to the right across a horizontal frictionless surface when a 5N force begins acting as shown in the diagram. (The force's x- and y-components are shown in the diagram as well.) What is the work done by the 5N force as the block slides 3 meters to the right?

a. +12J
b. -12J
c. +15J
d. -15J
e. +30J



69. A block on a horizontal frictionless plane is attached to a horizontal spring, and is then displaced a distance A from equilibrium and released from rest. Which one of the following statements about the block-spring system is correct?

a. The potential energy of the spring is at a minimum at equilibrium.
b. The potential energy of the spring is at a minimum at x=A.
c. The kinetic energy of the block is at a minimum at x=0.
d. The kinetic energy of the block is at a maximum at x=A.
e. The kinetic energy of the block is always equal to the potential energy of the spring.

70. An object starts at position x=0 with zero potential energy, and moves along the x-axis under the influence of a conservative force $\vec{F}$. If the force (in Newtons) is given by $\vec{F}=2x^3$, what is the magnitude of the potential energy of the object when it is at a location of 2 meters?

a. 32J **b.** 24J **c.** 16J **d.** 8J **e.** 4J

71. Two 1kg masses are in distant outer space at a distance of 1m apart from each other. How much work must you do to move them to a distance of 2m apart?

a. G **b.** $\frac{G}{2}$ **c.** $\frac{G}{4}$ **d.** $2G$ **e.** $4G$

72. A 10kg mass is attached to a string of length 40m, and hung down from a rooftop to make a long pendulum. If the pendulum is set into simple harmonic motion, what is its period of vibration?

a. $\pi/2$ seconds
b. π seconds
c. 2π seconds
d. 4π seconds
e. 8π seconds

73. A mass attached to a spring is vibrating with simple harmonic motion according to the following equation: $x = (0.4)\cos(8\pi t)$
Assuming all quantities are measured in S.I. units, what is the period of vibration of the mass?

a. 0.25s **b.** 0.4s **c.** 2s **d.** 4s **e.** 8s

74. A simple pendulum and a mass hanging on a spring both have a period of 1s when set into small oscillatory motion on Earth. They are taken to Planet X, which has the same diameter as Earth but twice the mass. Which of the following statements is true about the periods of the two objects on Planet X compared to their periods on Earth?

a. Both are shorter.
b. Both are the same.
c. Both are longer.
d. The period of the mass on the spring is shorter; the pendulum's is the same.
e. The period of the pendulum is shorter; the mass's is the same.

75. Three equal masses are connected at equal distances along a rod of length 3L and negligible mass. What is the moment of inertia about the left end of the rod?

a. $3mL^2$ **b.** $9mL^2$ **c.** $14mL^2$ **d.** $17mL^2$ **e.** $27mL^2$

76. Which of the following objects is in static equilibrium?

Object 1: A uniform teeter-totter with its fulcrum in its center, with equally-weighted children at its far ends.
Object 2: A merry-go-round slowing down under the action of friction.
Object 3: A kickball that was initially kicked directly upward, now stopped momentarily at the highest point of its trajectory.

a. Object 1 only
b. Object 2 only
c. Object 3 only
d. Objects 1 and 3
e. Objects 1, 2, and 3

77. The rotational acceleration of an object as a function of time is given by $3t^2$. Calculate the rotational speed, in rad/s, of the object at time t=4 seconds.

a. 12 **b.** 24 **c.** 40 **d.** 48 **e.** 64

78. A 1kg hoop of radius 2m is rotating about its center with an angular speed of 3rad/s. What is the rotational kinetic energy of the hoop?

a. 4J **b.** 6J **c.** 12J **d.** 18J **e.** 20J

79. A disk of rotational inertia I is rotating about its central axis at an angular speed ω when a non-rotating disk of inertia 2I is dropped down to stick on top of the first disk and rotate with it. What is the angular speed of the 2-disk combination?

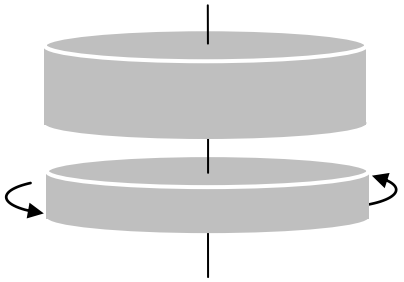
a. $\frac{1}{3}\omega$

b. $\frac{1}{2}\omega$

c. ω

d. 2ω

e. 3ω



80. An object of mass m is released from rest at the top of the frictionless incline shown in the diagram. The speed of the object as it reaches the base of the incline is equal to which of the following?

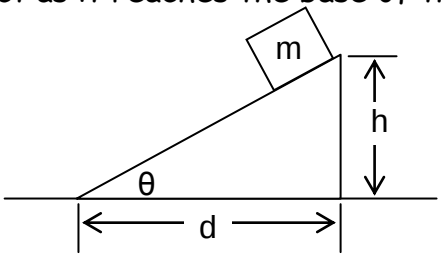
a. $\sqrt{2gh}$

b. $\sqrt{gh}$

c. $2\sqrt{gh}$

d. $\sqrt{\frac{1}{2}gh}$

e. $2\sqrt{mgh}$



81. A railroad car of mass m, moving at a speed v, collides with a second railroad car of mass M which is at rest. The two cars lock together and move along the track. What is the speed of the cars immediately after the collision?

a. $\frac{v}{2}$ **b.** $\frac{(m+M)}{v}$ **c.** $\frac{mv}{M}$ **d.** $\frac{mv}{(m+M)}$ **e.** $\frac{Mv}{m}$

82. Which one of the following can be calculated if the only values known are the mass of an object and its change in velocity?

a. force

b. acceleration

c. impulse

d. time interval

e. potential energy