DO NOT OPEN THE EXAMINATION PAPER UNTIL YOU ARE TOLD BY THE SUPERVISOR TO BEGIN

Menihek High School

PHYSICS 2204
FINAL EXAMINATION
June 11, 2007
(12:30 - 3:30 pm)

Value: 100 marks **Time: 3 hours**

GENERAL INSTRUCTIONS

1. **This is a two-part test. All parts are contained in this exam. The examination consists of items arranged as follows:**

Part I	**–**	***50 multiple choice items – Do ALL items***	**–**	***50%***
Part II	**–**	***short answer items – Do ALL items***	**–**	***50%***

2. **Section I may be answered on the answer sheets. Instructions for completing this answer sheet are given on the sheet itself. Please complete it according to those instructions and any other, given by the supervisor. Suggested time: (50 minutes)**

3. **Sections II is to be answered on the paper provided. Some choice is given within questions. Answers are to be written out in complete sentences, and terminology appropriate to physics is to be used when explanations or descriptions are required. When mathematical solutions are required, complete solutions are to be given. Please pass in the entire test to the supervisor when you have finished the examination. Suggested time: (1 hour and 10 minutes)**
Do not staple part I and part II together.

4. **Rough work may be done in any blank spaces in this test booklet.**

REGULATIONS FOR CANDIDATES

Candidates are expected to be thoroughly familiar with all regulations pertaining to their conduct during the examinations. These were explained by the chief supervisor prior to the first session, and have been posted for further reference near the entrance to the examination room. Candidates should ensure that they understand and comply with all requirements governing the following matters:

– Materials required
– Materials not permitted
– Use of handheld calculator
– Use of pen or pencil
– Communication and movement during the examination
– Punctuality
– Leaving the room
– Use of answer booklets
– Completion of required information
– Use of unauthorized means, and penalties

Formulas and Constants

$$\vec{v} = \frac{\vec{d}}{t} \qquad \vec{a} = \frac{\vec{v}_2 - \vec{v}_1}{t} \qquad \vec{v}_{av} = \frac{\vec{v}_1 + \vec{v}2}{2}$$

$$\vec{d} = \vec{v}_1 t + \frac{1}{2}\vec{a}t^2 \qquad 2\vec{a}\vec{d} = \vec{v}_2{}^2 - \vec{v}_1{}^2 \qquad \vec{d} = \frac{\left(\vec{v}_1 + \vec{v}_2\right)}{2}t$$

$$\vec{d} = \vec{v}_2 t - \frac{1}{2}\vec{a}t^2 \qquad \vec{F}_g = mg \qquad \vec{F}_{Net} = m\vec{a}$$

$$F_f = \mu F_N \qquad \vec{p} = m\vec{v} \qquad \vec{F}_{Net}\Delta t = m\vec{v}_2 - m\vec{v}_1$$

$$F = \frac{Gm_1m_2}{d^2} \qquad E_g = mgh \qquad E_K = \frac{1}{2}mv^2$$

$$W = Fd\cos\theta \qquad P = \frac{W}{t} \qquad m_Av_A + m_Bv_B = m_Av_A{}' + m_Bv_B{}'$$

$$m_Av_A + m_Bv_B = (m_A + m_B)v'$$

$$Fd = \frac{1}{2}mv_2{}^2 - \frac{1}{2}mv_1{}^2$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Constants

$$G = 6.67 \times 10^{-11}\frac{Nm^2}{kg^2}$$

$$g = 9.8\,m/s^2$$

Section I

Total Value: 50%

Estimated time - 1 hour

Instructions: Circle the letter of the correct answer.

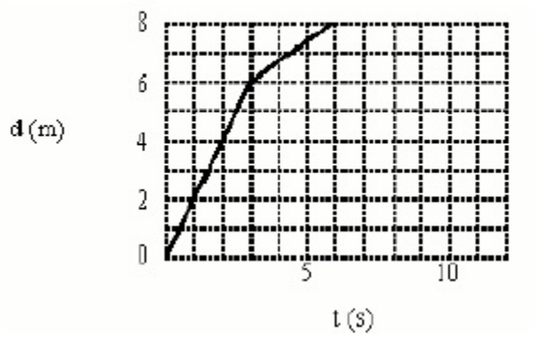
1. Which one of the following contains only vector quantities?
   A. acceleration, speed
   B. force, momentum
   C. mass, time
   D. time, momentum

2. An object travels a distance of 6.0 km with a uniform speed of 1.5×10^4 m/s. How long does it take?
   A. 4.0×10^{-1} s
   B. 2.5 s
   C. 4.0×10^{1} s
   D. 9.0×10^{7} s

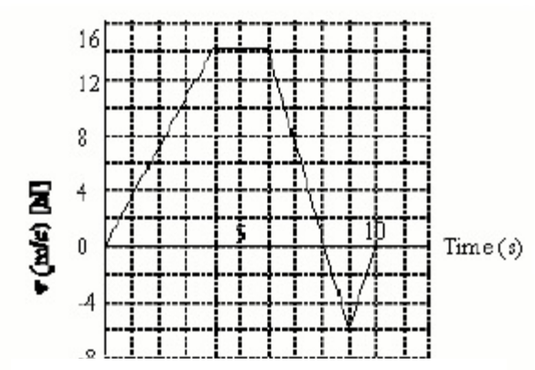
3. A person travels 100 km by car in a time of 2.0 hours and then 400 km/h by plane for 3.0 hours. What is their average speed?
   A. 1.0×10^{2} km/h
   B. 225 km/h
   C. 250 km/h
   D. 260 km/h

4. In the diagram , what is the average speed during the interval from t = 3.0 s to t = 6.0 s?

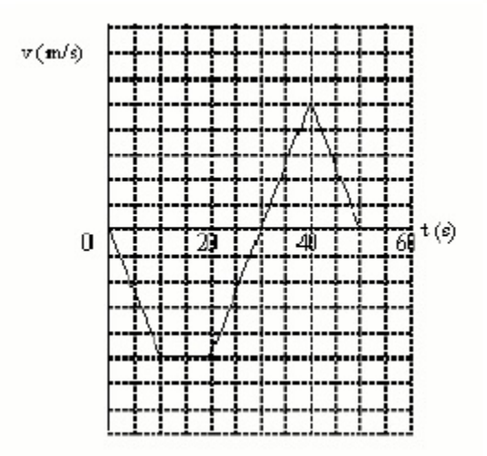
   A. 0.67 m/s
   B. 1.5 m/s
   C. 2.0 m/s
   D. 6.0 m/s



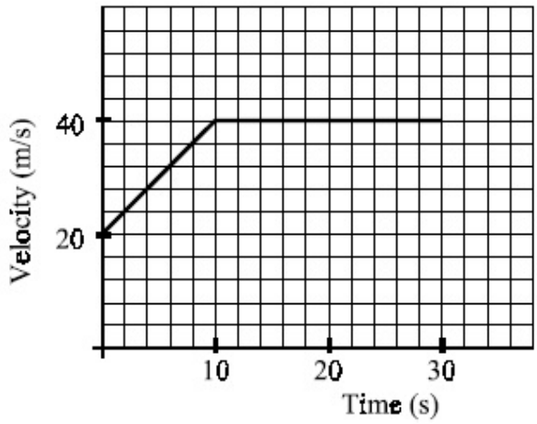
5. The graph shows the motion of a bicycle during a period of 10.0 s. What is the average acceleration from t = 6.0 s to t = 9.0 s ?
   A. -6.7 m/s^2
   B. -0.15 m/s^2
   C. 0.0 m/s^2
   D. 7.0 m/s^2



6. During which interval will the object be moving to the left and speeding up?
   A. 0 to 10 s
   B. 10 to 20 s
   C. 20 to 40 s
   D. 40 to 50 s

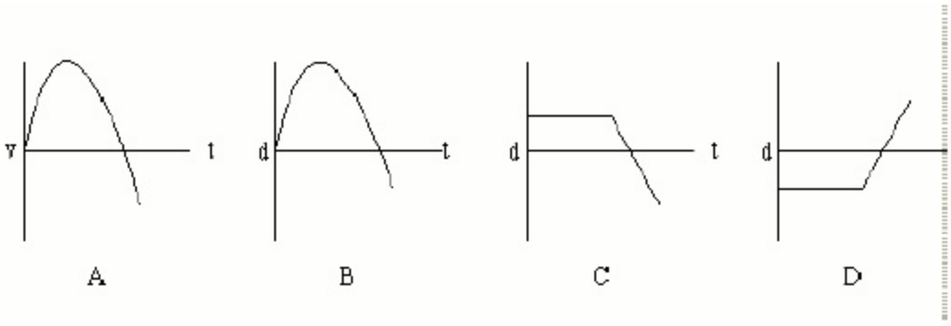


7. From the $\vec{v} - t$ graph on the right, what is the displacement traveled for the time interval 0 to 30.0 s?



A. 4.00×10^1 m
B. 5.00×10^2 m
C. 6.00×10^2 m
D. 1.10×10^3 m

8. Mr. Hunt is standing on a high tower and tosses a stone upward and allows it to fall onto ground below. Which graph would best describe the motion?



9. An 1800 kg car initially traveling at 15 m/s brakes to avoid hitting another car. The car accelerates at 1.92 m/s while braking to a stop. How far does the car travel during its acceleration?
A. 29 m
B. 59 m
C. 120 m
D. 180 m

10. A ball is thrown vertically upward at 2.0×10^1 m/s from a height of 3.0×10^1 m above the ground. What is its speed on impact with the ground below?
A. 14 m/s
B. 24 m/s
C. 31 m/s
D. 44 m/s

11. A 35 kg object released from rest near the surface of a planet falls 7.3 m in 1.5 s. What is the acceleration due to gravity on this planet?
A. 4.9 m/s^2
B. 6.5 m/s^2
C. 9.7 m/s^2
D. 170 m/s^2

12. An astronaut on the moon throws a 5.0 kg wrench vertically upwards with an initial speed of 15 m/s . The acceleration due to gravity on the surface of the moon is one-sixth that on the surface of the earth. What is the maximum height reached by the wrench?
A. 25 m
B. 46 m
C. 69 m
D. 75 m

13. What is the initial speed of a rock thrown straight down into water 5.20 m below, if it strikes the water 0.524 s after being thrown?

A. 2.40 m/s
B. 7.35 m/s
C. 12.1 m/s
D. 16.1 m/s

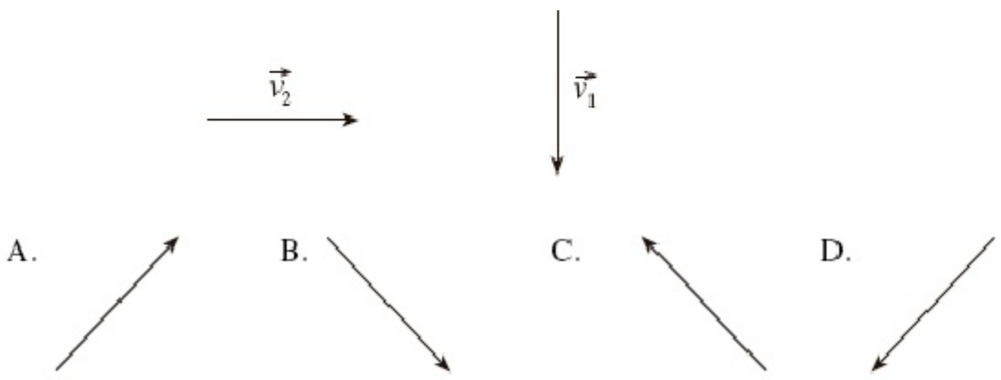
14. How long does it take a car to slow down from a speed of 54 km/h to 32 km/h over a distance of 65 m? Answer in seconds.

A. 1.5
B. 2.7
C. 5.4
D. 5.9

15. Three identical objects are thrown from the same height through a window at the same time. Object A is thrown horizontally at 4.0 m/s, object B is thrown horizontally at 8.0 m/s, and object C is simply dropped. If air resistance is negligible, which object will reach the ground first?

A. object A
B. object B
C. object C
D. all three will land at the same time

16. Consider the two vectors shown below. Which of the choices given best represents $v_2 + v_1$?



17. The train is travelling at 14 m/s [N]. A passenger on a train is walking is at 2 m/s [S]. Which of the following would be correct?

A. ${}_pV_e = 2$ m/s [N]
B. ${}_pV_e = 12$ m/s [N]
C. ${}_pV_e = 16$ m/s [N]
D. ${}_pV_e = 2$ m/s [S]

18. A boat is moving at 2.0 m/s southward in a river. If the current is flowing towards the west at 1.0 m/s, in what direction is the boat moving with respect to Earth?

A. Southwest
B. South
C. 30° South of West
D. 27° West of South

19. Truck X is traveling North at 50 km/h while directly behind it truck Y is traveling South at 30 km/h. What is the velocity of Y relative to X?

A. 20 km/h [N]
B. 80 km/h [N]
C. 20 km/h [S]
D. 80 km/h [S]

20. A taxi cab drives 2.0 km [W], then 3.0 km [N], then 4.0 km [W], and finally 5.0 km [N]. The entire trip takes 0.30 h. What is the taxi's average velocity?

A. 33 km/h [53˚ N of W]
B. 33 km/h [53˚ W of N]
C. 47 km/h [53˚ N of W]
D. 47 km/h [53˚ W of N]

21. A pilot wants to fly due north from the departure point. During the flight there is a wind blowing from the west. What direction must the pilot point the plane during the flight?

A. due east
B. due west
C. east of north
D. west of north

22. What is the minimum possible resultant when a pair of forces of magnitude 5 N and 4 N are added together in a variety of ways?

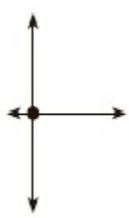
A. 0 N
B. 1 N
C. 5 N
D. 9 N

23 Which of the following fundamental forces is the strongest?

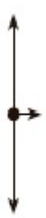
A. electrostatic
B. gravitational
C. strong nuclear
D. weak nuclear

24. A curling rock is travelling to the right across the ice as shown in the diagram.

Which of the following best represents the forces acting on the curling rock?

A. 

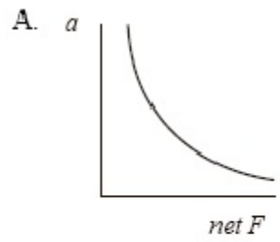
B. 

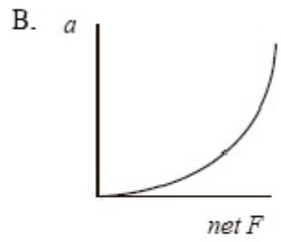
C. 

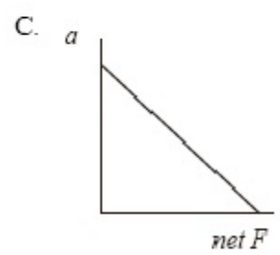
D. 

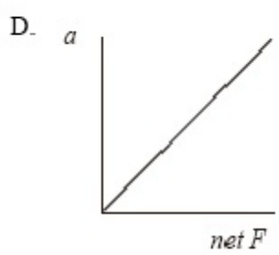
25. The units N/kg are used to represent which physical quantity?
A. electric field strength
B. gravitational field strength
C. gravitational force
D. net force

26. Which of the following graphs shows the relationship between acceleration and net force?

A. 

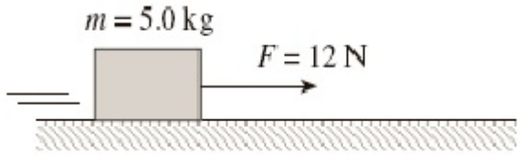
B. 

C. 

D. 

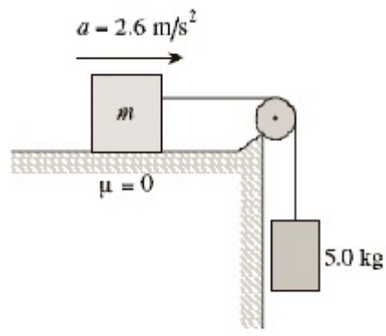
27. A large mass, *M*, collides with a stationary small mass, *m*. During the collision, the forces exerted on each mass are measured. Which of the following is correct about the magnitude of the forces?
A. Both masses exert equal forces on each other during the collision.
B. No force is exerted during the collision.
C. The large mass, *M*, exerts a greater force on the small mass, *m*.
D. The small mass, *m*, exerts a greater force on the large mass, *M*.

28. A 5.0 kg object is pulled at a constant speed by a horizontal 12 N force as shown in the diagram below.



What is the coefficient of friction between the object and the surface?
A. 0.24
B. 0.42
C. 1.0
D. 2.4

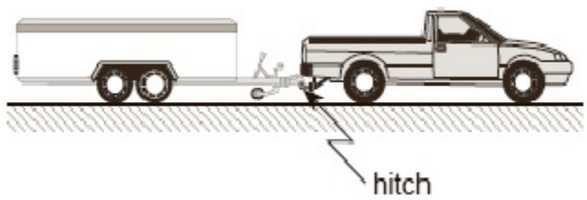
29. A block of mass *m* on a frictionless surface is attached to a hanging 5.0 kg mass as shown. The system accelerates at 2.6 m/s^2. What is the mass of the block?
A. 1.3 kg
B. 14 kg
C. 19 kg
D. 24 kg



30. A fisher suspends a fish on a newton spring scale in an elevator. When does the scale show the highest reading?

A. when the elevator moves downward with increasing speed
B. when the elevator moves upward with decreasing speed
C. when the elevator moves upward with increasing speed
D. when the elevator remains stationary

31. A 1200 kg trailer is accelerated from rest to 15 m/s in 5.0 s. The average force of friction acting on the trailer is 800 N.



What is the pulling force applied to the trailer through the hitch?
A. 800 N
B. 2800 N
C. 3600 N
D. 4400 N

32. A 2.0 kg mass is suspended by a spring scale from the ceiling of an elevator. If the spring scale reads 25 N, what is the acceleration of the elevator?
A. 2.7 m/s^2 upwards.
B. 2.7 m/s^2 downwards .
C. 13 m/s^2 upwards .
D. 13 m/s^2 downwards.

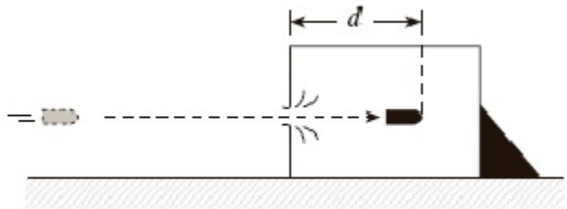
33. A 0.26 kg ball travelling due west at 22 m/s was hit by a bat and as a result the ball travelled due east at 18 m/s . If the bat remained in contact with the ball for 0.13 s, what average force did the bat exert on the ball?
A. 8.0 N
B. 80 N
C. 116 N
D. 310 N

34. Simon is sitting in a seat on a bus that is accelerating forward and drops his book on the floor. Where will the book hit the floor?

A. Behind the space directly under the book.
B. In the front of the space directly under his book.
C. In the space directly under the book.
D. None of the above.

35. A 0.40 kg ball rolls at 8.5 m/s towards a player. The player kicks the ball so that it then travels at 15.2 m/s in the opposite direction. What is the magnitude of the impulse that the ball sustained?
A. 1.3 Ns
B. 2.7 Ns
C. 4.7 Ns
D. 9.5 Ns

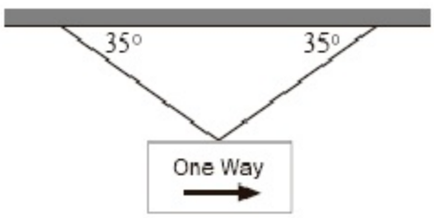
36. A 0.055 kg bullet was fired at 250 m/s into a block of wood as shown in the diagram below.



Assuming an average force of 9 500 N brings the bullet to rest in the wood, what distance, *d,* did the bullet penetrate the block?

A. 1.4×10^{-3} m
B. 1.4×10^{-2} m
C. 1.8×10^{-1} m
D. 3.6×10^{-1} m

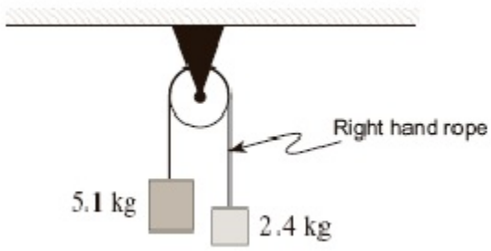
37. A traffic sign hangs from two cables as shown.



If the tension in each cable is 220 N, what is the weight of the sign?

A. 130 N
B. 250 N
C. 360 N
D. 440 N

38. A frictionless pulley is set up with two hanging masses as shown below.



What is the tension in the right hand rope while the masses move freely?

A. 8.5 N
B. 24 N
C. 26 N
D. 32 N

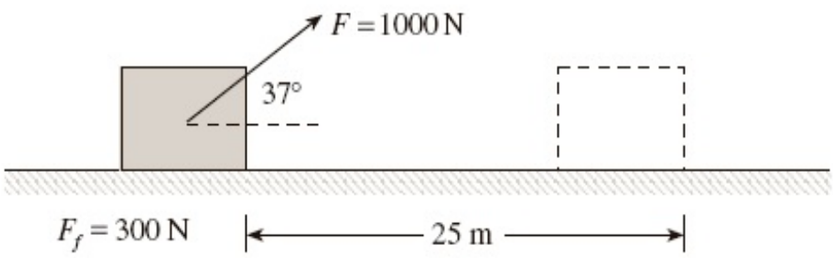
39. Two objects, each having a mass of 2.3×10^{8} kg are separated by a distance of 3.0×10^{3}m. What is the gravitational force between them?

A. 1.7×10^{-9} N
B. 5.1×10^{-6} N
C. 3.9×10^{-1} N
D. 1.2×10^{3} N

40. Two cars collide head-on and come to a complete stop immediately after the collision. Which of the following is correct?

	TOTAL MOMENTUM	TOTAL ENERGY
A.	is conserved	is conserved
B.	is conserved	is not conserved
C.	is not conserved	is conserved
D.	is not conserved	is not conserved

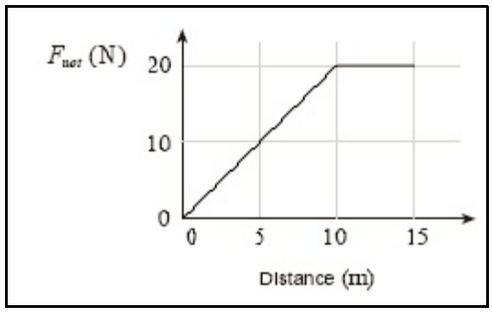
41. A 1000 N force is applied to a block as shown. There is 300 N of sliding friction as the block moves 25 m along the surface.



How much work was done by the applied force in moving this block?

A. 1.5×10^4 J
B. 1.8×10^4 J
C. 2.0×10^4 J
D. 2.7×10^4 J

42. A force is applied to an 8.0 kg object initially at rest. The magnitude of the net force varies with distance as shown.



What is the speed of the object after moving 15 m?

A. 5.0 m/s
B. 6.1 m/s
C. 7.1 m/s
D. 8.7 m/s

43. What is the unit of work, the joule (J), equivalent to?

A. $kg \cdot m/s^2$
B. $kg \cdot m^2/s^2$
C. $kg \cdot m^3/s^2$
D. watt

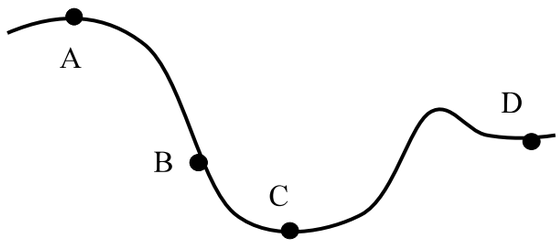
44. What is the work done by the brakes of a 1500 kg car as they slow the car from 25 m/s to 15 m/s?

A. $-\ 2.6 \times 10^4$ J
B. $-\ 7.5 \times 10^4$ J
C. $-\ 3.0 \times 10^5$ J
D. $-\ 1.2 \times 10^6$ J

45. Jason has a kinetic energy of 100 J. If his speed doubles, what will be his new kinetic energy?

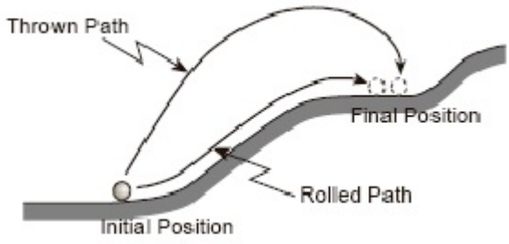
A. 25 J
B. 50 J
C. 200 J
D. 400 J

46. In the picture of the roller coaster shown to the right, where would the roller coaster be travelling the fastest?



A. A
B. B
C. C
D. D

47. A child rolls a ball up a hill as shown. The same child then throws an identical ball up the hill.



When both balls end up in the same location on the hill, which of the following correctly describes the potential energy change for each ball?

A. Both balls have the same potential energy change.
B. There is no potential energy change for either ball.
C. The thrown ball has a greater potential energy change than the rolled ball.
D. The thrown ball has a smaller potential energy change than the rolled ball.

48. A crane lifts a 3 900 kg shipping container through a vertical height of 45 m in 8.0 s. What is the minimum average power that the crane motor must supply?

A. 2.7×10^3 W
B. 7.7×10^3 W
C. 2.1×10^5 W
D. 1.7×10^6 W

49. An electric hoist provides 2.5 10^3 W of power to lift a 170 kg sack vertically upwards in 2.5 seconds. To what height has the sack been lifted?

A. 3.8 10^0 m
B. 3.8 10^1 m
C. 1.7 10^5 m
D. 1.7 10^6 m

50. Under which circumstance would the work energy theorem be the most valid?

A. A brick is pushed along a concrete surface.
B. A brick is thrown vertically upwards.
C. A cart is rolled along a level floor.
D. A cart is rolled down an incline.

SECTION II

Estimated Time - 2 hours
Total Value - 50%

1 A football is kicked with a vertical velocity of 16 m/s from the top of a bridge, 6.2 m above the ground. At what time will it strike the ground below?

{4}

2. A student stands on the edge of a building 110.0 m above the ground and throws a baseball upward with some initial velocity. The total time for the ball to travel from the student's hand to the ground is 6.5 s.

{3} A) What is the initial velocity of the ball?

{2} B) What is the velocity of the ball as it hits the ground?

3. A sprinter runs a 100.0 m dash. During the first 2.04 s of the race, he accelerates from rest to a velocity of 7.95 m/s [S]. For the rest of the race, he continues at his top speed of 7.95 m/s. What time does the sprinter achieve for the race?

{4}

4. A swimmer B can swim with a speed of 2.2 m/s in still water. He wishes to cross a river which has a current of 1.6 m/s [E] and is 450 m wide.

{3} A) In which direction should he head to get directly north across the river?

{2} B) How long does it take swimmer B to cross the river?

5. Wilderness trails are excellent for jogging. A jogger chooses a trail that is 7.2 km long and heads [N 25˚ W]. The trail that follows is 5.6 km long and heads [N 55˚ E]. The jogger takes a total of 1.0 h and 12 min to jog the two trails. Determine the displacement of the jogger.

{5}

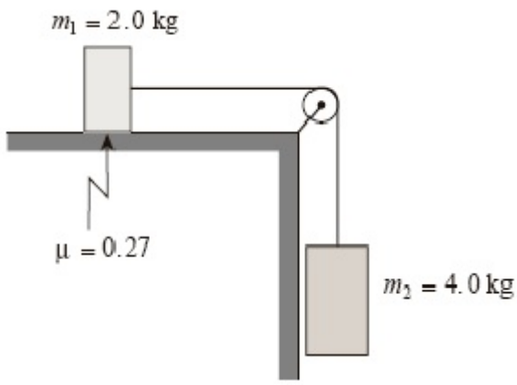
6. Use the concept of impulse to explain why a steel hammer is better than a rubber mallet of the same mass for driving nails.

{3}

7. A box of mass 4.5 kg is pushed across a rough surface ($\mu_K = 0.18$) for a distance of 2.0 m by a constant force of 10.0 N. If the object reaches a speed of 2.0 m/s by the end of the push, what was its speed at the beginning of the push?

{4}

8. Two masses are connected by a light string over a frictionless massless pulley. There is a coefficient of friction of 0.27 between mass m_1 and the horizontal surface.



{2} A) Draw and label a free body diagram showing the forces acting on mass m_1 and m_2.

{4} B) What is the acceleration of the system?

{2} C) Determine the tension in the string.

9. Two identical boulders are placed 20.0 m apart and the force of gravitational attraction between them is found to be 2.00×10^{-7} N. What is the mass of the boulders?

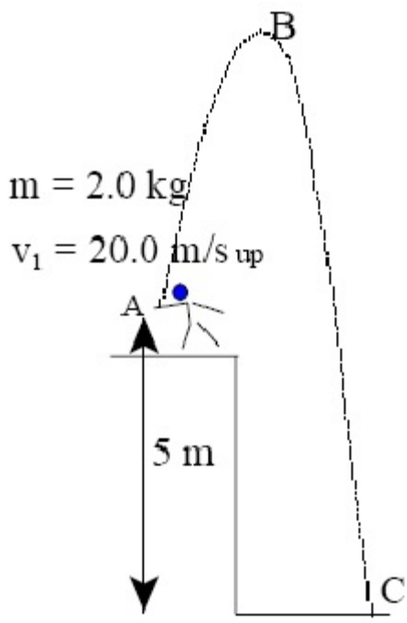
{3}

10. A 0.50-kg ball traveling at 6.0 m/s collides head-on with a 1.00-kg ball moving in the opposite direction at a velocity of 12.0 m/s. After the collision, the 0.50-kg ball moves in the opposite direction at a speed of 14 m/s. Find the velocity of the second ball.

{2}

11. A ball is thrown upward as shown in the diagram at the right. The initial launch height at A is 5.0 meters, the initial velocity of the ball $v_A = 20.0$ m/s up, and the mass of the ball, m = 2.0 kg.

What is the speed of the ball at "C", the instant before it hits the ground?



{4}

12. While driving a 1200 kg car at 20.0 m/s, you decide to pass the truck in front of you. To do this, the engine must provide an additional 50 000 J of work. What is the final speed of the car?

{3}