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

**MENIHEK HIGH SCHOOL**

# PHYSICS 2204

# FINAL EXAMINATION

**2007/2008**

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

## GENERAL INSTRUCTIONS

1. This is a two-part test. All parts are contained in this booklet. The examination consists of items arranged as follows:
   ***SECTION I – 50 selected response items – Do ALL items –50%***
   ***SECTION II – constructed response items – Do ALL items – 50%***

2. **Section I** may be answered using the answer sheet provided. 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.

3. **Section II** – is to be answered in the spaces provided in this test booklet. Please pass in the entire test to the supervisor when you have finished the examination.

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
– Models of calculators permitted
– Use of pen or pencil
– Punctuality
– Leaving the room
– Use of answer booklets
– Completion of required information
- Communication and movement during the examination
– Use of unauthorized means, and penalties

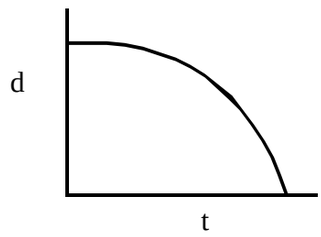
## PART I: Selected Response
## Total Value: 50%

**Instructions:** Shade the letter of the correct answer on the computer scorable answer sheet provided.

1. Which of the following contains scalar quantities only?

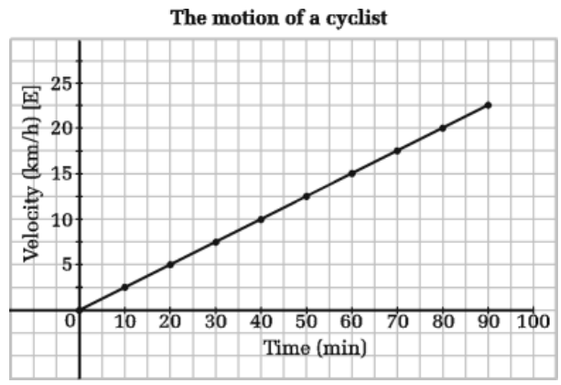
   (A) speed, displacement
   (B) speed, energy
   (C) velocity, energy
   (D) velocity, momentum

2. Which choice best describes the motion depicted in the graph?



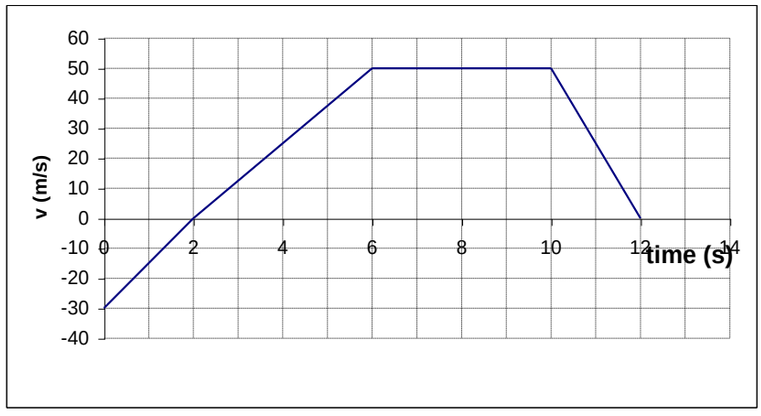

   (A) moving to the left and slowing down
   (B) moving to the left and speeding up
   (C) moving to the right and slowing down
   (D) moving to the right and speeding up

3. The following graph shows the motion of a cyclist. What is the cyclist's total displacement?



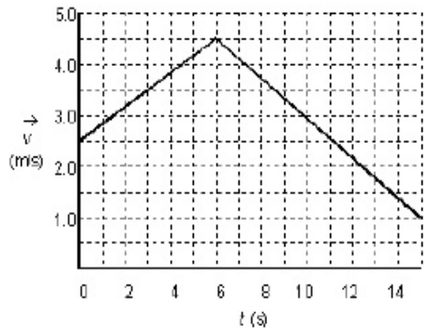

   (A) 4.0 km [E]
   (B) 17 km [E]
   (C) 34 km [E]
   (D) $1.0 \times 10^3$ km [E]

4. If we assume that motion to the right is positive, then which of the following statements describes the motion of the object depicted in the graph from $t = 10$ s to $t = 12$ s?



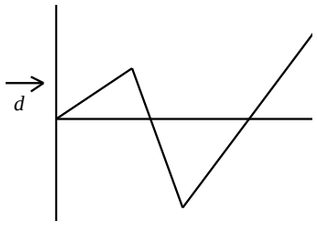

   (A) moving to the left and slowing down
   (B) moving to the left and speeding up
   (C) moving to the right and slowing down
   (D) moving to the right and speeding up

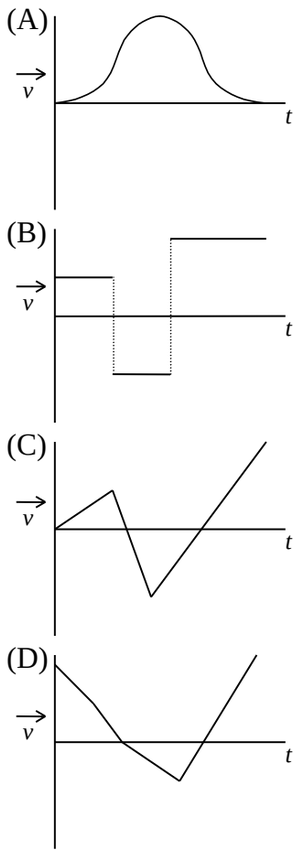
5. Examine the $\vec{v}-t$ graph shown at the right. What is the acceleration at $t$ = 10 s




(A) -0.3 m/s$^2$
(B) -0.39 m/s$^2$
(C) -0.50 m/s$^2$
(D) +0.3 m/s$^2$

6. Which velocity time graph corresponds to the displacement-time graph at the left?




7. What is the average speed of an object that travels 6.00 m north at 2.00 m/s and then travels south at 3.00 m/s for 1.00 second?

(A) 0.750 m/s
(B) 2.25 m/s
(C) 2.50 m/s
(D) 3.75 m/s

8. Which example illustrates uniform motion?

(A) A child is on a merry-go-round rotating at a constant speed.
(B) A satellite is in orbit about the Earth.
(C) A train is traveling west at a constant speed
(D) An object's speed changes at a rate of 10 m/s each second.

9. An object is thrown vertically upward at 18 m/s from a window and hits the ground 1.6 s later. What is the height of the window above the ground?

(A) 16 m
(B) 21 m
(C) 37 m
(D) 41 m

10. A motorcycle accelerates from rest at 6.0 $m/s^2$. How much farther will it travel during the second 3.0 s of motion than during the first 3.0 s?

(A) 27 m
(B) 54 m
(C) 81 m
(D) 98 m

11. How long would it take a truck to increase its speed from 10 m/s to 30 m/s if it does so with uniform acceleration over a distance of 80 m?

(A) 2 s
(B) 4 s
(C) 5 s
(D) 8 s

12. A jogger is running at 4.2 m/s when she begins to accelerate uniformly. If she runs a distance of 14 m in the next 3.0 s, what is her new speed?

(A) 4.9 m/s
(B) 5.1 m/s
(C) 7.7 m/s
(D) 14 m/s

13. If a ball is thrown vertically upwards at 38 m/s from a height of 12 m. What will be the maximum height reached?

(A) 74 m
(B) 86 m
(C) 147 m
(D) 159 m

14. A car accelerates uniformly from 50 km/h to 80 km/h in 4 s. If it continues to accelerate at this rate how much longer will it take to accelerate to 120 km/h?

(A) 1.3 s
(B) 4.0 s
(C) 5.3 s
(D) 9.3 s

15. 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

16. Three identical boats set out to cross a river that has a current. Boat A points directly across the river, boat B points 20º downstream from a point straight across the river, and boat C points 20º upstream from a point straight across the river. Which boat will arrive on the opposite shore first?

(A) all three boats will arrive at the same time
(B) boat A
(C) boat B
(D) boat C

17. Truck X is traveling North at 45 km/h while directly behind it truck Y is travelling South at 65 km/h. What is the velocity of X relative to Y?

(A) 20 km/h [N]
(B) 20 km/h [S]
(C) 110 km/h [N]
(D) 110 km/h [S]

18. A pilot wishes to travel north in an airplane with an air speed of 300 km/h. The wind is blowing from the east at 20 km/h. Which direction should the pilot head in?

(A) exactly north
(B) [N 4º W]
(C) [N 4º E]
(D) [E 4º N]

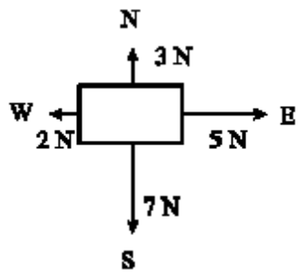
19. Which of the following would be a **non-inertial** frame of reference if you were at that location?

(A) In a balloon ascending at a constant velocity
(B) In an elevator undergoing free-fall
(C) In a stationary elevator
(D) On a train travelling North at 30 m/s

20. Which of the following vectors is the same as 26 m/s [W 78°S]?

(A) 26 m/s [ E 78°N]
(B) 26 m/s [W 12°S]
(C) 26 m/s [S 12°W]
(D) 26 m/s [S 78° W]

21. What is the equilibrant force on the object in the diagram to the right?




(A) 5 N [E 53°S]
(B) 5 N [W 53° N]
(C) 25 N [E 37°S]
(D) 25 N [W 37°N]

22. A falling 0.60 kg object experiences a frictional force due to air resistance of 1.5 N. What is the object's acceleration?

(A) 2.5 $m/s^2$
(B) 4.4 $m/s^2$
(C) 7.3 $m/s^2$
(D) 12 $m/s^2$

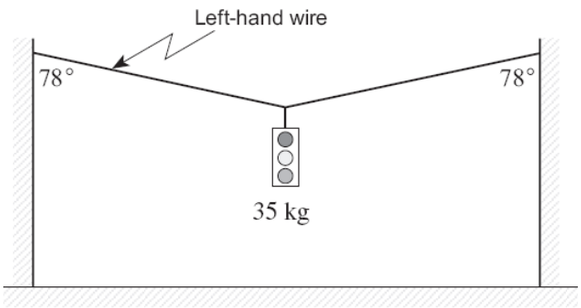
23. A block of wood on a horizontal surface accelerates at 0.2 $m/s^2$ when a force of 24.6 N is applied to it. If the object has a mass of 10.0 kg what must be the value of $\mu$?

(A) 0.081
(B) 0.231
(C) 0.492
(D) 12.3

24. A 45 kg woman is standing in an elevator that is accelerating downwards at 2.0 $m/s^2$. What force (normal force) does the elevator floor exert on the woman's feet during this acceleration?

(A) 90 N
(B) 350 N
(C) 440 N
(D) 530 N

25. A 35 kg traffic light is suspended by two wires as shown. What is the tension in the left-hand wire?




(A) 84 N
(B) 410 N
(C) 820 N
(D) 1 600 N

26. A boy is holding a basketball as shown. There are two forces on the ball (F1 & F2) and three forces on the boy (F3, F4, & F5), which may be described as follows:
$F_1$ = the earth's gravitational force on the ball
$F_2$ = the force that the hands exerts upward on the ball
$F_3$ = the force the ball is pushing down on the hands
$F_4$ = the earth's gravitational force on the boy
$F_5$ = the force that the earth is pushing back on the boy

Which choice represents an action-reaction pair?
(A) $F_1$ & $F_2$
(B) $F_2$ & $F_3$
(C) $F_3$ & $F_4$
(D) $F_4$ & $F_5$

27. Which way will an object swing if it is hanging from the rear view mirror of a car moving down a straight road at a constant speed and the brakes are suddenly applied?

(A) backward
(B) forward
(D) left
(E) right

28. Which statement is true about collisions in an isolated system?

(A) Both momentum and kinetic energy are always conserved.
(B) Kinetic energy is always conserved but momentum may not be conserved.
(C) Momentum is always conserved but kinetic energy may not be conserved.
(D) Momentum may not be conserved and kinetic energy may not be conserved.

29. Which of the following is a list of nature's basic forces, in order from weakest to strongest?

(A) electromagnetic, gravity, weak nuclear, strong nuclear
(B) gravity, electromagnetic, strong nuclear, weak nuclear
(C) gravity, electromagnetic, weak nuclear, strong nuclear
(D) gravity, weak nuclear, electromagnetic, strong nuclear

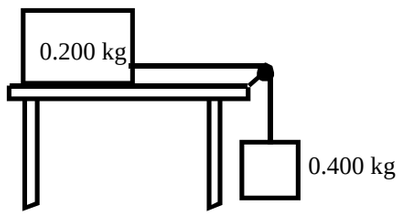
30. A certain force $F$ causes an object with mass, $m$, to accelerate at 12.0 m/s$^2$. What will be the acceleration if the net force is tripled and the mass is doubled?

(A) 9.00 m/s$^2$
(B) 12.0 m/s$^2$
(C) 18.0 m/s$^2$
(D) 102 m/s$^2$

31. If you jump from a chair to the floor, you do not lock your knees. Instead you bend your knees to cushion the fall. Why?

(A) It decreases the change in momentum.
(B) It decreases the impulse.
(C) It increases the time it takes to come to a complete stop.
(D) It makes your contact more like an elastic collision.

32. A 0.400 kg mass is attached to a 0.200 kg mass as shown in the diagram. Assuming no friction, what is the acceleration of system?



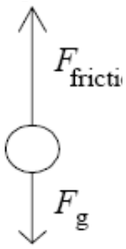

(A) 0.70 $m/s^2$
(B) 6.53 $m/s^2$
(C) 9.80 $m/s^2$
(D) 19.6 $m/s^2$

33. In an automobile collision, the severity of injury to the driver can be reduced by an airbag. In a car initially travelling at 100 km/h, the airbag stops a 62 kg driver in 0.090 s. What is the magnitude of average force exerted by the airbag on the driver?

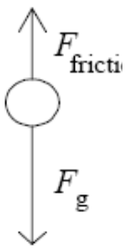
(A) $6.1 \times 10^2$ N
(B) $9.6 \times 10^3$ N
(C) $1.9 \times 10^4$ N
(D) $6.9 \times 10^4$ N

34. A Styrofoam ball is falling through the air at terminal velocity. Which free body diagram is the best representation of the event?

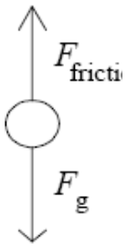
(A)




(B)




(C)




(D)

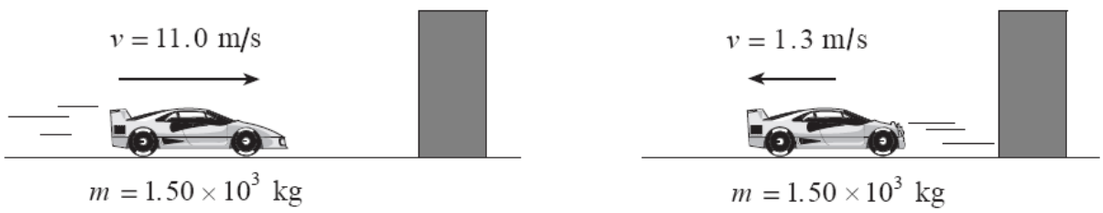
35. What is the force of gravitational attraction between a 65 kg person and his 8.0 kg bicycle if their centers are separated by 2.0 m?

(A) $1.1 \times 10^{-8}$ N
(B) $2.1 \times 10^{-8}$ N
(C) $3.4 \times 10^{-8}$ N
(D) $8.7 \times 10^{-9}$ N

36. Which of the following is equal to impulse?

(A) Change in Energy
(B) Change in Momentum
(C) Energy
(D) Momentum

37. A 1.50 x $10^3$ kg car travelling at 11.0 m/s collides with a wall as shown.




The car rebounds off the wall with a speed of 1.3 m/s. If the collision lasts for 1.7 s, what force does the wall apply to the car during the collision?

(A) 8.6 x $10^3$ N
(B) 1.1x $10^4$ N
(C) 1.5 x $10^4$ N
(D) 1.8 x $10^4$ N

38. A 1 500 kg car traveling at 25 m/s collides with a 2 500 kg van stopped at a traffic light. As a result of the collision the two vehicles become entangled. With what initial speed will the entangled mass move off, and is the collision elastic or inelastic?

| | SPEED | TYPE OF COLLISION |
|---|---|---|
| A. | 9.4 m/s | Elastic |
| B. | 9.4 m/s | Inelastic |
| C. | 15 m/s | Elastic |
| D. | 15 m/s | Inelastic |

39. A lawn mower is pushed with a force of 88 N along a handle. The handle makes a 41° angle with the horizontal. How much work is done to move the lawn mower 2.5 m in the yard?

(A) 170 J
(B) 190 J
(C) 220 J
(D) 250 J

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

(A) $3.8 \times 10^0$ m
(B) $3.8 \times 10^1$ m
(C) $1.7 \times 10^5$ m
(D) $1.7 \times 10^6$ m

41. A moving object initially has a kinetic energy equal to 100 J. What would be its kinetic energy if the speed was changed from 5.0 m/s to 15.0 m/s?

(A) 200 J
(B) 300 J
(C) 400 J
(D) 900 J

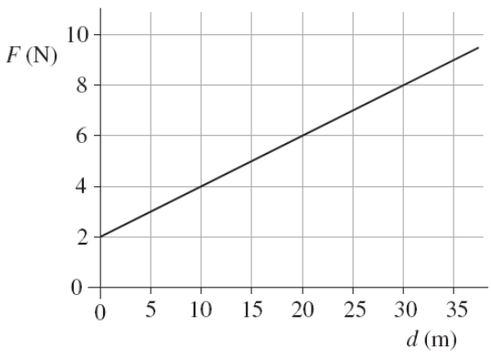
42. In which case is the most work being done on the 0.20 kg hockey puck?

(A) The puck travels a distance of 40 m at a constant speed of 80 m/s.
(B) The stick exerts a force of 70 N on the puck and it is moved 0.40 m.
(C) The stick increases the speed of the puck from 0 m/s to 50 m/s.
(D) The stick slows down the puck from 40 m/s to 0 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. The graph below shows how the force applied to an object varies with distance. What is the work done to move the object from 10 m to 30 m?




(A) 40 J
(B) 80 J
(C) 120 J
(D) 240 J

45. A 1.3 kg stone is dropped from a position that is 25 m above the ground. It falls to another position, which is 15 m above the ground. Find the speed of the stone at this final position.

(A) 11 m/s
(B) 14 m/s
(C) 17 m/s
(D) 21 m/s

46. Which of the following is the most likely conclusion if 33 J of work are done on a dynamics cart on a table and its kinetic energy is measured to be 28 J?

(A) Some energy was converted to potential energy.
(B) Some mechanical energy was lost due to friction.
(C) The kinetic energy was measured incorrectly.
(D) The work was measured incorrectly.

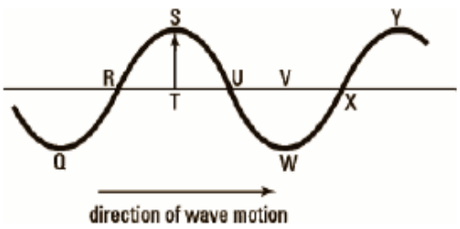
47. Brenda carries an 8.0 kg suitcase as she walks 25 m along a horizontal walkway to her room at a constant speed of 1.5 m/s. How much work does Brenda do in carrying her suitcase?
(A) zero
(B) 40 J
(C) 200 J
(D) 300 J

48. A 10.0 g bullet traveling horizontally at 755 m/s strikes a stationary target and stops after penetrating 14.5 cm into the target. What is the average force of the target on the bullet?

(A) $6.26 \times 10^3$ N
(B) $1.97 \times 10^4$ N
(C) $3.13 \times 10^4$ N
(D) $2.07 \times 10^5$ N

49. What is amplitude?
(A) a function of frequency and wavelength
(B) maximum displacement from the rest position
(C) minimum vertical distance from rest axis
(D) one full period of motion of an object.

50. Which term can be defined as the distance from point R to point X in the diagram?




(A) amplitude
(B) frequency
(C) period
(D) wavelength

## PART I: Constructed Response
## Total Value: 50%

1. An arrow is shot vertically into the air with an initial velocity of 60.0 m/s.

(A) How long does it take the arrow to reach its maximum height? **{2}**

(B) What is the displacement of the arrow at 7.0 s? **{2}**

2. You are driving with a constant velocity of 25.0 m/s when a child suddenly steps into the path of your vehicle 55 m away. When you fully apply your brakes, your car slows down at a constant rate of 8.0 $m/s^2$. What is the **minimum reaction time** that is required so that the child will not be hit? **{4}**

3 A construction worker ascending at a constant speed of 4.6 m/s in an open elevator, 35 m above the ground, accidentally drops a hammer. Calculate the time it takes the hammer to hit the ground. **{4}**

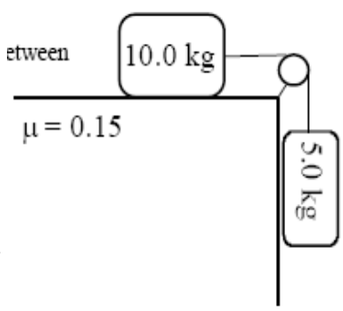
4. A pilot in a solar powered airplane has an air speed of 128 km/h. The pilot wants to fly directly North from Corner Brook to St. Anthony, a distance of 425 km. When she takes off, the wind is blowing from the West with a speed of 55.0 km/h.

(A) In what direction should the pilot fly in order to seek her destination? **{3}**

(B) What is her velocity with respect to the ground? **{2}**

(C) How long did it take the pilot to fly to St. Anthony? **{2}**

5. A 10.0 kg block is on a horizontal table. The coefficient of friction between the block and the table is 0.15. It is connected to a 5.0 kg hanging mass by a lightweight string and a pulley as shown. Ignore the mass of the string and any friction in the pulley.




A Draw a free-body diagram for the system. **{2}**

B Calculate the acceleration of the system. **{4}**

C Calculate the tension in the string. **{2}**

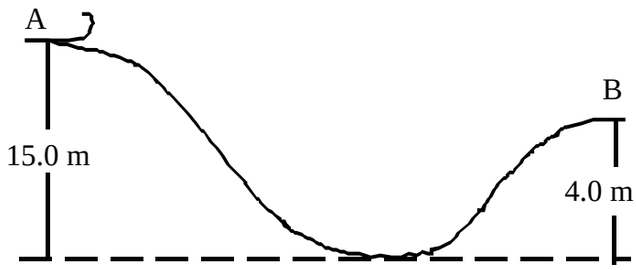
6. A 5.0 kg mass moving right at 3.0 m/s strikes a 4.0 kg mass, which is traveling left at 2.0 m/s. The 5.0 kg mass bounces off the 4.0 kg mass with a velocity of 1.5 m/s [left]. What was the velocity of the 4.0 kg mass after the collision occurred? **{2}**

7. The universal gravitational constant is $G = 6.67 \times 10^{-11}\ Nm^2/kg^2$. If the gravitational force between two objects is $2.73 \times 10^{-8}$ N when the objects are 1570 cm apart, what is the mass of each object, if one is twice the mass of the other? **{4}**

8. A 930.0 kg piano needs to be moved into an auditorium for a concert. An applied force moves the piano from rest to 0.800 m/s [forward] in 6.00 s. The coefficient of friction between the two surfaces is $\mu = 0.52$ Find the applied force that is needed to move the piano with this acceleration. **{4}**

9. A deliveryman pushes a box up a ramp, exerting a force of 450 N. He walks on the ramp, pushing the box for 35.0 m. If the box has a mass of 75.0 kg, what is the height of the ramp and the angle it makes with the ground? **{4}**

10. Some children go tobogganing on an icy hill as shown in the diagram. They start from rest at the top of the hill as shown. The toboggan and the children have a combined mass of 90.0 kg. Ignoring friction, what is the speed of the toboggan at position B? **{4}**




11. A 40.0-kg girl rides her 0.50-kg skateboard. She starts from rest and at a constant acceleration reaches 3.0 m/s in 12 s on a horizontal surface. How much power did she use?