Grade 12 Physics

Exam Prep

Spring 2016

Name:_____ Date:_____

Physics 12

Motion and Forces Test

Part A: Matching (5 marks)

1. Displacement
2. Vector
3. Velocity
4. Newton's First Law
5. Acceleration
6. Distance
7. Newton's Second Law
8. Time
9. Friction
10. Coefficient of friction

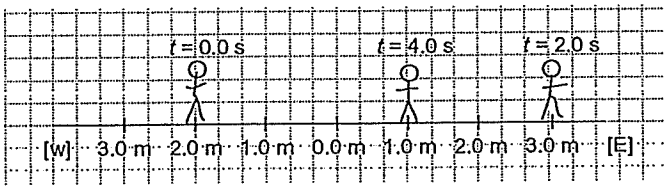
a) A ratio that determines how large the force of friction is.
b) A change in position
c) The change in velocity divided by the time it took to make the change in velocity.
d) SI unit is minutes
e) The change in displacement divided by the time it took to make the displacement.
f) A force that always acts against the motion
g) A change in time
h) Every action has an equal and opposite reaction
i) The coefficient of friction for moving objects
j) F=ma
k) A quantity that has only direction
l) A scalar quantity that describes how far an object is from the origin.
m) An object that is at rest will remain at rest, and an object that is moving will continue to move in a straight line with a constant speed, if and only if the net force is zero.
n) A quantity that has magnitude and direction

Part B: Multiple Choice (10marks)

1. Convert 75 km/h to m/s.

A. 1.3 m/s
B. 21 m/s
C. 1300 m/s
D. 75000 m/s

Use the following motion diagram to answer question 2.



2. A boy walks from 2.0 m [W] to 3.0 m [E] in 2.0 s. He then walks to a position 1.0 m [E] in the next 2.0 s time interval, as shown below. Which of the following correctly shows the boy's distance and displacement during the time interval 0 s to 4.0 s?

	Distance	Displacement
A	3.0 m	1.0 m [E]
B	3.0 m	3.0 m [E]
C	7.0 m	1.0 m [E]
D	7.0 m	3.0 m [E]

3. Which of the following is not one of Newton's three laws?
   a) For every action there is an opposite and equal reaction
   b) An object at rest will move without outside influence.
   c) Law of inertia
   d) Acceleration is produced when a force acts on an object.

4. A skier accelerates uniformly from 5.2m/s to 12.8m/s at 0.85m/s^2. Find the distance he travels.
   a) 80m
   b) 11m
   c) 8.9m
   d) 7.7m

5) Which of the following statements concerning vector and scalar quantities is **incorrect**?
   a) All scalar quantities have magnitude
   b) All vector quantities have direction
   c) All scalar quantities have direction
   d) All vector quantities have magnitude

6) A boat is headed north in a river that flows due east at a speed of 3.0m/s. If the resultant velocity of the boat is 5.0m/s [37° East of North], what is the speed of the boat with respect to the water?

a. 5.8m/s

b. 6.0m/s

c. 4.0m/s

d. 8.0m/s

7) An 1800 kg car initially travelling at 15 m/s brakes to avoid hitting another car. The car accelerates at -1.9 $m/^s$ 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

8) If Force is constant, what happens to the acceleration if mass increases by a factor 2?

a) It increases by a factor of 2

b) It increases by a factor of 4

c) It decreases by a factor of 2

d) It decreases by a factor 4

9) What is the F_N for a mass of 100g?

a) 980N

b) -0.98N

c) 980N

d) 0.98

10) What force is needed to stop a truck (m=1500) travelling at 25m/s if it stops in 55m?

a) -8500N

b) 850N

c) 8500N

d) 85N

Part C: Long Answer

1. A car accelerates uniformly from 3.00 m/s to 12.0 m/s and moves a distance of 90.0 m. How long does it take the car? (2 marks)

2. A boat can travel 2.85 m/s in still water. If the boat heads directly across a stream whose current is 1.20 m/s, what is the velocity of the boat relative to someone on the shore? [3 marks]

3. Caitlyn flies a plane that has a maximum speed of 310km/h. She wants to fly directly South. There is a 25km/h wind that blows towards the East.
   a. What heading must she take to fly directly south? (3 marks)

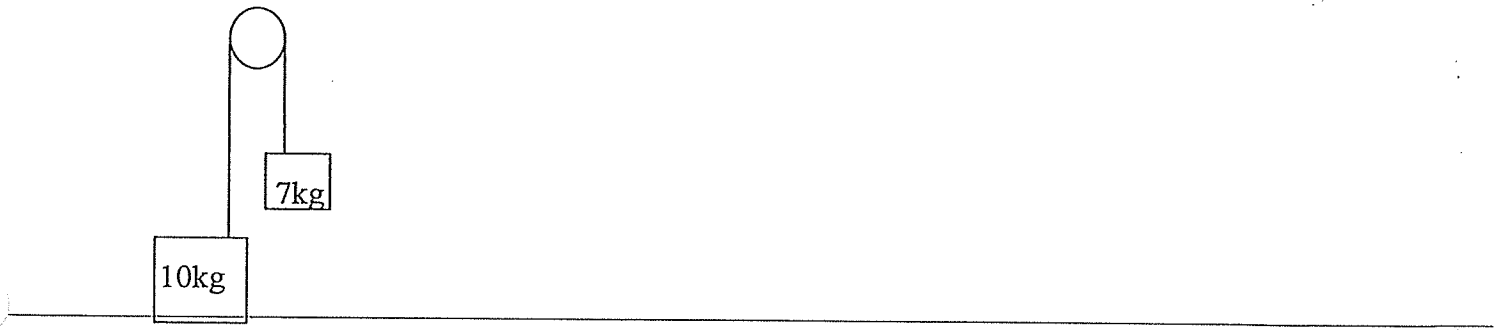
   b. If she wants to fly 1250 km, how long does it take her? (3 marks) Hint: Find resulting velocity.

4. a) Jill has a mass of 60.kg. She is an elevator accelerating upward at 3.5m/s. What is her apparent weight? (2 marks)

b) Jill enters the same elevator but now it is accelerating downward at 2.5m/s. What is her apparent weight? (2 marks)

c) What acceleration must the elevator have to give for the scale that Jill is standing on a reading of 72kg? (2 marks)

5. Two blocks, one mass of 10kg and the other of mass 7kg are tied together with a massless rope. This rope is strung over a massless, resistance free pulley. The blocks are released. Find the acceleration of the blocks and the tension in the rope. (4 marks)



6. You are driving a 1500kg car at a speed of 14m/s when you see a red light and hit the brakes. The tires lock and you skid to a halt after 25m. What is the coefficient of kinetic friction between the tires and the road? (4 marks)

7. Bill runs 650m North. Then he runs 505m @ 35^0 North of East. The, he runs 680m @ 45^0 South of West. What is Bill's Displacement? (4 marks)

8.Two blocks are connected by a string over a frictionless, massless pulley while on an inclined plane of 35°. The hanging block has a mass of 31.0kg and the one on the plane has a mass of 15.0kg. The coefficient of kinetic friction on the inclined plane is 0.27.

a) What is the acceleration of the system? (4 marks) Draw a picture.

b) What is the tension in the string? (2 marks)

Name:_____ Date:_____

Physics 12

Momentum and Projectile Test

Part A: Matching (5 marks)

1. Mass	a) The displacement an object makes divided by the time it took to make the displacement.
2. Law of Conservation of Momentum	b) An object that has independent vertical and horizontal motions.
3. Velocity	c) The product between the net force and the time the force was made.
4. Impulse	d) SI unit is seconds
5. Projectile	e) A collision where all energy is conserved
6. Momentum	f) A force that always acts against the motion
7. Time	g) A collision where energy is lost.
8. Elastic collision	h) Every action has an equal and opposite reaction
9. Inelastic collision	i) Momentum is conserved before and after a collision.
10. Force	j) A push or a pull.
	k) A quantity that has only direction
	l) The product between an objects mass and velocity.
	m)
	n) SI unit is kg

Part B: Multiple Choice (10marks)

1. A 50 kg person runs into a brick wall at 9.0 m/s and rebounds straight back at 8.0 m/s. What is his change of momentum as a result of the collision?
   a. 50 kg•m/s
   b. 450 kg•m/s
   c. 400 kg•m/s
   d. 850 kg•m/s
2. Two objects collide. It is an inelastic collision. Which of the following is true?
   a. Momentum is lost
   b. Energy is lost
   c. Momentum is conserved but energy is lost
   d. Energy is conserved but momentum is lost.
3. What average force will stop a hammer with a momentum of 50 N•s in 0.5 seconds?
   a. 0.01 N
   b. 25 N
   c. 50 N
   d. 100 N

4. A 5,000 kg car traveling at 30.0 m/s hits a stationary 9,000 kg truck. If the two vehicles stick together after the collision, how fast will they be moving?
    a. 10.7 m/s
    b. 16.7 m/s
    c. 30.0 m/s
    d. 54.0 m/s

5. Two 2.5 kg carts are moving along together with a velocity of 2.0 m/s when a spring compressed between them expands rapidly. The front cart continues with a velocity of 3.0 m/s, in the same direction. What is the velocity of the back car?
    a. 3 m/s
    b. -3 m/s
    c. 1 m/s
    d. -1 m/s

6. A car of mass 1500 kg traveling at 15.6 m/s loses its brakes and collides with the rear end of the car in front of it, which has a mass of 1020 kg and is traveling in the same direction at 12.5 m/s. If the smaller car is given a speed of 15.3 m/s by the collision, what is the speed of the larger car after the collision?
    a. 34.5 m/s
    b. 0 m/s
    c. -1.5 m/s
    d. 13.7 m/s

7. A 10 kg curling stone is sliding along the ice when it hits a stationary 15 kg bucket of sand. After the collision, the curling stone's velocity is 3.0 m/s east, and the bucket has a velocity of 2.2 m/s, at 40° S of E. What was the speed and direction of the curling stone before collision?
    a. 3.94 m/s at 21° N of E
    b. 3.94 m/s at 21° S of E
    c. 5.92 m/s at 21.8° N of E
    d. 5.92 m/s at 21.8° S of E
8. A hockey player of mass 82 kg is traveling north with a velocity of 4.1 m/s. He collides with a 76 kg player traveling east at 3.4 m/s. If the two players "lock together momentarily, in what direction will they be going immediately after the collision?

a. 22.5° N of E
b. 32.5° N of E
c. 42.5° N of E
d. 52.5° N of E

9. At what speed must a ball be thrown upwards to reach a maximum height of 25m?
   a) 22m/s
   b) 2.6m/s
   c) 3100m/s
   d) 250m/s

10. A 15kg rock is thrown horizontally from a very high cliff at a speed of 65m/s
What is the speed of the rock after it has fallen a distance of 35m

a) 59m/s
b) 65m/s
c) 36m/s
d) 70m/s

Part C: Long Answer

1. A ball is thrown horizontally from a 75.0 meter high cliff with an initial velocity of 17.0 m/s. The ground following the cliff is flat.

a) Calculate the time it takes to hit the ground. (2 marks)
b) Calculate the **range** (the distance moved in the horizontal direction) the projectile moves. (1mark)
c) What is the final velocity of the ball in the x direction? (.5 mark)
d) What is the final velocity of the ball in the y direction? (2 marks)
e) What is the resultant velocity of the ball? (1.5 marks)

2. An arrow is shot with an initial velocity of 45.0 m/s at an angle of 33.5 degrees from the horizontal. Assuming the ground is flat, calculate the following:

a) The x and y component of the velocity (1 mark)
b) The time it takes for the arrow to reach the peak. (2marks)
c) The maximum height. (1 mark)
d) The displacement of the arrow in the x direction at $t = 2.1$ seconds.(1mark)
e) The range the arrow travels. (1 mark)
f) The times the arrow is at a y displacement of 5.00 meters. (3 marks)

3) A force of 201N acts on a soccer ball for 0.65s.

a) What is the bowling ball's change in momentum? (2marks)

b) What is the change in velocity? (1 mark)

4) A 85Kg fullback running at 10.2m/s collides in mid air with a 132 defensive tackle moving in the opposite direction. Both players wind up with zero speed.

a) Identify and draw the before and after situations. (.5 marks)

b) What is the fullback's momentum before the collision? (1 mark)

c) What is the fullback's change in momentum? (.5 mark)

e) What is the change in the defensive tackle's momentum? (.5 marks)

f) What was the defensive tackle's original speed (1 mark)

5) A stationary billiard ball is struck by an identical ball moving at 4.5m/s. After the collision, the second ball moves 65.0^0 to the left of its original direction. The stationary ball moves 25^0 to the right of the moving ball's original direction. What is the velocity of each ball after the collision? (5 marks) **Hint:** Draw a picture

Name:_____ Date:_____

Physics 12

Circular Motion, Work and Energy Test

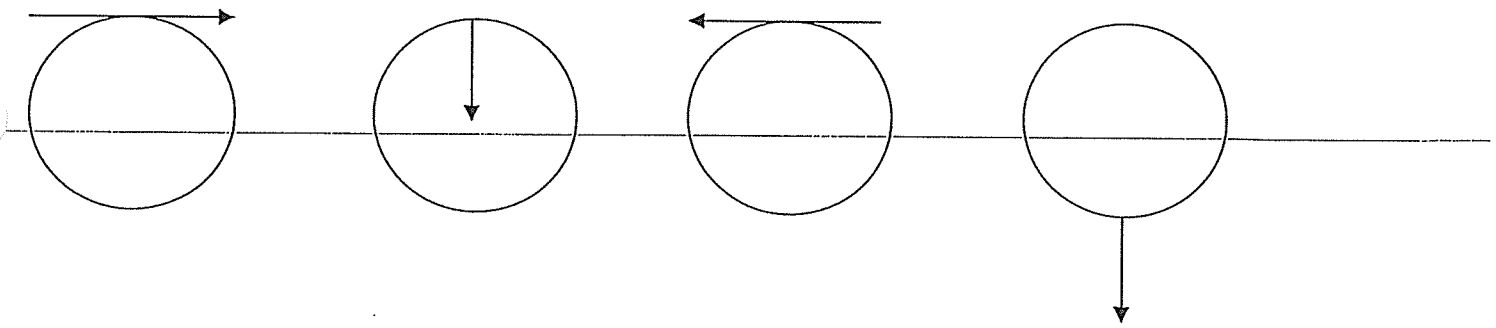
Part A: Matching (5 marks). Write the letters next to the correct term

1. Kinetic Energy	a)Center seeking acceleration.
2. Law of Conservation of Energy	b) A theorem that states that work done on object causes a change in kinetic energy.
3. Banked curve	c) The idea that all energy can not be created or destroyed.
4. Potential Energy	d) SI unit is seconds
5. Centripetal acceleration	e) A push or a pull
6. Work Energy Theorem	f) A force that always acts against the motion
7. Work	g) A concept that uses gravity to balance centripetal force.
8. Period	h) Every action has an equal and opposite reaction
9. Force	i) Energy that an object has due to gravity.
10. Frequency	j) The number of revolutions in 1 second
	k) The length of time for one revolution to occur.
	l) The product between an objects mass and velocity.
	m) Energy that an object has due to movement
	n) The change in mechanical (Potential or Kinetic Energy)

Part B: Multiple Choice (10marks)

1. An object of mass 5kg moves at a constant velocity of 6m/s in a circular path of radius 2m. Find the magnitude of the acceleration
   a. $0 m/s^2$
   b. $18 m/s^2$
   c. $3 m/s^2$
   d. $5 m/s^2$
2. A toy plane attached to a string is spinning in a clockwise circle when the string breaks at the apex of the motion. What diagram represents the direction of the velocity (arrow)?

a) b) c) d)



3. Elmira, New York boasts of having the fastest carousel ride in the world. The merry-go-round takes riders on a spin of 8.0m/s and the radius of the ride is 7.4m. Determine the time it takes for the riders to complete one revolution?
    a. 5.8s
    b. 6.0s
    c. 8.0s
    d. 3.2s
4. Using the information from 3, find the centripetal acceleration?
    a. $4.0 m/s^2$
    b. $8.0 m/s^2$
    c. $10 m/s^2$
    d. $8.6 m/s^2$
5. If the radius of the moon's orbit is on average 385000 km from the centre of the earth and the Moon's period is 27.3 days, what is its centripetal acceleration?
    a. $3.67X10^{-3} m/s^2$
    b. $2.73X10^{-3} m/s^2$
    c. $2.73X10^{-6} m/s^2$
    d. $3.67X10^{-6} m/s^2$
6. A soccer ball is kicked at a wall and only bounces back halfway. How come it didn't bounce all the way back?
    a. Energy was destroyed
    b. Energy was lost in the form of heat and sound when it hit the wall and heat from friction while it rolled on the ground.
    c. Energy was lost in the form of chemical energy when it hit the wall.
    d. Energy was lost in the form of electromagnetism due to the electrical wires in the wall.
7. What is the change in gravitational potential energy as a 3500 kg object is raised vertically from 5 meters off the surface of the earth to a height of 25.0 m?
    a. 8.58×10^5 N
    b. 6.86×10^5 N
    c. 7.00×10^4 N
    d. 3.43×10^4 N
8. A 950 kg elevator ascends a vertical height of 410 m with an average speed of 9.1 m/s. What average power must be supplied from the lifting motor?
    a. 8.47×10^4 W
    b. 3.82×10^6 W
    c. 8.66×10^4 W
    d. 4.19×10^5 W
9. A 2.5 kg ball is thrown vertically down from a bridge of height 55.0 m with an initial speed of 5.0 m/s, what is the velocity of the ball when it is 20.0 meters off the ground?
    a. 19.2 m/s
    b. 26.7 m/s
    c. -19.2 m/s
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10. A 60.0 kg girl runs up a flight of stairs 5.32 m high in 4.60 s. what is her power output in Watts?
    a. 3100 W
    b. 588 W
    c. 69.4 W
    d. 680. W

Part C: Long Answer

1. A particle beam accelerator has a radius of 1.0km. The Lead atoms in the accelerator have a velocity of 250m/s.
    a. What is their acceleration? (1 mark)

    b. If the atoms have a mass of $3.44X10^{-25}$kg, how much force is applied to the atom? (1 mark)

    c. How much kinetic energy do the atoms have? (1 marks)

2. A dare devil motorcyclist goes down a ramp and around a vertical. If the loop has a radius of 12m, what is the slowest speed the rider can have at the top of the loop to avoid falling? Draw a free body diagram.(3 marks)

3. A lawn mower is pushed across a lawn by a force of 210N at a 31^0 angle above the horizontal. If 73.5W of power is developed over 78s, what distance did it travel? (4 marks)

4. a. A skier (m=75kg) starts at the top of a hill that is 630m high and finishes at the bottom. What is his speed if no energy is lost? The angle of the hill is 35^0. (3 marks) Show all formulas and calculations to get full marks for each part to this question.

b. The skier then continues up a second hill and stops at a height of 450m and of this hill is 25°. What was the work done by friction? (4 marks)

c. What was the force of friction? (3 marks)

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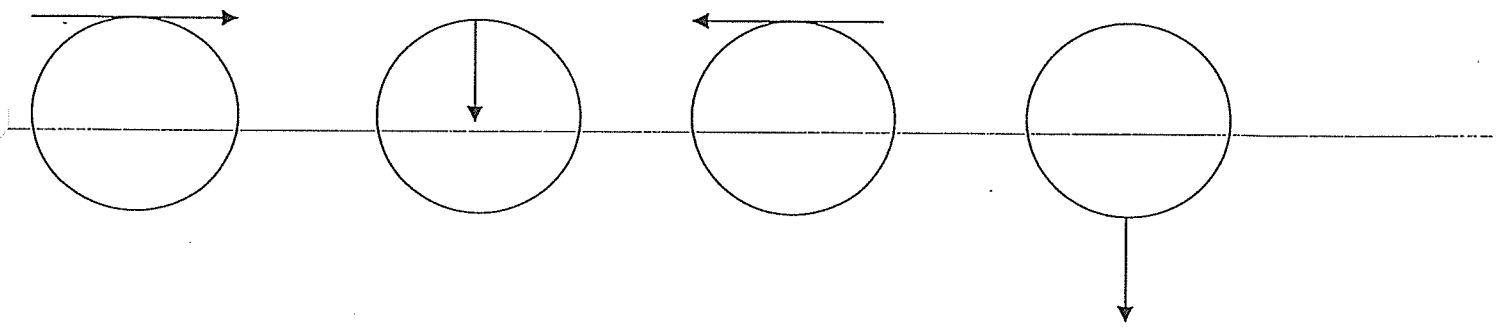

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c. What was the force of friction? (3 marks)

Name: Key Date:

Physics 12

Momentum and Projectile Test 40.5

Part A: Matching (5 marks)

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3. Velocity a	c) The product between the net force and the time the force was made.
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5. Projectile b	e) A collision where all energy is conserved
6. Momentum L	f) A force that always acts against the motion
7. Time d	g) A collision where energy is lost.
8. Elastic collision e	h) Every action has an equal and opposite reaction
9. Inelastic collision g	i) Momentum is conserved before and after a collision.
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	k) A quantity that has only direction
	l) The product between an objects mass and velocity.
	m)
	n) SI unit is kg

Part B: Multiple Choice (10marks)

1. A 50 kg person runs into a brick wall at 9.0 m/s and rebounds straight back at 8.0 m/s. What is his change of momentum as a result of the collision?
   a. 50 kg•m/s
   b. 450 kg•m/s
   c. 400 kg•m/s
   (d.) 850 kg•m/s
2. Two objects collide. It is an inelastic collision. Which of the following is true?
   a. Momentum is lost
   b. Energy is lost
   (c) Momentum is conserved but energy is lost
   d. Energy is conserved but momentum is lost.
3. What average force will stop a hammer with a momentum of 50 N•s in 0.5 seconds?
   a. 0.01 N
   b. 25 N
   c. 50 N
   (d) 100 N

/9

4. A 5,000 kg car traveling at 30.0 m/s hits a stationary 9,000 kg truck. If the two vehicles stick together after the collision, how fast will they be moving?
   (a.) 10.7 m/s
   b. 16.7 m/s
   c. 30.0 m/s
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   a. 3 m/s
   b. -3 m/s
   c. 1 m/s
   (d.) -1 m/s

10 kg·m →

$10 = 3(2.5) + 2.5x$

6. A car of mass 1500 kg traveling at 15.6 m/s loses its brakes and collides with the rear end of the car in front of it, which has a mass of 1020 kg and is traveling in the same direction at 12.5 m/s. If the smaller car is given a speed of 15.3 m/s by the collision, what is the speed of the larger car after the collision?
   a. 34.5 m/s
   b. 0 m/s
   c. -1.5 m/s
   d. ~~13.7~~ m/s
   12.9 m/s

$1500(15.6) + 1020(12.5) = 1500(15.3) + 1020(x)$

$21150 - 1500(15.3) = x$

1020

7. A 10 kg curling stone is sliding along the ice when it hits a stationary 15 kg bucket of sand. After the collision, the curling stone's velocity is 3.0 m/s east, and the bucket has a velocity of 2.2 m/s, at 40° S of E. What was the speed and direction of the curling stone before collision?
   a. 3.94 m/s at 21° N of E
   b. 3.94 m/s at 21° S of E
   c. 5.92 m/s at 21.8° N of E
   (d.) 5.92 m/s at 21.8° S of E

$P_i = P_f$

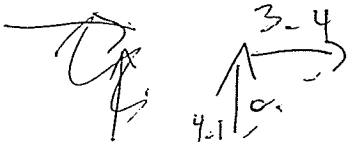
55

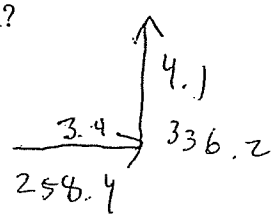
~~4.6~~

1.41.4

25.27

8. A hockey player of mass 82 kg is traveling north with a velocity of 4.1 m/s. He collides with a 76 kg player traveling east at 3.4 m/s. If the two players "lock together momentarily, in what direction will they be going immediately after the collision?
   a. 22.5° N of E
   b. 32.5° N of E
   c. 42.5° N of E
   (d.) 52.5° N of E





9. At what speed must a ball be thrown upwards to reach a maximum height of 25m?

a) 22m/s
b) 2.6m/s
c) 3100m/s
d) 250m/s

v_i
$v_f = 0$
$a = -9.8$
$d = 25$
$t =$

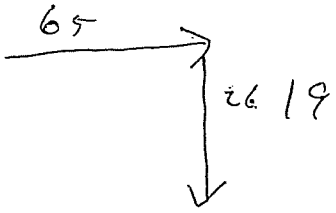
$v_f^2 = v_i^2 + 2ad$
$v_i = \sqrt{2(9.8)(25)}$

10. A 15kg rock is thrown horizontally from a very high cliff at a speed of 65m/s What is the speed of the rock after it has fallen a distance of 35m

a) 59m/s
b) 65m/s
c) 36m/s
d) 70m/s

$V_i = 0$
$V_f =$
$a = -9.8$
$d = -35$
$t =$

$v_f^2 = v_i^2 + 2ad$
$v_f = \sqrt{2(9.8)(35)}$



Part C: Long Answer

1. A ball is thrown horizontally from a 75.0 meter high cliff with an initial velocity of 17.0 m/s. The ground following the cliff is flat.

a) Calculate the time it takes to hit the ground. (2 marks)
b) Calculate the **range** (the distance moved in the horizontal direction) the projectile moves. (1mark)
c) What is the final velocity of the ball in the x direction? (.5 mark)
d) What is the final velocity of the ball in the y direction? (2 marks)
e) What is the resultant velocity of the ball? (1.5 marks)

a) Horiz
$v = 17 m/s$
$d =$
$t =$

Vertical
$v_i = 0$
$v_f =$
$a = -9.8$
$d = -75$
$t =$

$d = v_i t + \frac{1}{2} a t^2$
$-75 = -4.9 t^2$
$t = 3.91 s$

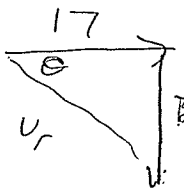
b) $d = vt$
$d = (17)(3.91)$
$= 66.5 m$

c) $17 m/s$

d) $v_i = 0$
$v_f =$
$a = -9.8$
$d = -75$
$t = 3.91$

$v_f^2 = v_i^2 + 2ad$
$v_f = \sqrt{0 + 2(-9.8)(-75)}$
$v_f = 38.3 m/s$ [down]

e)



$v_r = \sqrt{17^2 + 38.3^2}$
$v_r = 41.9 m/s$
$\theta = \tan^{-1}\left(\frac{38.3}{17}\right)$
$\theta = 66.1°$

$v_r = 41.9 m/s$ @ $66.1°$ below Horiz

9

2. An arrow is shot with an initial velocity of 45.0 m/s at an angle of 33.5 degrees from the horizontal. Assuming the ground is flat, calculate the following:

a) The x and y component of the velocity (1 mark)
b) The time it takes for the arrow to reach the peak. (2marks)
c) The maximum height. (1 mark)
d) The displacement of the arrow in the x direction at t = 2.1 seconds.(1mark)
e) The range the arrow travels. (1 mark)
f) The times the arrow is at a y displacement of 5.00 meters. (3 marks)

$X = 45\cos 33.5 = 37.5$ m/s

$Y = 45\sin 33.5 = 24.837$ m/s

b) $V_i = 24.837$
$V_f = 0$
$a = -9.8$
$t =$

$V_f = V_i + at$

$\frac{9.8t}{9.8} = \frac{24.837}{9.8}$

$t = 2.53$ s

c) $V_i = 24.837$
$V_f = 0$
$a = -9.8$
$d =$
$t =$

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

$\frac{19.6d}{19.6} = \frac{24.837}{19.6}$

$d = 1.27$ m

d) Horiz

$d = vt$
$= 37.5(2.1)$
$= 78.8$ m

e) $(2.53)2 = 5.06$

$t = 5.06$

$d = vt$
$= 37.5(5.01)$
$= 189.75$
$= 190.$ m

f) $V_f =$
$V_i = 24.837$
$a = -9.8$
$d = 5$
$t =$

$d = v_i t + \frac{1}{2}at^2$

$5 = 24.837t - 4.9t^2$

$4.9t^2 - 24.837t + 5 = 0$

$t = \frac{24.837 \pm \sqrt{24.837^2 - 4(4.9)(5)}}{9.8}$

$= \frac{24.837 \pm 22.7749}{9.8}$

0.206s

$t_1 = 2.065$

$t_2 = 4.86$ s

9

3) A force of 201N acts on a soccer ball for 0.65s.

a) What is the bowling ball's change in momentum? (2marks)

$F\Delta t = \Delta p$

$201(0.65) = \Delta p$

$\Delta p = 130.65 = 131 \text{ N}\cdot\text{s}$

b) What is the change in velocity? (1 mark) $m = 7.0\text{kg}$

$\Delta p = m\Delta v$

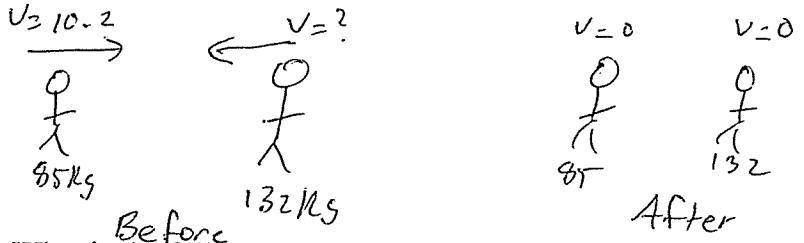
$\frac{130.65}{7} = \Delta v$

$\Delta v = 18.66$

$= 19 \text{ m/s}$

4) A 85Kg fullback running at 10.2m/s collides in mid air with a 132Kg defensive tackle moving in the opposite direction. Both players wind up with zero speed.

a) Identify and draw the before and after situations. (.5 marks)



b) What is the fullback's momentum before the collision? (1 mark)

$p = mv$

$= 85(10.2)$

$= 867 \text{ N}\cdot\text{s}$

c) What is the fullback's change in momentum? (.5 mark)

$-867 \text{ N}\cdot\text{s}$

e) What is the change in the defensive tackle's momentum? (.5 marks)

$(132)(6.57) = +867\ kg \cdot m/s$

f) What was the defensive tackle's original speed (1 mark)

$(10.2)(85) + (132)v = 0$

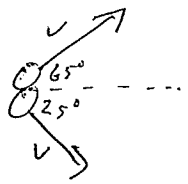
$v = \frac{(10.2)(85)}{132} = 6.568 \approx 6.57\ m/s$

5) A stationary billiard ball is struck by an identical ball moving at 4.5m/s. After the collision, the second ball moves 65.0^0 to the left of its original direction. The stationary ball moves 25^0 to the right of the moving ball's original direction. What is the velocity of each ball after the collision? (5 marks) **Hint:** Draw a picture

Before

$v=4.5$ $v=0$

m_1 m_2



$p_i = p_f$

x

$p_i = p_f$

$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$

$4.5 = V_1 \cos 65 + V_2 \cos 25$

$4.5 = V_2\, 0.4663 + V_2\, 0.9063$

$4.5 = V_2 (1.4034)$

$1.4034 \quad 1.4034$

$V_2 = 3.206$

$V_2 = 3.2\ m/s$ @ 25° below horiz

y

$p_i = p_f$

$V_1 \sin 65 = V_2 \sin 25$

$V_1 = V_2 \frac{\sin 25}{\sin 65}$

$V_1 = 0.4663\, V_2$

$V_1 = 0.46636 (4.1)$

$= 1.912$

$= 1.9\ m/s$ @ 65° above Horiz

Just for Fun

$V_2 = V_1 \frac{\sin 65}{\sin 25} = 2.1445 V_1$

$4.5 = V_1 \cos 65 + 2.1445 V_1 \cos$

6.5

Formulas

$d = p_2 - p_1$ $\quad v = \frac{\Delta d}{\Delta t}$ $\quad a = \frac{\Delta v}{\Delta t}$

$$V_f = V_i + at$$

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

$$d = V_i t + 1/2at^2$$

$$d = V_f t - 1/2at^2$$

$$d = \left(\frac{Vf + Vi}{2}\right)t$$

$F = ma$ $\quad g = 9.8 m/s^2$

$f = \mu F_N$

$$a = \frac{\sum F}{\sum m}$$

$p_i = p_f$ $\quad p = mv$

$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$

$F\Delta t = \Delta p$

Name:_____ Momentum and Energy Test

Part A: Matching (5 marks) *Please write the letter next to the corresponding number*

1. Impulse
2. Momentum
3. Elastic Collision
4. Inelastic Collision
5. Law of Conservation of Energy
6. Kinetic Energy
7. Work Energy Theorem
8. Mass
9. Work
10. Potential Energy

a. SI unit is kg.
b. A force that acts against the motion.
c. The product between the net force and the time the force was applied.
d. A push or a pull.
e. Energy that an object has due to gravity.
f. The fact that when work is done to an object, it creates a change in kinetic energy.
g. The product between a mass and its velocity.
h. The fact that energy is neither created nor destroyed.
i. A collision where all energy is conserved.
j. SI units are in seconds.
k. Force applied to an object over a distance.
l. A collision where energy is lost.
m. Energy that an object has due to its motion.
n. An object that has independent vertical and horizontal motions.

Part B: Multiple Choice (10 marks)

1. Two objects collide. It is an inelastic collision. Which of the following is true?
   a. Momentum is conserved before and after a collision.
   b. Momentum is not conserved after a collision.
   c. Momentum increases after a collision.
   d. Momentum increases then decreases after a collision.
2. What average force will stop a hammer with an impulse of 50kg m/s in 0.5s?
   a. 0.01N
   b. 25N
   c. 50N
   d. 100N
3. How much momentum does a 110kg linebacker have if they are moving at 4.5m/s?
   a. 24 kg m/s
   b. 48 kg m/s
   c. 495 kg m/s
   d. 5.0×10^2 kg m/s

4. A soccer ball is kicked at a wall and only bounces back half way. How come it didn't bounce all the way back?
    a. Energy was destroyed.
    b. Energy was lost in the form of heat and sound when it hit the wall and heat from friction while it rolled on the ground.
    c. Energy was lost in the form of chemical energy when it hit the wall.
    d. Energy was lost in the form of electromagnetism due to electrical wires in the wall.
5. What is the kinetic energy of a car (m=1300kg) that is moving with a velocity of 25m/s?
    a. 33 000J
    b. 410 000J
    c. 810 000J
    d. 820 000J
6. What is the gravitational potential energy of a rock (m=1.2kg) held 14m above the ground?
    a. 40.J
    b. 80.J
    c. 160J
    d. 320J
7. What is the velocity of a 5.4kg package the moment before it hits the ground if it was dropped from a height of 3.0m?
    a. 5.0m/s
    b. 5.4m/s
    c. 7.2m/s
    d. 7.7m/s

8. How high does a 3.2kg box go if it is thrown upward with a velocity of 12.1m/s?
    a. 7.5m/s
    b. 7.9m/s
    c. 10.m/s
    d. 15m/s
9. How much work is required to move a 12 kg baby from the ground to 1.5m up?
    a. 90.J
    b. 180J
    c. 270J
    d. 540J.

10. What is the impulse on an object if it experiences a force of 35N for 2.0s?
    a. 35 Ns
    b. 70Ns
    c. 70.Ns
    d. 105Ns

Part C: Long Answer (29 marks)

1. A 6.5 kg cart travelling at 12.7m/s collides with a stationary 3.4kg cart, and the two carts stick together. What is their common velocity after the collision? Include a diagram. (3 marks)

2. A 820kg motorcycle moving north at 23.2m/s collides with a 1200kg car moving east at 12.3m/s. The two cars are stuck together. In what direction and at what speed do they move after the collision? (5 marks)

3. A bomb (m=340kg) is dropped from a plane that is 1100m in the air
    a. What is its kinetic energy when it is 178m above the ground? (2 marks)

    b. What is its velocity when it is 178m above the ground (2 marks)

    c. What is its velocity when it hits the ground? (3 marks)

4. Dr. Ken Hurt (m=75kg) rolled down a frictionless hill that was 65m vertically up from the base.
    a. What is his gravitational potential energy at the top of the hill? (1 mark)

    b. What is his kinetic energy at the bottom of the hill and his velocity? (3 marks)

    c. Ken continues to roll up a second hill that has friction and an angle of elevation of 45°. He comes to a stop 45m vertically up from the base. What is the coefficient of friction on the hill? (5 marks)

Name:_____ Circular Motion and Universal Gravity Test

Part A: Matching (5 marks)

f 1. Velocity	a. A change in position
a 2. Displacement	b. A quantity with both direction and magnitude
d 3.Force	c. A force that opposes motion
h 4.Distance	d. The SI unit is Newton
b 5.Vector	e. An acceleration directed towards the centre of the circle.
M 6.Scalar	f. The displacement divided by the time to make the displacement
c 7.Friction	g. The number of rotations per second
j 8.Normal Force	h. A scalar quantity measuring how far you travelled
g 9.Frequency	i. The SI unit is in kg
e 10.Centripetal acceleration	j. The force that a surface pushes back on an object
	k. A quantity with just direction
	l. A change in distance
	m. A quantity with just magnitude
	n. The amount of time for one revolution to occur.

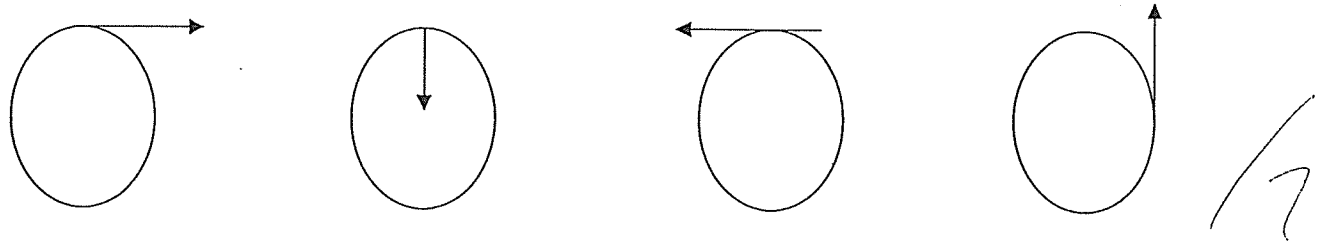
37

Part B: Multiple Choice (10 marks)

C 1. An object moves with a constant velocity of 6.0m/s in a circular path of radius 2.0m. Find the magnitude of the acceleration.
   a. $0 m/s^2$
   b. $5.0 m/s^2$
   c. $18 m/s^2$
   d. $90 m/s^2$

A 2. A toy plane attached to a string is spinning in a clockwise circle when the string breaks at the apex (top) of the motion. Which diagram represents the direction of the velocity (arrow)?

a. b. c. d.



17

C

3. Coney Island in New York boasts of having the fastest carousel ride in the world. The merry-go-round takes riders on a spin of 8.0m/s and the radius of the ride is 7.4m. Determine the centripetal acceleration.
   a. $4.0 m/s^2$
   b. $8.0 m/s^2$
   c. $8.6 m/s^2$
   d. $10. m/s^2$
4. Using the information in question3,determine the time it takes for the riders to complete onerevolution.
   a. 3.2s

B

   b. 5.8s
   c. 6.0s
   d. 8.0s

A

5. If the radius of the moon's orbit is on average 385000km from the centre of the Earth and the moon's period is 27.3 days, what is the centripetal acceleration?
   a. $2.73 \times 10^{-3} m/s^2$
   b. $3.67 \times 10^{-3} m/s^2$
   c. $2.73 \times 10^{-6} m/s^2$
   d. $3.67 \times 10^{-6} m/s^2$

A

6. If the mass of the Earth doubled, what happens to the force of gravity?
   a. It doubles
   b. It is halved
   c. It grows by a factor of four
   d. It shrinks by a factor four

B

7. A person weighing 500N sits on the floor. They exert a force on the floor of
   a. 1000N
   b. 500N
   c. 250N
   d. 125N

A

8. The mass of an object at the surface of the Earth compared to the mass of the same object at a distance of two earth radii from the surface is
   a. The same
   b. One quarter
   c. One half
   d. One ninth

/6

9. What is the force of gravity on a satellite (m=1000.kg) that is orbiting 25600km above the Earth?
   a. 402N away from the Earth
   b. 402N towards the Earth
   c. 390N away from the Earth
   d. 390N towards the Earth

10. If the Earth's radius were to ~~shrink~~ increase by a factor of two, then the acceleration would be
   a. The same
   b. One quarter
   c. One half
   d. One ninth

Long Answer

1. A motorcycle wheel with a radius of 73cm undergoes 82 rotations in 27s. Find the centripetal acceleration at any point on the wheel. (2 marks)

$r = 0.73$

$f = 82/27$

$a_c =$

$a_c = 4\pi^2 r f^2$

$= 4\pi^2 (0.73)\left(\frac{82}{27}\right)^2$

$= 265.8$

$= 270 \text{ m/s}^2$

2. The outer edge of a 15cm diameter plate experiences an acceleration of 3.2m/s^2. What is the speed of the plate? (2 marks)

$v = \sqrt{ar}$

$= \sqrt{2.7(0.075)}$ $= 0.49 \text{ m/s}$

$= 0.63 \text{ m/s}$

3. What is the centripetal force experience by the plate in question 3 if it has a mass of 250g? (1 mark)

$F = ma$ 3.2

$= 0.250(3.6)$ $= 0.90$

$= 2.45$

$= 2.5 \text{ N}$

/7

4. On Earth, two parts of a rocket weigh 15000N and 12345N. These parts are separated from a centre-to-centre distance of 12m. Find the magnitude of the gravitational force that each part exerts on the other out in space, far from any other objects. (5 marks)

$m_1 = \frac{F_g}{g} = \frac{15000}{9.8} = 1530.6$

$m_2 \frac{F_g}{g} = \frac{12345}{9.8} = 1259.69$

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

$= \frac{6.67 \times 10^{-11}(1530.6)(1259.69)}{12^2}$

$= 8.9 \times 10^{-7}\ N$

5. An alien weighs 9876N on Earth. What will the alien weigh on their home planet whose radius is 5 times that of Earth and whose mass is half that of Esrth's? (3 marks)

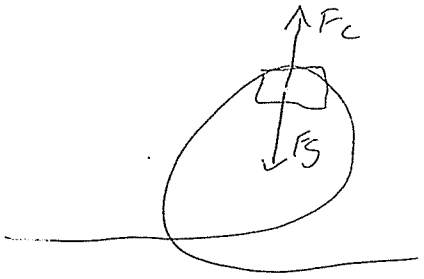
$F_g \propto \frac{\frac{1}{2}}{5^2} = \left(\frac{1}{50}\right)(9876) = 197.5\ N$

6. Calculate the acceleration of gravity on Jupiter. Jupiter has a mass of 1.90×10^{27}kg and a radius of 6.99×10^{7}m (3 marks)

$a_c = \frac{Gm}{r^2} = \frac{6.67 \times 10^{-11}(1.90 \times 10^{27})}{(6.99 \times 10^{7})^2}$

$= 25.9\ m/s^2$

7. On a roller coaster, how fast does the roller coaster have to go to survive a loop with a radius of 16m? Please draw a FBD. (3 marks)



$F_c = F_g$

$\frac{mv^2}{r} = mg$

$v = \sqrt{rg}$

$= \sqrt{16(9.8)}$

$= 13 \text{ m/s}$

8. How should they design a highway such that a car travelling at 80.km/h can successfully navigate a curve of 50.m? (3 marks)

$\frac{80\text{km}}{\text{h}} \cdot \frac{\text{h}}{3600} \cdot \frac{1000\text{m}}{1\text{km}}$

$=$

$= 22.\overline{22}$

$\tan\theta = \frac{v^2}{rg}$

$\theta = \tan^{-1}\left(\frac{v^2}{rg}\right)$

$= \tan^{-1}\left(\frac{22.22^2}{50(9.8)}\right)$

$= 95.2°$

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Name:_____ Date:_____

Physics 12

Circular Motion, Work and Energy Test

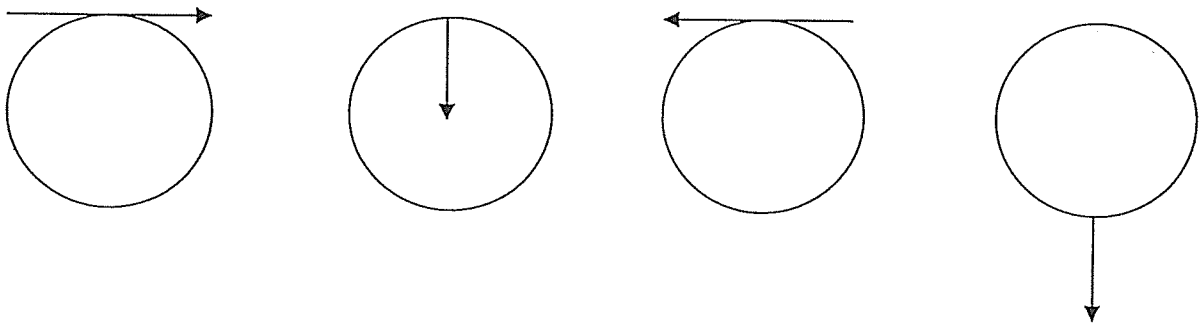
Part A: Matching (5 marks). Write the letters next to the correct term

1. Kinetic Energy	a)Center seeking acceleration.
2. Law of Conservation of Energy	b) A theorem that states that work done on object causes a change in kinetic energy.
3. Banked curve	c) The idea that all energy can not be created or destroyed.
4. Potential Energy	d) SI unit is seconds
5. Centripetal acceleration	e) A push or a pull
6. Work Energy Theorem	f) A force that always acts against the motion
7. Work	g) A concept that uses gravity to balance centripetal force.
8. Period	h) Every action has an equal and opposite reaction
9. Force	i) Energy that an object has due to gravity.
10. Frequency	j) The number of revolutions in 1 second
	k) The length of time for one revolution to occur.
	l) The product between an objects mass and velocity.
	m) Energy that an object has due to movement
	n) The change in mechanical (Potential or Kinetic Energy)

Part B: Multiple Choice (10marks)

1. An object of mass 5kg moves at a constant velocity of 6m/s in a circular path of radius 2m. Find the magnitude of the acceleration
   a. $0 m/s^2$
   b. $18 m/s^2$
   c. $3 m/s^2$
   d. $5 m/s^2$
2. A toy plane attached to a string is spinning in a clockwise circle when the string breaks at the apex of the motion. What diagram represents the direction of the velocity (arrow)?

a) b) c) d)



3. Elmira, New York boasts of having the fastest carousel ride in the world. The merry-go-round takes riders on a spin of 8.0m/s and the radius of the ride is 7.4m. Determine the time it takes for the riders to complete one revolution?
    a. 5.8s
    b. 6.0s
    c. 8.0s
    d. 3.2s
4. Using the information from 3, find the centripetal acceleration?
    a. $4.0 m/s^2$
    b. $8.0 m/s^2$
    c. $10 m/s^2$
    d. $8.6 m/s^2$
5. If the radius of the moon's orbit is on average 385000 km from the centre of the earth and the Moon's period is 27.3 days, what is its centripetal acceleration?
    a. $3.67X10^{-3} m/s^2$
    b. $2.73X10^{-3} m/s^2$
    c. $2.73X10^{-6} m/s^2$
    d. $3.67X10^{-6} m/s^2$
6. A soccer ball is kicked at a wall and only bounces back halfway. How come it didn't bounce all the way back?
    a. Energy was destroyed
    b. Energy was lost in the form of heat and sound when it hit the wall and heat from friction while it rolled on the ground.
    c. Energy was lost in the form of chemical energy when it hit the wall.
    d. Energy was lost in the form of electromagnetism due to the electrical wires in the wall.
7. What is the change in gravitational potential energy as a 3500 kg object is raised vertically from 5 meters off the surface of the earth to a height of 25.0 m?
    a. 8.58×10^5 N
    b. 6.86×10^5 N
    c. 7.00×10^4 N
    d. 3.43×10^4 N
8. A 950 kg elevator ascends a vertical height of 410 m with an average speed of 9.1 m/s. What average power must be supplied from the lifting motor?
    a. 8.47×10^4 W
    b. 3.82×10^6 W
    c. 8.66×10^4 W
    d. 4.19×10^5 W
9. A 2.5 kg ball is thrown vertically down from a bridge of height 55.0 m with an initial speed of 5.0 m/s, what is the velocity of the ball when it is 20.0 meters off the ground?
    a. 19.2 m/s
    b. 26.7 m/s
    c. -19.2 m/s
    d. -26.7 m/s

10. A 60.0 kg girl runs up a flight of stairs 5.32 m high in 4.60 s. what is her power output in Watts?
    a. 3100 W
    b. 588 W
    c. 69.4 W
    d. 680. W

Part C: Long Answer

1. A particle beam accelerator has a radius of 1.0km. The Lead atoms in the accelerator have a velocity of 250m/s.
    a. What is their acceleration? (1 mark)

    b. If the atoms have a mass of $3.44X10^{-25}$kg, how much force is applied to the atom? (1 mark)

    c. How much kinetic energy do the atoms have? (1 marks)

2. A dare devil motorcyclist goes down a ramp and around a vertical. If the loop has a radius of 12m, what is the slowest speed the rider can have at the top of the loop to avoid falling? Draw a free body diagram.(3 marks)

3. A lawn mower is pushed across a lawn by a force of 210N at a 31^0 angle above the horizontal. If 73.5W of power is developed over 78s, what distance did it travel? (4 marks)

4. a. A skier (m=75kg) starts at the top of a hill that is 630m high and finishes at the bottom. What is his speed if no energy is lost? The angle of the hill is 35^0. (3 marks) Show all formulas and calculations to get full marks for each part to this question.

b. The skier then continues up a second hill and stops at a height of 450m and of this hill is 25^o. What was the work done by friction? (4 marks)

c. What was the force of friction? (3 marks)

Formulas

Motion

$d = p_2 - p_1$ $\quad v = \frac{\Delta d}{\Delta t}$ $\quad a = \frac{\Delta v}{\Delta t}$

$V_f = V_i + at$ $\quad V_f{}^2 = V_i{}^2 + 2ad$ $\quad d = V_i + \frac{1}{2}at^2$

$d = V_f - \frac{1}{2}at^2$ $\quad d = (\frac{V_f + V_i}{2})t$

Dynamics

F = ma $\quad$ g=9.8m/s^2

f=μF$_N$

$a = \frac{\sum F}{\sum m}$

Momentum

p_i=p_f $\quad$ p=mv

$m_1v_{1i} + m_2v_{2i} = m_1v_{2i} + m_1v_{2f}$

FΔt=Δp

Circular Motion

$a_c = \frac{v^2}{r}$ $\quad F_c = \frac{mv^2}{r}$ $\quad a_c = 4\pi^2 r f^2$ $\quad a_c = \frac{4\pi^2 r}{T^2}$ $\quad T = \frac{1}{f}$

Energy and Work

$E_i = E_f$ $\quad PE = mgh$ $\quad KE = \frac{1}{2}mv^2$ $\quad W = Fd$

Math

$C = 2\pi r$

$sin\theta = \frac{O}{H} \quad cos\theta = \frac{A}{H} \quad tan\theta = \frac{O}{A}$