Mechanics Review Test
June 2008

Name_____

This year there were 46 credits possible of 85 or about 54% of the test

1 The speedometer in a car does *not* measure the car's velocity because velocity is a

(1) vector quantity and has a direction associated with it
(2) vector quantity and does not have a direction associated with it
(3) scalar quantity and has a direction associated with it
(4) scalar quantity and does not have a direction associated with it

2 A projectile launched at an angle of 45° above the horizontal travels through the air. Compared to the projectile's theoretical path with no air friction, the actual trajectory of the projectile with air friction is

(1) lower and shorter
(2) lower and longer
(3) higher and shorter
(4) higher and longer

3 Cart *A* has a mass of 2 kilograms and a speed of 3 meters per second. Cart *B* has a mass of 3 kilograms and a speed of 2 meters per second. Compared to the inertia and magnitude of momentum of cart *A*, cart *B* has

(1) the same inertia and a smaller magnitude of momentum
(2) the same inertia and the same magnitude of momentum
(3) greater inertia and a smaller magnitude of momentum
(4) greater inertia and the same magnitude of momentum

4 Approximately how much time does it take light to travel from the Sun to Earth?

(1) 2.00×10^{-3} s
(2) 1.28×10^{0} s
(3) 5.00×10^{2} s
(4) 4.50×10^{19} s

5 A rock falls from rest a vertical distance of 0.72 meter to the surface of a planet in 0.63 second. The magnitude of the acceleration due to gravity on the planet is

(1) 1.1 m/s^2
(2) 2.3 m/s^2
(3) 3.6 m/s^2
(4) 9.8 m/s^2

6 Two stones, *A* and *B*, are thrown horizontally from the top of a cliff. Stone *A* has an initial speed of 15 meters per second and stone *B* has an initial speed of 30. meters per second. Compared to the time it takes stone *A* to reach the ground, the time it takes stone *B* to reach the ground is

(1) the same
(2) twice as great
(3) half as great
(4) four times as great

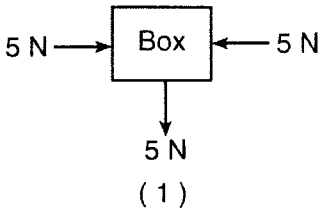
7 The speed of an object undergoing constant acceleration increases from 8.0 meters per second to 16.0 meters per second in 10. seconds. How far does the object travel during the 10. seconds?

(1) 3.6×10^{2} m
(2) 1.6×10^{2} m
(3) 1.2×10^{2} m
(4) 8.0×10^{1} m

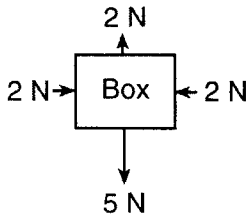
8 A 1200-kilogram space vehicle travels at 4.8 meters per second along the level surface of Mars. If the magnitude of the gravitational field strength on the surface of Mars is 3.7 newtons per kilogram, the magnitude of the normal force acting on the vehicle is

(1) 320 N
(2) 930 N
(3) 4400 N
(4) 5800 N

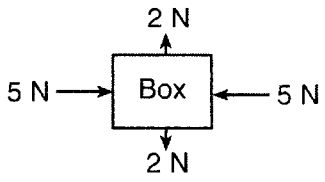
9 Which diagram represents a box in equilibrium?



(1)



(3)



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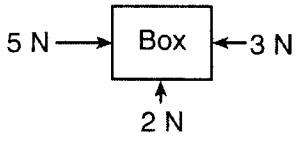
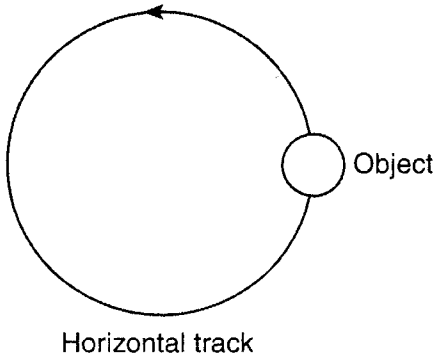
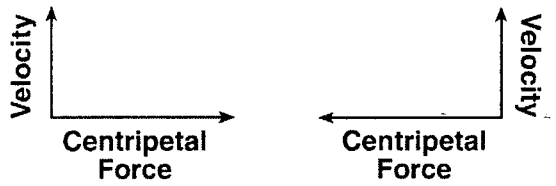


(4)

10 The diagram below shows an object moving counterclockwise around a horizontal, circular track.

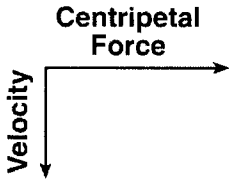


Which diagram represents the direction of both the object's velocity and the centripetal force acting on the object when it is in the position shown?

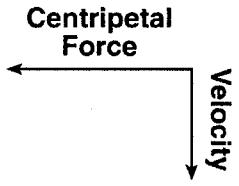


(1)

(2)



(3)



(4)

11 An airplane flies with a velocity of 750. kilometers per hour, 30.0° south of east. What is the magnitude of the eastward component of the plane's velocity?

(1) 866 km/h
(2) 650. km/h
(3) 433 km/h
(4) 375 km/h

12 An 80-kilogram skier slides on waxed skis along a horizontal surface of snow at constant velocity while pushing with his poles. What is the horizontal component of the force pushing him forward?

(1) 0.05 N
(2) 0.4 N
(3) 40 N
(4) 4 N

13 A 1750-kilogram car travels at a constant speed of 15.0 meters per second around a horizontal, circular track with a radius of 45.0 meters. The magnitude of the centripetal force acting on the car is

(1) 5.00 N
(2) 583 N
(3) 8750 N
(4) 3.94×10^5 N

14 A 0.45-kilogram football traveling at a speed of 22 meters per second is caught by an 84-kilogram stationary receiver. If the football comes to rest in the receiver's arms, the magnitude of the impulse imparted to the receiver by the ball is

(1) 1800 N•s
(2) 9.9 N•s
(3) 4.4 N•s
(4) 3.8 N•s

Note that question 15 has only three choices.

15 A carpenter hits a nail with a hammer. Compared to the magnitude of the force the hammer exerts on the nail, the magnitude of the force the nail exerts on the hammer during contact is

(1) less
(2) greater
(3) the same

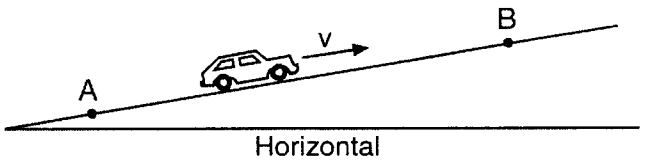
16 As a meteor moves from a distance of 16 Earth radii to a distance of 2 Earth radii from the center of Earth, the magnitude of the gravitational force between the meteor and Earth becomes

(1) $\frac{1}{8}$ as great
(2) 8 times as great
(3) 64 times as great
(4) 4 times as great

17 A 60.-kilogram student climbs a ladder a vertical distance of 4.0 meters in 8.0 seconds. Approximately how much total work is done against gravity by the student during the climb?

(1) 2.4×10^3 J
(2) 2.9×10^2 J
(3) 2.4×10^2 J
(4) 3.0×10^1 J

18 A car travels at constant speed v up a hill from point A to point B, as shown in the diagram below.



As the car travels from A to B, its gravitational potential energy

(1) increases and its kinetic energy decreases
(2) increases and its kinetic energy remains the same
(3) remains the same and its kinetic energy decreases
(4) remains the same and its kinetic energy remains the same

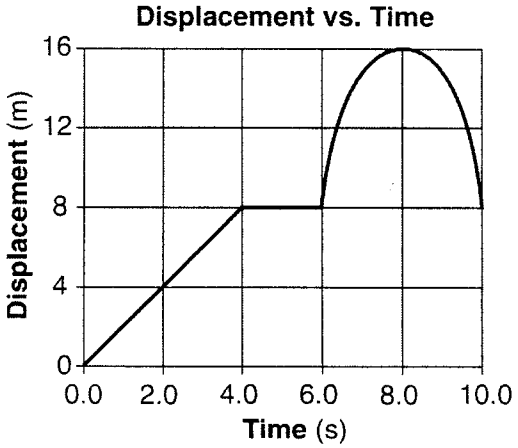
19 What is the maximum amount of work that a 6000.-watt motor can do in 10. seconds?

(1) 6.0×10^1 J
(2) 6.0×10^2 J
(3) 6.0×10^3 J
(4) 6.0×10^4 J

36 The mass of a paper clip is approximately

(1) 1×10^6 kg
(2) 1×10^3 kg
(3) 1×10^{-3} kg
(4) 1×10^{-6} kg

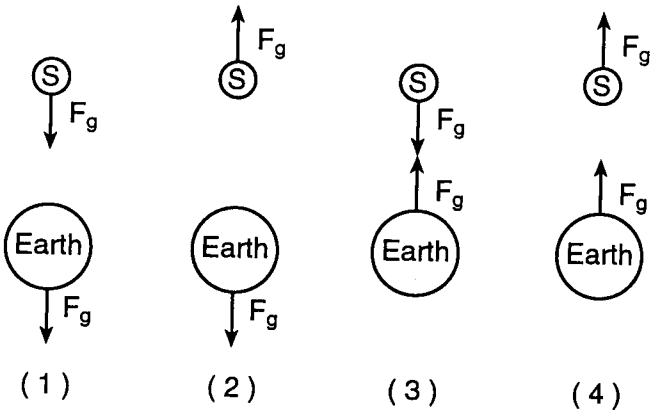
37 The graph below represents the displacement of an object moving in a straight line as a function of time.



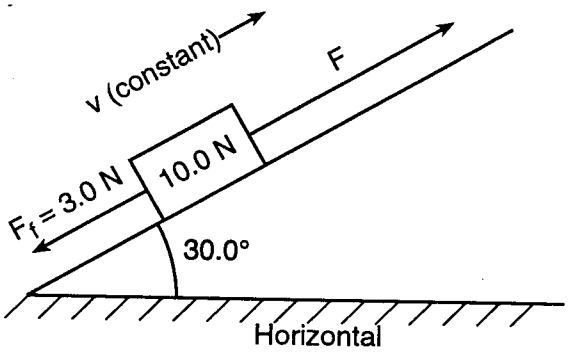
What was the total distance traveled by the object during the 10.0-second time interval?

(1) 0 m
(2) 8 m
(3) 16 m
(4) 24 m

38 Which diagram best represents the gravitational forces, F_g, between a satellite, S, and Earth?



39 A block weighing 10.0 newtons is on a ramp inclined at 30.0° to the horizontal. A 3.0-newton force of friction, F_f, acts on the block as it is pulled up the ramp at constant velocity with force F, which is parallel to the ramp, as shown in the diagram below.



(Vectors not drawn to scale)

What is the magnitude of force F?

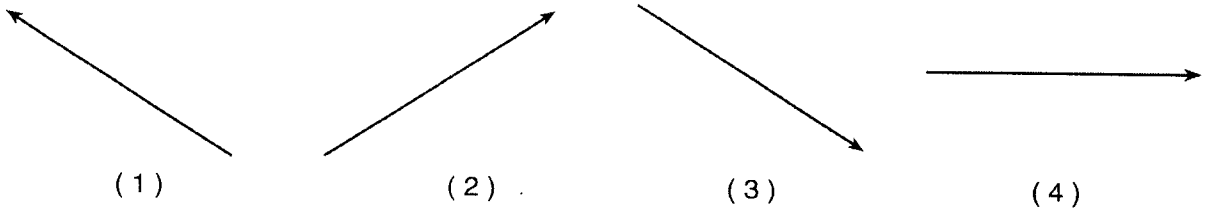
(1) 7.0 N
(2) 8.0 N
(3) 10. N
(4) 13 N

40 A 25-newton horizontal force northward and a 35-newton horizontal force southward act concurrently on a 15-kilogram object on a frictionless surface. What is the magnitude of the object's acceleration?

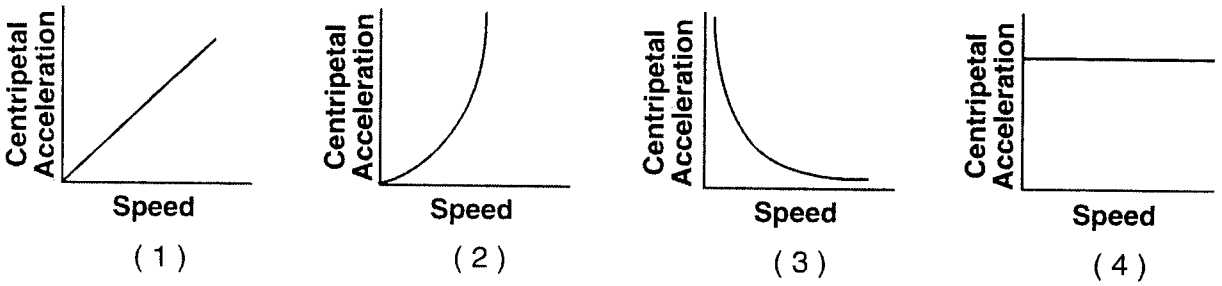
(1) 0.67 m/s^2
(2) 1.7 m/s^2
(3) 2.3 m/s^2
(4) 4.0 m/s^2

41 The diagram below represents two concurrent forces.

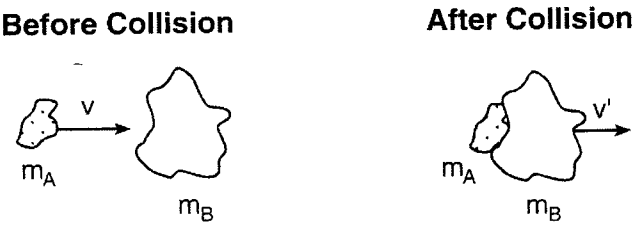
Which vector represents the force that will produce equilibrium with these two forces?



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



43 The diagram below represents two masses before and after they collide. Before the collision, mass m_A is moving to the right with speed v, and mass m_B is at rest. Upon collision, the two masses stick together.



Which expression represents the speed, v', of the masses after the collision? [Assume no outside forces are acting on m_A or m_B.]

(1) $\frac{m_A + m_B v}{m_A}$

(2) $\frac{m_A + m_B}{m_A v}$

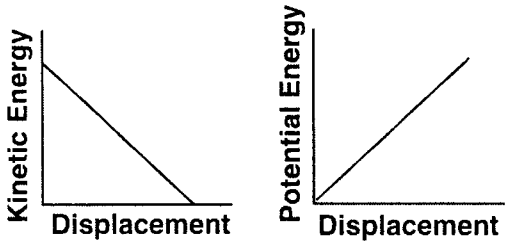
(3) $\frac{m_B v}{m_A + m_B}$

(4) $\frac{m_A v}{m_A + m_B}$

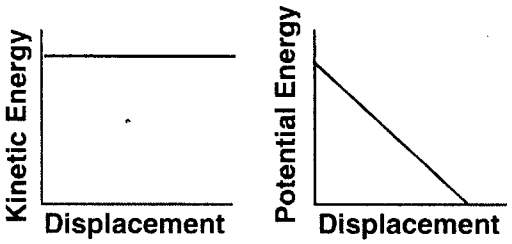
44 Which combination of fundamental units can be used to express energy?

(1) kg•m/s
(2) kg•m^2/s
(3) kg•m/s^2
(4) kg•m^2/s^2

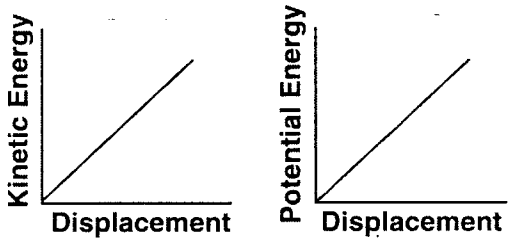
45 An object is thrown vertically upward. Which pair of graphs best represents the object's kinetic energy and gravitational potential energy as functions of its displacement while it rises?



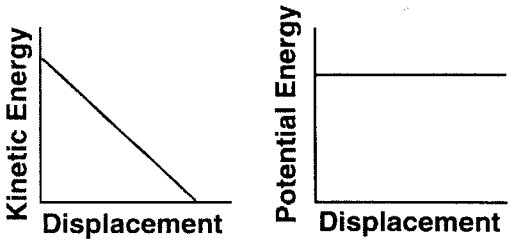
(1)



(3)



(2)



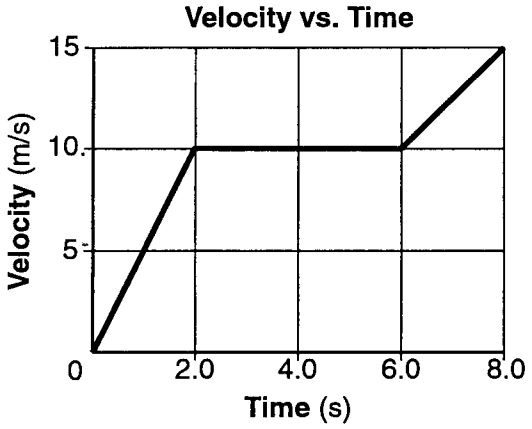
(4)

Part B–2

Answer all questions in this part.

Directions (52–61): Record your answers in the spaces provided in your answer booklet.

52 The graph below represents the velocity of an object traveling in a straight line as a function of time.



Determine the magnitude of the total displacement of the object at the end of the first 6.0 seconds. [1]

Base your answers to questions 53 and 54 on the information below.

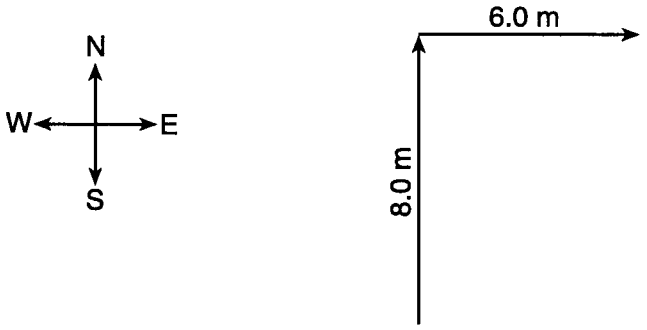
A 65-kilogram pole vaulter wishes to vault to a height of 5.5 meters.

53 Calculate the *minimum* amount of kinetic energy the vaulter needs to reach this height if air friction is neglected and all the vaulting energy is derived from kinetic energy. [Show all work, including the equation and substitution with units.] [2]

54 Calculate the speed the vaulter must attain to have the necessary kinetic energy. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 55 through 57 on the information and vector diagram below.

A dog walks 8.0 meters due north and then 6.0 meters due east.



55 Using a metric ruler and the vector diagram, determine the scale used in the diagram. [1]

56 On the diagram *in your answer booklet,* construct the resultant vector that represents the dog's total displacement. [1]

57 Determine the magnitude of the dog's total displacement. [1]

Part C

Answer all questions in this part.

Directions (62–76): Record your answers in the spaces provided in your answer booklet.

Base your answers to questions 62 through 64 on the information below.

A kicked soccer ball has an initial velocity of 25 meters per second at an angle of 40.° above the horizontal, level ground. [Neglect friction.]

62 Calculate the magnitude of the vertical component of the ball's initial velocity. [Show all work, including the equation and substitution with units.] [2]

63 Calculate the maximum height the ball reaches above its initial position. [Show all work, including the equation and substitution with units.] [2]

64 On the diagram *in your answer booklet,* sketch the path of the ball's flight from its initial position at point *P* until it returns to level ground. [1]

Base your answers to questions 68 through 71 on the information and data table below.

The spring in a dart launcher has a spring constant of 140 newtons per meter. The launcher has six power settings, 0 through 5, with each successive setting having a spring compression 0.020 meter beyond the previous setting. During testing, the launcher is aligned to the vertical, the spring is compressed, and a dart is fired upward. The maximum vertical displacement of the dart in each test trial is measured. The results of the testing are shown in the table below.

Data Table

Power Setting	Spring Compression (m)	Dart's Maximum Vertical Displacement (m)
0	0.000	0.00
1	0.020	0.29
2	0.040	1.14
3	0.060	2.57
4	0.080	4.57
5	0.100	7.10

Directions (68–69): Using the information in the data table, construct a graph on the grid *in your answer booklet,* following the directions below.

68 Plot the data points for the dart's maximum vertical displacement versus spring compression. [1]

69 Draw the line or curve of best fit. [1]

70 Using information from your graph, calculate the energy provided by the compressed spring that causes the dart to achieve a maximum vertical displacement of 3.50 meters. [Show all work, including the equation and substitution with units.] [2]

71 Determine the magnitude of the force, in newtons, needed to compress the spring 0.040 meter. [1]

Mechanics Review Test

June 2008

Name _____

Answers

1 _____
2 _____
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7 _____
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9 _____
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17 _____
18 _____
19 _____
36 _____
37 _____
38 _____
39 _____
40 _____

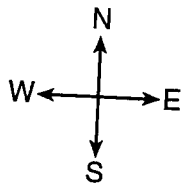
41 _____
42 _____
43 _____
44 _____
45 _____

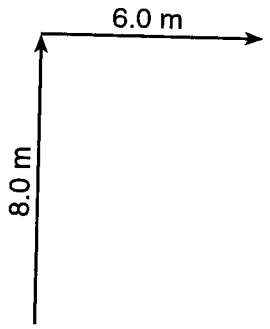
52 displacement = _____ meter

53 -

54 -

55 - 1 km = _____ meter





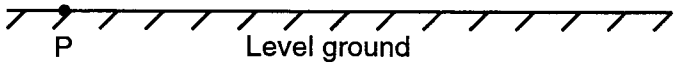
56 - On Diagram

57 displacement = _____ m

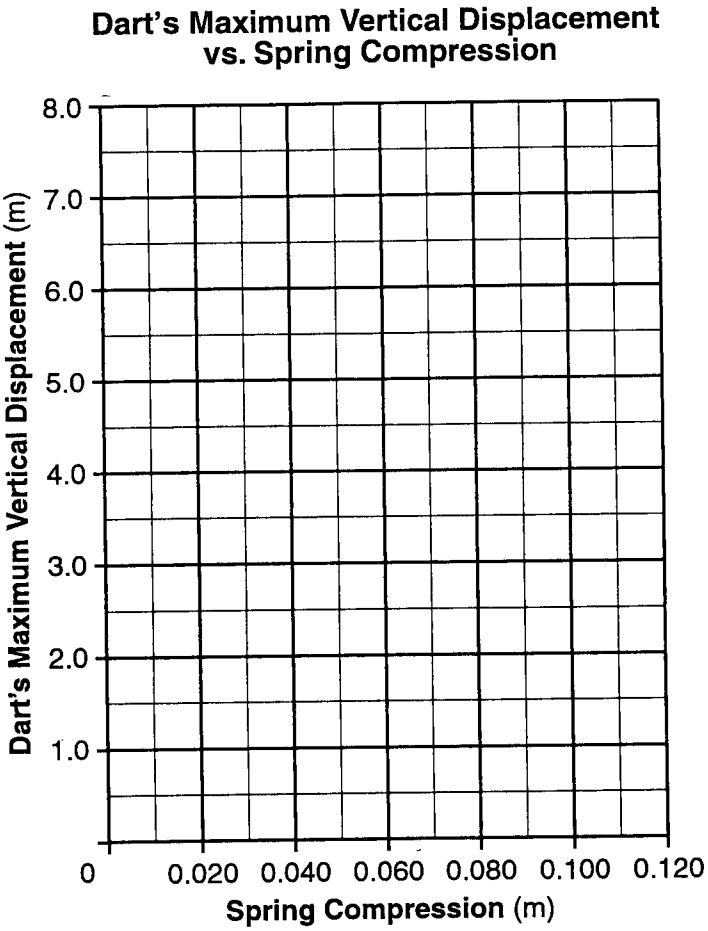
62

63 -

64 -



68 - 69
on graph



70 -

71 - Force = _____ Newtons

Mechanics Review Test
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Name Answer Key

Answers

1 1	9 2	17 1	41 3
2 1	10 2	18 2	42 2
3 4	11 2	19 4	43 4
4 3	12 3	36 3	44 4
5 3	13 3	37 4	45 1
6 1	14 2	38 3	
7 3	15 3	39 2	
8 3	16 3	40 1	

52 displacement = 50 meters

53 - KE changes to PE

$KE = PE = mgh$

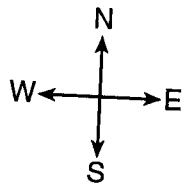
$= 65K(10\ m/s^2)(5.5\ m) = 3500J$

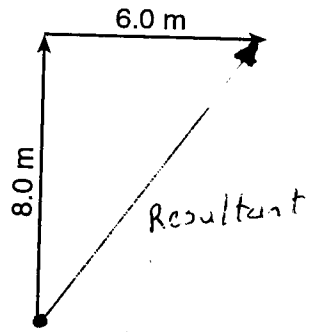
54 - $KE = \frac{1}{2}mv^2$

$3500J = \frac{1}{2}65K(v)^2$

$v = 10\ m/s$

55 - 1 cm = 2 meter





56 - On Diagram

57 displacement = 10 m

62

$V_{vert} = V\sin\theta$ OR $A_y = A\sin\theta$

$= 25\ m/s(\sin 40^\circ)$

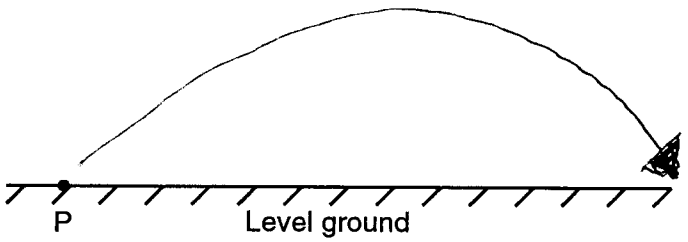
$V_y = 16\ m/s$

63 - $V_{F_y}^2 = V_{i_y}^2 + 2ad_y$

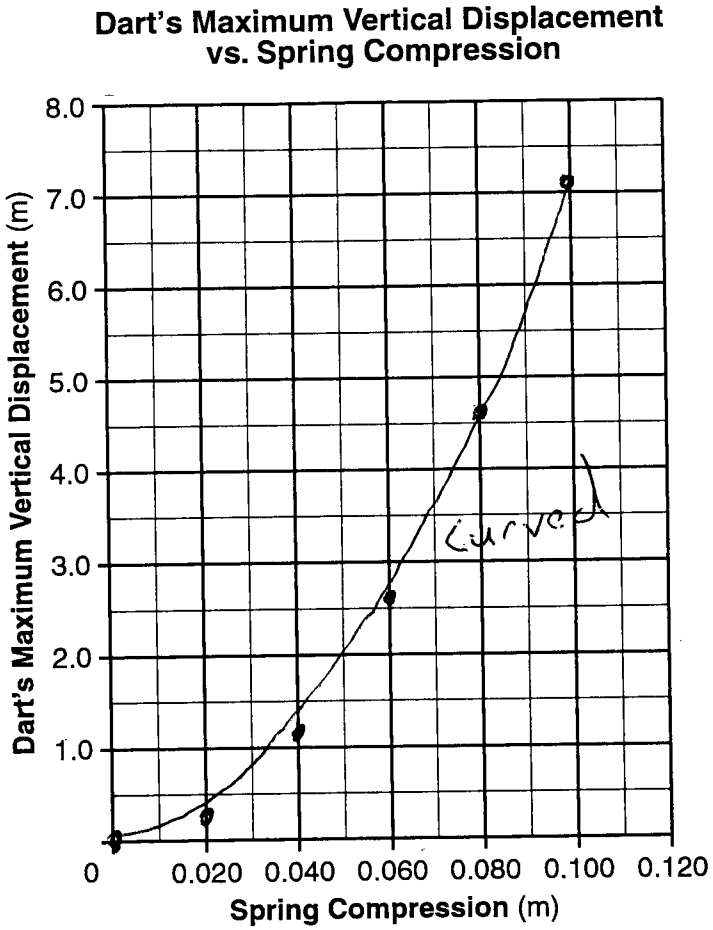
$(0\ m/s)^2 = (16\ m/s)^2 + 2(-10\ m/s^2)d_y$

$d_y = 13\ m$

64 -



68-69 on graph



70 - $PE_s = \frac{1}{2}kx^2$

$= \frac{1}{2}\left(140\frac{N}{m}\right)(.07m)^2$

$= .343$

71 - Force = 5.6 Newtons

$F = kx$

$F = 140\frac{N}{m}(.04m)$

Credits of 46	%	Credits of 85	Scaled Regents score
46	100.0	85	100
45	97.8	83.2	98
44	95.7	81.3	96
43	93.5	79.5	95
42	91.3	77.6	94
41	89.1	75.8	92
40	87.0	73.9	90
39	84.8	72.1	88
38	82.6	70.2	86
37	80.4	68.4	85
36	78.3	66.5	84
35	76.1	64.7	82
34	73.9	62.8	80
33	71.7	61.0	78
32	69.6	59.1	77
31	67.4	57.3	74
30	65.2	55.4	72
29	63.0	53.6	71
28	60.9	51.7	70
27	58.7	49.9	68
26	56.5	48.0	65
25	54.3	46.2	63
24	52.2	44.3	61
23	50.0	42.5	60
22	47.8	40.7	58
21	45.7	38.8	56
20	43.5	37.0	54
19	41.3	35.1	51
18	39.1	33.3	49
17	37.0	31.4	46
16	34.8	29.6	45
15	32.6	27.7	43
14	30.4	25.9	40
13	28.3	24.0	37