June 2009
Mechanics Review Test

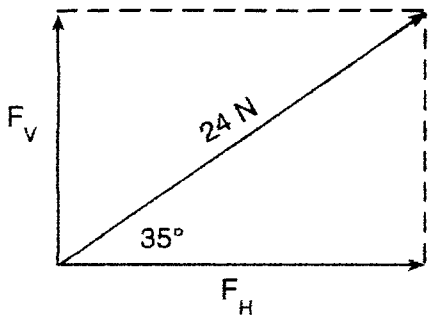
Name _____

In this test mechanics was worth 43 of a possible 85 credits or about 51% of test

1 On a highway, a car is driven 80. kilometers during the first 1.00 hour of travel, 50. kilometers during the next 0.50 hour, and 40. kilometers in the final 0.50 hour. What is the car's average speed for the entire trip?

(1) 45 km/h
(2) 60. km/h
(3) 85 km/h
(4) 170 km/h

2 The vector diagram below represents the horizontal component, F_H, and the vertical component, F_V, of a 24-newton force acting at 35° above the horizontal.



What are the magnitudes of the horizontal and vertical components?

(1) F_H = 3.5 N and F_V = 4.9 N
(2) F_H = 4.9 N and F_V = 3.5 N
(3) F_H = 14 N and F_V = 20. N
(4) F_H = 20. N and F_V = 14 N

3 Which quantity is a vector?

(1) impulse
(2) power
(3) speed
(4) time

4 A high-speed train in Japan travels a distance of 300. kilometers in 3.60×10^3 seconds. What is the average speed of this train?

(1) 1.20×10^{-2} m/s
(2) 8.33×10^{-2} m/s
(3) 12.0 m/s
(4) 83.3 m/s

5 A 25-newton weight falls freely from rest from the roof of a building. What is the total distance the weight falls in the first 1.0 second?

(1) 19.6 m
(2) 9.8 m
(3) 4.9 m
(4) 2.5 m

6 A golf ball is given an initial speed of 20. meters per second and returns to level ground. Which launch angle above level ground results in the ball traveling the greatest horizontal distance? [Neglect friction.]

(1) 60.°
(2) 45°
(3) 30.°
(4) 15°

Base your answers to questions 7 and 8 on the information below.

A go-cart travels around a flat, horizontal, circular track with a radius of 25 meters. The mass of the go-cart with the rider is 200. kilograms. The magnitude of the maximum centripetal force exerted by the track on the go-cart is 1200. newtons.

7 What is the maximum speed the 200.-kilogram go-cart can travel without sliding off the track?

(1) 8.0 m/s
(2) 12 m/s
(3) 150 m/s
(4) 170 m/s

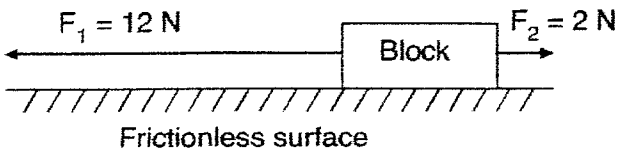
8 Which change would increase the maximum speed at which the go-cart could travel without sliding off this track?

(1) Decrease the coefficient of friction between the go-cart and the track.
(2) Decrease the radius of the track.
(3) Increase the radius of the track.
(4) Increase the mass of the go-cart.

9 A 0.50-kilogram cart is rolling at a speed of 0.40 meter per second. If the speed of the cart is doubled, the inertia of the cart is

(1) halved
(2) doubled
(3) quadrupled
(4) unchanged

10 Two forces, F_1 and F_2, are applied to a block on a frictionless, horizontal surface as shown below.



If the magnitude of the block's acceleration is 2.0 meters per second^2, what is the mass of the block?

(1) 1 kg
(2) 5 kg
(3) 6 kg
(4) 7 kg

11 Which body is in equilibrium?

(1) a satellite orbiting Earth in a circular orbit
(2) a ball falling freely toward the surface of Earth
(3) a car moving with a constant speed along a straight, level road
(4) a projectile at the highest point in its trajectory

12 What is the weight of a 2.00-kilogram object on the surface of Earth?

(1) 4.91 N
(2) 2.00 N
(3) 9.81 N
(4) 19.6 N

13 A 70.-kilogram cyclist develops 210 watts of power while pedaling at a constant velocity of 7.0 meters per second east. What average force is exerted eastward on the bicycle to maintain this constant speed?

(1) 490 N
(2) 30. N
(3) 3.0 N
(4) 0 N

14 The gravitational potential energy, with respect to Earth, that is possessed by an object is dependent on the object's

(1) acceleration
(2) momentum
(3) position
(4) speed

15 As a ball falls freely toward the ground, its total mechanical energy

(1) decreases
(2) increases
(3) remains the same

16 A spring with a spring constant of 4.0 newtons per meter is compressed by a force of 1.2 newtons. What is the total elastic potential energy stored in this compressed spring?

(1) 0.18 J
(2) 0.36 J
(3) 0.60 J
(4) 4.8 J

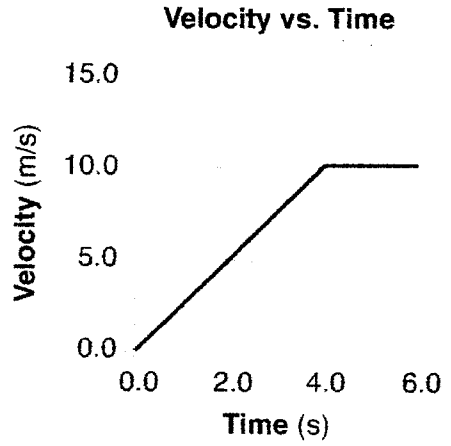
17 A distance of 1.0 meter separates the centers of two small charged spheres. The spheres exert gravitational force F_g and electrostatic force F_e on each other. If the distance between the spheres' centers is increased to 3.0 meters, the gravitational force and electrostatic force, respectively, may be represented as

(1) $\frac{F_g}{9}$ and $\frac{F_e}{9}$
(2) $\frac{F_g}{3}$ and $\frac{F_e}{3}$
(3) $3F_g$ and $3F_e$
(4) $9F_g$ and $9F_e$

36 The work done in lifting an apple one meter near Earth's surface is approximately

(1) 1 J
(2) 0.01 J
(3) 100 J
(4) 1000 J

Base your answers to questions 37 and 38 on the graph below, which represents the motion of a car during a 6.0-second time interval.



37 What is the acceleration of the car at t = 5.0 seconds?

(1) 0.0 m/s^2
(2) 2.0 m/s^2
(3) 2.5 m/s^2
(4) 10. m/s^2

38 What is the total distance traveled by the car during this 6.0-second interval?

(1) 10. m
(2) 20. m
(3) 40. m
(4) 60. m

39 A person weighing 785 newtons on the surface of Earth would weigh 298 newtons on the surface of Mars. What is the magnitude of the gravitational field strength on the surface of Mars?

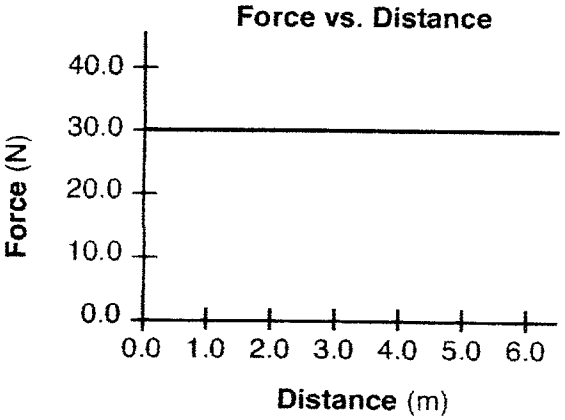
(1) 2.63 N/kg
(2) 3.72 N/kg
(3) 6.09 N/kg
(4) 9.81 N/kg

40 A motorcycle being driven on a dirt path hits a rock. Its 60.-kilogram cyclist is projected over the handlebars at 20. meters per second into a haystack. If the cyclist is brought to rest in 0.50 second, the magnitude of the average force exerted on the cyclist by the haystack is

(1) 6.0×10^1 N
(2) 5.9×10^2 N
(3) 1.2×10^3 N
(4) 2.4×10^3 N

Base your answers to questions 41 and 42 on the information below.

A boy pushes his wagon at constant speed along a level sidewalk. The graph below represents the relationship between the horizontal force exerted by the boy and the distance the wagon moves.



41 What is the total work done by the boy in pushing the wagon 4.0 meters?

(1) 5.0 J
(2) 7.5 J
(3) 120 J
(4) 180 J

42 As the boy pushes the wagon, what happens to the wagon's energy?

(1) Gravitational potential energy increases.
(2) Gravitational potential energy decreases.
(3) Internal energy increases.
(4) Internal energy decreases.

43 Which is an SI unit for work done on an object?

(1) $\frac{kg \cdot m^2}{s^2}$
(2) $\frac{kg \cdot m^2}{s}$
(3) $\frac{kg \cdot m}{s}$
(4) $\frac{kg \cdot m}{s^2}$

48 A cart travels 4.00 meters east and then 4.00 meters north. Determine the magnitude of the cart's resultant displacement. [1]

49 A 70-kilogram hockey player skating east on an ice rink is hit by a 0.1-kilogram hockey puck moving toward the west. The puck exerts a 50-newton force toward the west on the player. Determine the magnitude of the force that the player exerts on the puck during this collision. [1]

50 On a snow-covered road, a car with a mass of 1.1×10^3 kilograms collides head-on with a van having a mass of 2.5×10^3 kilograms traveling at 8.0 meters per second. As a result of the collision, the vehicles lock together and immediately come to rest. Calculate the speed of the car immediately before the collision. [Neglect friction.] [Show all work, including the equation and substitution with units.] [2]

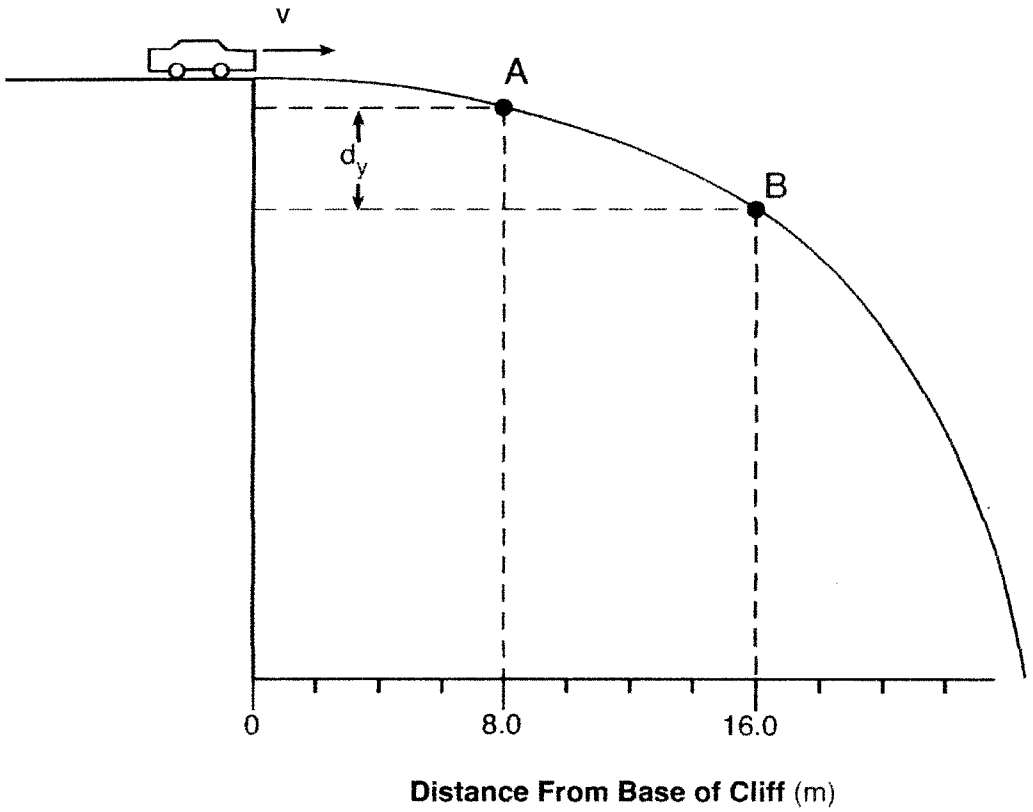
51 A baby and stroller have a total mass of 20. kilograms. A force of 36 newtons keeps the stroller moving in a circular path with a radius of 5.0 meters. Calculate the speed at which the stroller moves around the curve. [Show all work, including the equation and substitution with units.] [2]

52 A 10.-newton force compresses a spring 0.25 meter from its equilibrium position. Calculate the spring constant of this spring. [Show all work, including the equation and substitution with units.] [2]

Directions (60–72): Record your answers in the spaces provided in your answer booklet.

Base your answers to questions 60 through 62 on the information below.

The path of a stunt car driven horizontally off a cliff is represented in the diagram below. After leaving the cliff, the car falls freely to point *A* in 0.50 second and to point *B* in 1.00 second.



60 Determine the magnitude of the horizontal component of the velocity of the car at point *B*. [Neglect friction.] [1]

61 Determine the magnitude of the vertical velocity of the car at point *A*. [1]

62 Calculate the magnitude of the vertical displacement, d_y, of the car from point *A* to point *B*. [Neglect friction.] [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 63 through 65 on the information below.

A roller coaster car has a mass of 290. kilograms. Starting from rest, the car acquires 3.13×10^5 joules of kinetic energy as it descends to the bottom of a hill in 5.3 seconds.

63 Calculate the height of the hill. [Neglect friction.] [Show all work, including the equation and substitution with units.] [2]

64 Calculate the speed of the roller coaster car at the bottom of the hill. [Show all work, including the equation and substitution with units.] [2]

65 Calculate the magnitude of the average acceleration of the roller coaster car as it descends to the bottom of the hill. [Show all work, including the equation and substitution with units.] [2]

Answer Sheet
Mechanics June 2009

Name _____

1 _____
2 _____
3 _____
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10 _____
11 _____
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14 _____
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16 _____
17 _____
36 _____
37 _____
38 _____

39 _____
40 _____
41 _____
42 _____

43 _____

48 displacement = _____ meters

49 Force = _____ Newtons

50

51

52

60 $V_{Hor.}$ = _____ m/sec

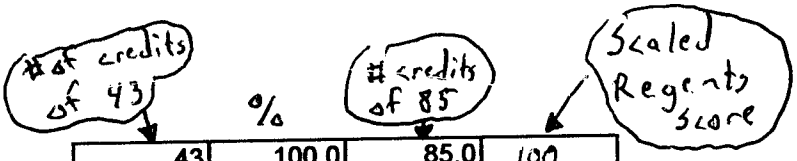
61 $V_{Vert.}$ = _____ m/sec

62 -

63 -

64 -

65 -



# of credits of 43	%	# credits of 85	Scaled Regents Score
43	100.0	85.0	100
42	97.7	83.0	98
41	95.3	81.0	96
40	93.0	79.1	94
39	90.7	77.1	92
38	88.4	75.1	90
37	86.0	73.1	88
36	83.7	71.2	86
35	81.4	69.2	84
34	79.1	67.2	82
33	76.7	65.2	80
32	74.4	63.3	79
31	72.1	61.3	77
30	69.8	59.3	75
29	67.4	57.3	73
28	65.1	55.3	71
27	62.8	53.4	69
26	60.5	51.4	67
25	58.1	49.4	65
24	55.8	47.4	64
23	53.5	45.5	63
22	51.2	43.5	61
21	48.8	41.5	59
20	46.5	39.5	57
19	44.2	37.6	54
18	41.9	35.6	52
17	39.5	33.6	50
16	37.2	31.6	48
15	34.9	29.7	44
14	32.6	27.7	43
13	30.2	25.7	41
12	27.9	23.7	39
11	25.6	21.7	36
10	23.3	19.8	33
9	20.9	17.8	31
8	18.6	15.8	28

Answer Sheet
Mechanics June 2009

Name Answer Key

1 3
2 4
3 1
4 4
5 3

6 2
7 2
8 3
9 4

10 2
11 3
12 4
13 2
14 3
15 3

16 1
17 1
36 1
37 1
38 3

39 2
40 4
41 3
42 3

43 1

48 displacement = 5.66 meters

49 Force = 50 Newtons

50 $P_{Before} = P_{After} = 0 Kg\,m/s$ (Because they stop)

$P_{car\,1} = P_{car\,2}$

$1.1 \times 10^3 Kg\,(V_1) = 2.5 \times 10^3 Kg\,(8\,m/s)$

$V_1 = 8\,m/s$

51 $F_c = m\frac{v^2}{r}$

$36N = \frac{20Kg\,(V)^2}{5m}$

$V = 3\,m/s$

52 $F = Kx$

$10N = k\,(.25m)$

$K = 40\,N/m$

60 $V_{Hor.} =$ 16 m/sec

61 $V_{Vert.} =$ 4.9 m/sec

62 - $d = V_i t + \frac{1}{2} a t^2$

$= 4.9\,m/s\,(.5s) + \frac{1}{2}(10\,m/s^2)(.5s)^2$

$d_y = 3.7m$

63 - $PE_{start} = KE_{Bottom} = 3.13 \times 10^5$ joules

$mgh = 3.13 \times 10^5$ joules

$290 Kg\ (10 m/s^2)\ h = 3.13 \times 10^5$ joules

$h = 110 m$

64 -

$KE = \frac{1}{2} mv^2 \Rightarrow 3.13 \times 10^5 \text{ joule} = \frac{1}{2}(290 Kg)\, v^2$

$v = 46.5 m/s$

65 -

$a = \frac{\Delta V}{t} = \frac{46.5 m/s}{5.3 sec} = 8.8 m/s^2$

# of credits of 43	%	# credits of 85	Scaled Regents Score
43	100.0	85.0	100
42	97.7	83.0	98
41	95.3	81.0	96
40	93.0	79.1	94
39	90.7	77.1	92
38	88.4	75.1	90
37	86.0	73.1	88
36	83.7	71.2	86
35	81.4	69.2	84
34	79.1	67.2	82
33	76.7	65.2	80
32	74.4	63.3	79
31	72.1	61.3	77
30	69.8	59.3	75
29	67.4	57.3	73
28	65.1	55.3	71
27	62.8	53.4	69
26	60.5	51.4	67
25	58.1	49.4	65
24	55.8	47.4	64
23	53.5	45.5	63
22	51.2	43.5	61
21	48.8	41.5	59
20	46.5	39.5	57
19	44.2	37.6	54
18	41.9	35.6	52
17	39.5	33.6	50
16	37.2	31.6	48
15	34.9	29.7	44
14	32.6	27.7	43
13	30.2	25.7	41
12	27.9	23.7	39
11	25.6	21.7	36
10	23.3	19.8	33
9	20.9	17.8	31
8	18.6	15.8	28