Mechanics Review Test
January 2009

Name_____

This year had 31 credits of a possible 85 or about 36% of test

1 A force of 25 newtons east and a force of 25 newtons west act concurrently on a 5.0-kilogram cart. What is the acceleration of the cart?

(1) 1.0 m/s^2 west
(2) 0.20 m/s^2 east
(3) 5.0 m/s^2 east
(4) 0 m/s^2

2 An unstretched spring has a length of 10. centimeters. When the spring is stretched by a force of 16 newtons, its length is increased to 18 centimeters. What is the spring constant of this spring?

(1) 0.89 N/cm
(2) 2.0 N/cm
(3) 1.6 N/cm
(4) 1.8 N/cm

3 What is the acceleration due to gravity at a location where a 15.0-kilogram mass weighs 45.0 newtons?

(1) 675 m/s^2
(2) 9.81 m/s^2
(3) 3.00 m/s^2
(4) 0.333 m/s^2

4 As a car is driven south in a straight line with *decreasing* speed, the acceleration of the car must be

(1) directed northward
(2) directed southward
(3) zero
(4) constant, but not zero

5 A baseball dropped from the roof of a tall building takes 3.1 seconds to hit the ground. How tall is the building? [Neglect friction.]

(1) 15 m
(2) 30. m
(3) 47 m
(4) 94 m

6 Which object has the greatest inertia?

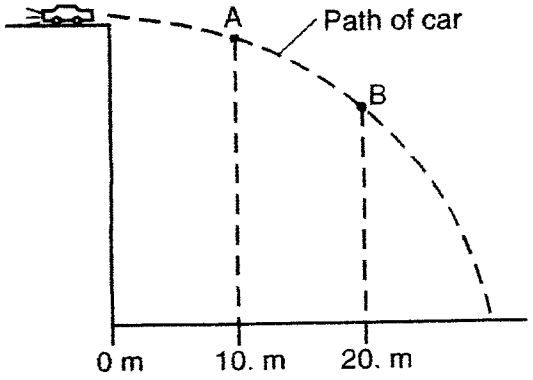
(1) a falling leaf
(2) a softball in flight
(3) a seated high school student
(4) a rising helium-filled toy balloon

7 Centripetal force F_c acts on a car going around a curve. If the speed of the car were twice as great, the magnitude of the centripetal force necessary to keep the car moving in the same path would be

(1) F_c
(2) $2F_c$
(3) $\frac{F_c}{2}$
(4) $4F_c$

Note that question 8 has only three choices.

8 The diagram below represents the path of a stunt car that is driven off a cliff, neglecting friction.



Compared to the horizontal component of the car's velocity at point *A*, the horizontal component of the car's velocity at point *B* is

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

9 What is the average power required to raise a 1.81×10^4-newton elevator 12.0 meters in 22.5 seconds?

(1) 8.04×10^2 W
(2) 9.65×10^3 W
(3) 2.17×10^5 W
(4) 4.89×10^6 W

10 If the speed of a moving object is doubled, the kinetic energy of the object is

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

11 Which statement best explains why a "wet saw" used to cut through fine optical crystals is constantly lubricated with oil?

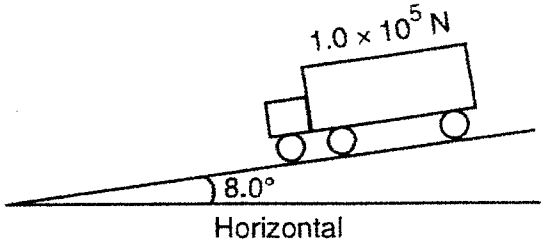
(1) Lubrication decreases friction and minimizes the increase of internal energy.
(2) Lubrication decreases friction and maximizes the increase of internal energy.
(3) Lubrication increases friction and minimizes the increase of internal energy.
(4) Lubrication increases friction and maximizes the increase of internal energy.

Directions (36–46): For *each* statement or question, write on the separate answer sheet the *number* of the word or expression that, of those given, best completes the statement or answers the question.

36 The weight of a typical high school physics student is closest to

(1) 1500 N
(2) 600 N
(3) 120 N
(4) 60 N

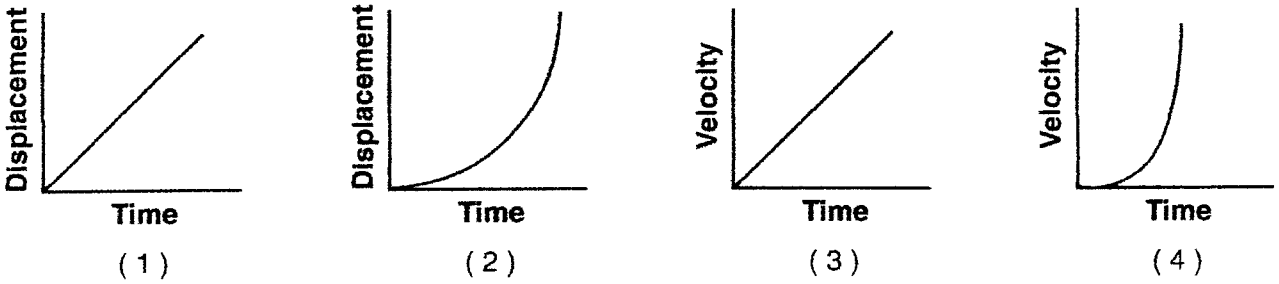
37 The diagram below shows a 1.0×10^5-newton truck at rest on a hill that makes an angle of 8.0° with the horizontal.



What is the component of the truck's weight parallel to the hill?

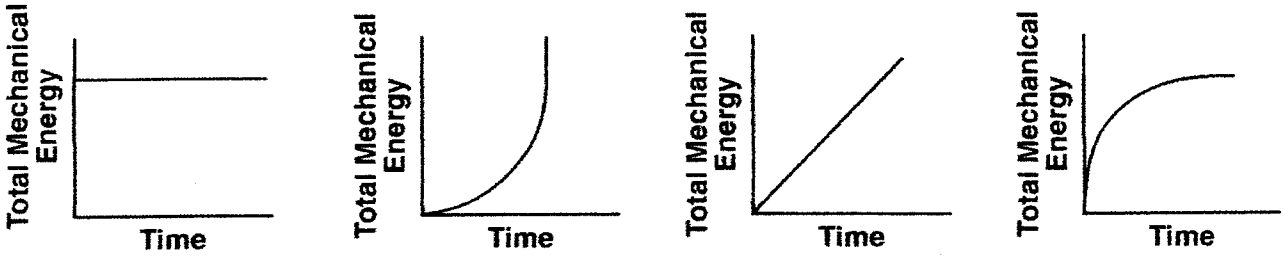
(1) 1.4×10^3 N
(2) 1.0×10^4 N
(3) 1.4×10^4 N
(4) 9.9×10^4 N

38 Which graph best represents the motion of an object in equilibrium?



(1) (2) (3) (4)

39 A wooden crate is pushed at constant speed across a level wooden floor. Which graph best represents the relationship between the total mechanical energy of the crate and the duration of time the crate is pushed?



(1) (2) (3) (4)

40 A child does 0.20 joule of work to compress the spring in a pop-up toy. If the mass of the toy is 0.010 kilogram, what is the maximum vertical height that the toy can reach after the spring is released?

(1) 20. m
(2) 2.0 m
(3) 0.20 m
(4) 0.020 m

41 A book of mass m falls freely from rest to the floor from the top of a desk of height h. What is the speed of the book upon striking the floor?

(1) $\sqrt{2gh}$
(2) $2gh$
(3) mgh
(4) mh

47 A person walks 150. meters due east and then walks 30. meters due west. The entire trip takes the person 10. minutes. Determine the magnitude and the direction of the person's total displacement. [2]

Base your answers to questions 48 and 49 on the information below.

The instant before a batter hits a 0.14-kilogram baseball, the velocity of the ball is 45 meters per second west. The instant after the batter hits the ball, the ball's velocity is 35 meters per second east. The bat and ball are in contact for 1.0×10^{-2} second.

48 Determine the magnitude and direction of the average acceleration of the baseball while it is in contact with the bat. [2]

49 Calculate the magnitude of the average force the bat exerts on the ball while they are in contact. [Show all work, including the equation and substitution with units.] [2]

50 A car travels at constant speed around a section of horizontal, circular track. On the diagram *in your answer booklet,* draw an arrow at point *P* to represent the direction of the centripetal acceleration of the car when it is at point *P*. [1]

51 Calculate the magnitude of the impulse applied to a 0.75-kilogram cart to change its velocity from 0.50 meter per second east to 2.00 meters per second east. [Show all work, including the equation and substitution with units.] [2]

58) A box at the top of a rough incline possesses 981 joules more gravitational potential energy than it does at the bottom. As the box slides to the bottom of the incline, 245 joules of heat is produced. Determine the kinetic energy of the box at the bottom of the incline. [1]

Part C

Answer all questions in this part.

Directions (59–72): Record your answers in the spaces provided in your answer booklet.

Base your answers to questions 59 and 60 on the information below.

A 1200-kilogram car moving at 12 meters per second collides with a 2300-kilogram car that is waiting at rest at a traffic light. After the collision, the cars lock together and slide. Eventually, the combined cars are brought to rest by a force of kinetic friction as the rubber tires slide across the dry, level, asphalt road surface.

59 Calculate the speed of the locked-together cars immediately after the collision. [Show all work, including the equation and substitution with units.] [2]

60 Calculate the magnitude of the frictional force that brings the locked-together cars to rest. [Show all work, including the equation and substitution with units.] [2]

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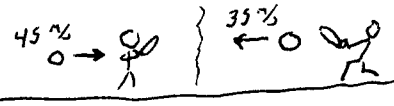
Name Answer Key

1	4	8	3	36	2
2	2	9	2	37	3
3	3	10	4	38	1
4	1	11	1	39	1
5	3			40	2
6	3			41	1
7	4				

47-

magnitude = 120 m

direction = East



Note reverse of direction

48) accel $\rightarrow a = \frac{\Delta V}{t}$

$= \frac{80\ m/s}{1 \times 10^{-2}\ second} = 8 \times 10^{3}\ m/s^2$

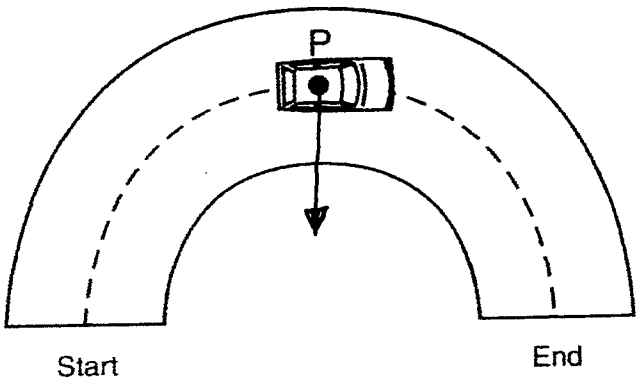
direction = East

49) $F_{Net} = ma$

$= .14 kg\ (8 \times 10^{3}\ m/s^2)$

$F = 1.1 \times 10^{3} N$

50)



51 $J = \Delta p = m\Delta V$

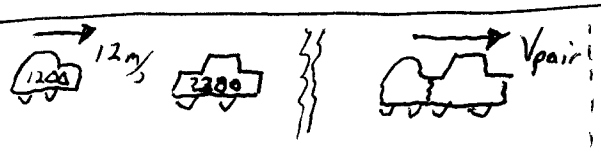
$= .75 K (1.5\ m/s)$

$J = 1.1 N \cdot sec$

58).

KE = 736 joules

59)



$P_{1200\ Before} = P_{pair\ After}$

$1200K (12\ m/s) = 3500K (V_{pair})$

$V_{pair} = 4.1\ m/s$

60)

$F_{Fric} = \mu F_{Normal}$

$= .67 (35,000 N)$

$= 23,000 N$

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Name _____

1 _____
2 _____
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10 _____
11 _____
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40 _____
41 _____

47-

magnitude = _____

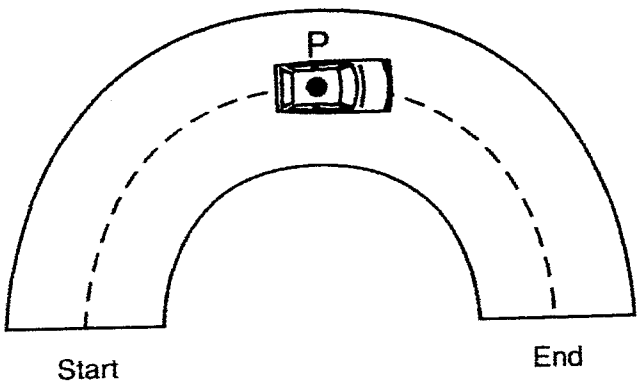
direction = _____

18) accel =

direction = _____

49)

50)



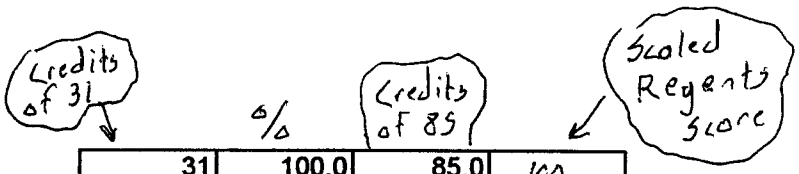
51

58)

KE = _____ joules

59)

60)



31	100.0	85.0	100
30	96.8	82.3	97
29	93.5	79.5	96
28	90.3	76.8	93
27	87.1	74.0	91
26	83.9	71.3	88
25	80.6	68.5	86
24	77.4	65.8	84
23	74.2	63.1	81
22	71.0	60.3	71
21	67.7	57.6	77
20	64.5	54.8	74
19	61.3	52.1	71
18	58.1	49.4	68
17	54.8	46.6	66
16	51.6	43.9	63
15	48.4	41.1	60
14	45.2	38.4	57
13	41.9	35.6	55
12	38.7	32.9	51
11	35.5	30.2	47
10	32.3	27.4	43
9	29.0	24.7	41
8	25.8	21.9	37
7	22.6	19.2	32
6	19.4	16.5	30
5	16.1	13.7	25
4	12.9	11.0	20
3	9.7	8.2	15