Name: Key Period: _____

Physics Midterm Exam – 2004

Pt 1 1Pt Each

Part A

/35

DIRECTIONS (1-20): Complete all questions in this part. Determine the answer that best completes each statement or question. Please show all work where possible.

1. How far will a brick starting from rest fall freely in 3.0 seconds?

(1) 15 m
(2) 29 m
(3) 44 m
(4) 88 m

$\Delta s = v_i \Delta t + \frac{1}{2} a (\Delta t)^2$

2. A car initially traveling at a speed of 16 meters per second accelerates uniformly to a speed of 20. meters per second over a distance of 36 meters. What is the magnitude of the car's acceleration?

(1) 0.11 m/s^2
(2) 2.0 m/s^2
(3) 0.22 m/s^2
(4) 9.0 m/s^2

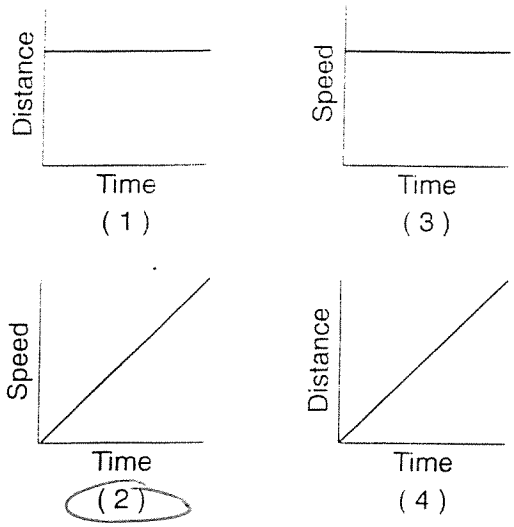
$v_f^2 = v_i^2 + 2a\Delta s$

3. A 1.5-kilogram lab cart is accelerated uniformly from rest to a speed of 2.0 meters per second in 0.50 second. What is the magnitude of the force producing this acceleration?

(1) 0.70 N
(2) 1.5 N
(3) 3.0 N
(4) 6.0 N

$F\Delta t = m\Delta v$

4. Which graph best represents the motion of an object that is *not* in equilibrium as it travels along a straight line?



5. An object weighs 100. newtons on Earth's surface. When it is moved to a point one Earth radius above Earth's surface, it will weigh

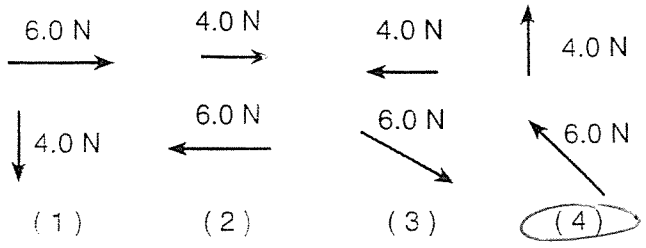
(1) 25.0 N
(2) 50.0 N
(3) 100. N
(4) 400. N

$\frac{Gm_1m_2}{r^2}$ $2r \Rightarrow \frac{1}{4}F$

6. A ball is thrown at an angle of 38° to the horizontal. What happens to the magnitude of the ball's vertical acceleration during the total time interval that the ball is in the air?

(1) It decreases, then increases.
(2) It decreases, then remains the same.
(3) It increases, then decreases.
(4) It remains the same.

7. Which pair of forces acting concurrently on an object will produce the resultant of greatest magnitude?



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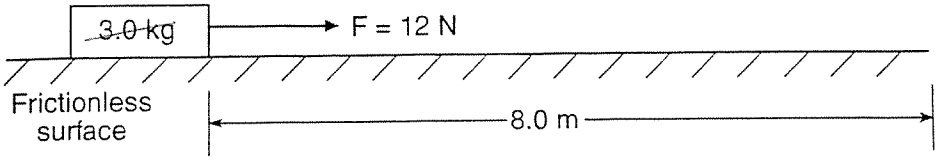
8. A 3.0-kilogram block is initially at rest on a frictionless, horizontal surface. The block is moved 8.0 meters in 2.0 seconds by the application of a 12-newton horizontal force, as shown in the diagram below.



What is the average power developed while moving the block?

(1) 24 W
(2) 32 W
(3) 48 W
(4) 96 W

$P = F\bar{v}$

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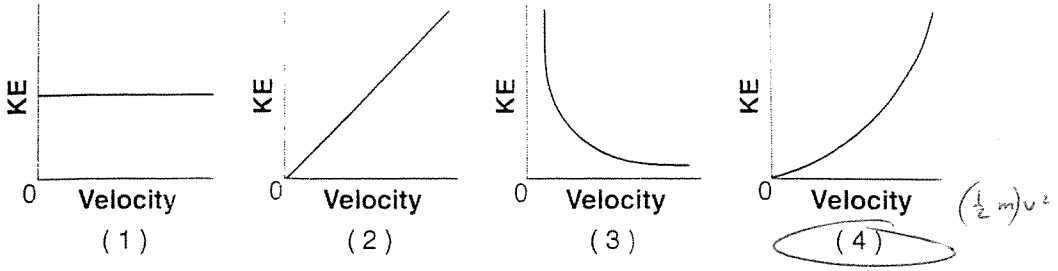
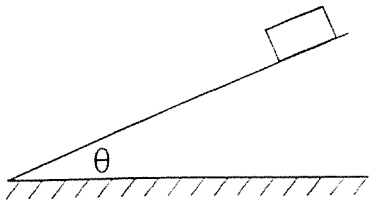
9. Which graph best represents the relationship between the kinetic energy, *KE*, and the velocity of an object accelerating in a straight line?



10. The diagram below shows a block sliding down a plane inclined at angle θ with the horizontal.



As angle θ is increased, the coefficient of kinetic friction between the bottom surface of the block and the surface of the incline will

(1) decrease
(2) increase
(3) remain the same

11. If the sum of all the forces acting on a moving object is zero, the object will

(1) slow down and stop
(2) change the direction of its motion
(3) accelerate uniformly
(4) continue moving with constant velocity

12. A vector makes an angle, θ, with the horizontal. The horizontal and vertical components of the vector will be equal in magnitude if angle θ is

(1) 30°
(2) 45°
(3) 60°
(4) 90°

13. An object weighing 15 newtons is lifted from the ground to a height of 0.22 meter. The increase in the object's gravitational potential energy is approximately

(1) 310 J
(2) 32 J
(3) 3.3 J
(4) 0.34 J

mgh

14. A 1,200-kilogram car traveling at 10. meters per second hits a tree and is brought to rest in 0.10 second. What is the magnitude of the average force acting on the car to bring it to rest?

(1) 1.2×10^2 N
(2) 1.2×10^3 N
(3) 1.2×10^4 N
(4) 1.2×10^5 N

$mav = Fat$

15. A 10.-newton force is required to hold a stretched spring 0.20 meter from its rest position. What is the potential energy stored in the stretched spring?

(1) 1.0 J
(2) 2.0 J
(3) 5.0 J
(4) 50. J

$F_{final} = 10\,N$

$F_{avg} = 5\,N \quad (5\,N)(.20\,m) = W$

$F_s = 10N \rightarrow k = 50\,N/m \rightarrow \frac{1}{2}kx^2$

$PE = \frac{1}{2}kx^2$

Base your answers to questions 16 and 17 on the information below.

A 2.0×10^3-kilogram car travels at a constant speed of 12 meters per second around a circular curve of radius 30. meters.

16. As the car goes around the curve, the centripetal force is directed

(1) toward the center of the circular curve
(2) away from the center of the circular curve
(3) tangent to the curve in the direction of motion
(4) tangent to the curve opposite the direction of motion

17. What is the magnitude of the centripetal acceleration of the car as it goes around the curve?

(1) 0.40 m/s^2
(2) 4.8 m/s^2
(3) 800 m/s^2
(4) 9,600 m/s^2

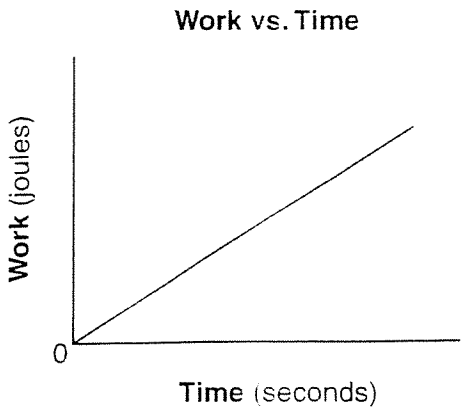
$\frac{v^2}{r}$

18. What is the approximate width of a person's little finger?

(1) 1 m
(2) 0.1 m
(3) 0.01 m
(4) 0.001 m

1 cm

19. The graph below shows the relationship between the work done by a student and the time of ascent as the student runs up a flight of stairs.

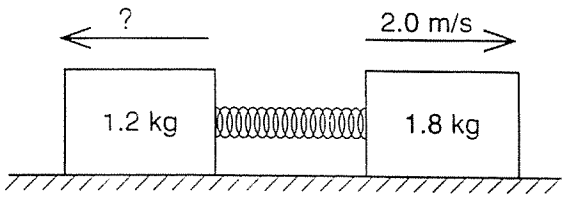


The slope of the graph would have units of

(1) joules
(2) seconds
(3) watts
(4) newtons

$\frac{W}{t} = P$

20. A 1.2-kilogram block and a 1.8-kilogram block are initially at rest on a frictionless, horizontal surface. When a compressed spring between the blocks is released, the 1.8-kilogram block moves to the right at 2.0 meters per second, as shown.



What is the speed of the 1.2-kilogram block after the spring is released?

(1) 1.4 m/s
(2) 2.0 m/s
(3) 3.0 m/s
(4) 3.6 m/s

$p_i = p_f$

$0\ kg\,m/s = (1.8\,kg)(2.0\,m/s) + (1.2\,kg)(v)$

Part B

Directions (21 - 31): Answer all problems and make sure to write out the equation, substitute with units, and write your answer with units. No Work = No Credit

+4

Base your answers to questions 21 through 23 on the information below.

A force of 10. newtons toward the right is exerted on a wooden crate initially moving to the right on a horizontal wooden floor. The crate weighs 25 newtons.

21. Calculate the magnitude of the force of friction between the crate and the floor. [Show all work, including the equation and substitution with units] [2]

* Ref. table μ_k (wood on wood) = 0.3

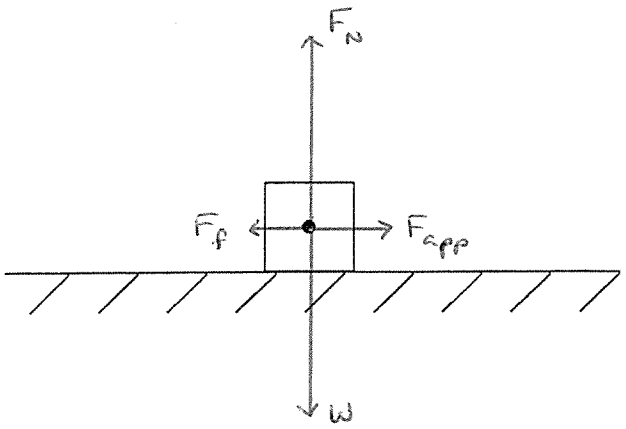
$F_f = \mu_k F_N = (0.3)(25\ N)$

$F_f = 7.5\ N$

+1 Static Friction
+2 Right Ans.

$F_f = W F_N$
$= 3(10N)$
0 pts

22. On the diagram below, draw and label all vertical and horizontal forces acting on the crate. [1]



+1 All Right

Numbers only
+0.5

23. What is the magnitude of the net force acting on the crate? [1]

$F_{net} = F_{app} - F_f = 10N - 7.5\ N$

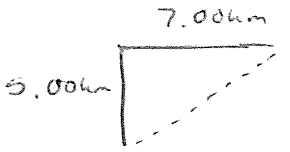
+1 All Right

$F_{net} = 2.5\ N$

Base your answers to questions 24 to 25 on the information below.

A hiker walks 5.00 kilometers due north and then 7.00 kilometers due east. +4

24. What is the magnitude of her resultant displacement? [1]



$a^2 + b^2 = c^2$

$5^2_{km} + 7^2_{km} = c^2$

$c = 8.60\ km$

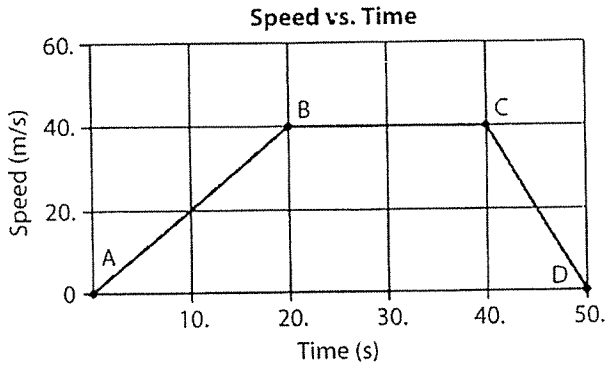
$500^2 + 700^2 =$

+1 for both

25. What total distance has she traveled? [1]

12.0 km

Base your answers to questions 26 to 27 on the following speed time graph which represents the linear motion of a cart.



26. Determine the magnitude of acceleration of the cart during interval AB. [1]

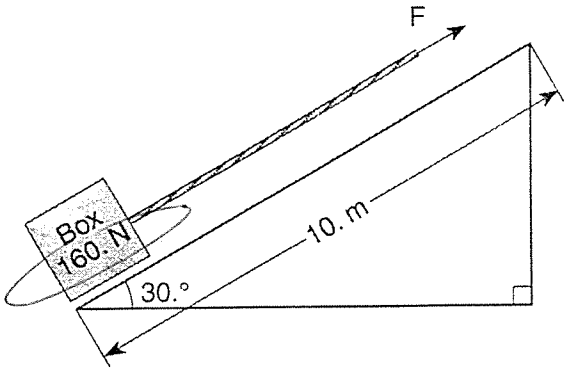
$a = \frac{\Delta v}{\Delta t} = \frac{40\ m/s}{20\ s} = 2.0\ m/s^2$

27. What is the average speed of the cart during interval CD. [1]

$\bar{v} = \frac{v_i + v_f}{2} = \frac{40\ m/s + 0\ m/s}{2} = 20\ m/s$

Base your answers to questions 28 and 29 on the information and diagram below

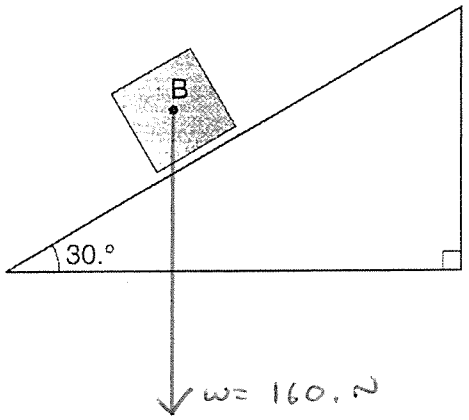
A 160.-newton box sits on a 10.-meter-long frictionless plane inclined at an angle of 30.° to the horizontal as shown. Force (F) applied to a rope attached to the box causes the box to move with a constant speed up the incline.



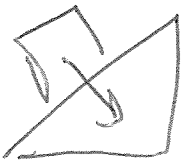
JM

28. On the diagram below, construct a vector to represent the weight of the box. Use a metric ruler and scale of 1.0 centimeter = 40. newtons. Begin the vector at point B and label its magnitude in newtons. [2]

↳ 160. N = 4.0 cm



+2 Must include 160 N
4 cm
+1 Missing Arrow



0 pts

29. Calculate the amount of work done in moving the box from the bottom to the top of the incline plane. [Show all work, including the equation and substitution with units] [2]

Frictionless $\Rightarrow |F_{appl}| = |F_{\parallel}|$

+1 Use cos instead of sin

$F_{\parallel} = |W| \sin\theta = (160.\text{ N}) \sin(30.°) = 80.\text{ N}$

$W = F\Delta s = (80.\text{ N})(10.\text{ m}) = 800\text{ J}$

1386 +1

$\sin 30° = \frac{h}{10.\text{m}}$ $\quad h = 5.0\text{m}$

$W = E = PE = mgh = (160.\text{N})(5.0\text{m}) = 800\text{ J}$

Base your answers on questions 30 and 31 on the following information:

An outfielder throws a baseball to the third baseman at a speed of 18.5 meters per second and at an angle of 60.° above the horizontal.

+3

30. Find the initial horizontal velocity (v_x) and the initial vertical veolicy (v_y) of the baseball? [1]

$V_x =$ $9.25\ m/s$ $= V_i \cos\theta$ $\qquad$ $v_y =$ $16.0\ m/s$ $= V_i \sin\theta$

31. If the ball is caught at the same height it is thrown, calculate the amount of time the ball is in the air. [2]

x	y
$\Delta t = \Delta t$	
$a = 0\ m/s^2$	$a = -9.81\ m/s^2$
$V_i = 9.25\ m/s$	$V_i = 16.0\ m/s$
	$\Delta s = 0m$

$\Delta s = V_i \Delta t + \frac{1}{2} a(\Delta t)^2$

$0m = (16.0\ m/s)\Delta t + \frac{1}{2}(-9.81\ m/s^2)(\Delta t)^2$

$0 = 16 - 4.905(\Delta t)$

$\Delta t = 3.3\ s$

+1 stopwatch-find height halfway