PHYS 1303 Final Exam – Example Problems

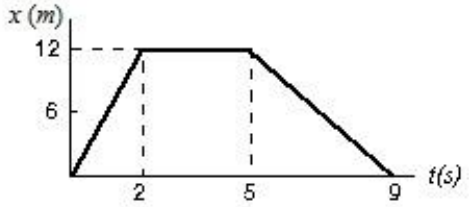
1. 1 m is equivalent to 3.281 ft. A cube with an edge of 1.5 ft has a volume of:
A) 1.2×10^2 m^3
B) 9.6×10^{-2} m^3
C) 10.5 m^3
D) 9.5×10^{-2} m^3
E) 0.21 m^3

2. During a short interval of time the speed v in m/s of an automobile is given by $v = at^2 + bt^3$, where the time t is in seconds. The units of a and b are respectively:
A) m·s^2; m·s^4
B) s^3/m; s^4/m
C) m/s^2; m/s^3
D) m/s^3; m/s^4
E) m/s^4; m/s^5

3. A stone is released from rest from the edge of a building roof 190 m above the ground. Neglecting air resistance, the speed of the stone, just before striking the ground, is:
A) 43 m/s
B) 61 m/s
C) 120 m/s
D) 190 m/s
E) 1400 m/s

4. The position of an object is given as a function of time by $x = 2t^2 - t^3 + c$, where x is in m, t is in seconds, and c is a constant. Its average velocity over the interval from $t = 0$ s to $t = 2$ s:
A) is 0
B) is –2 m/s
C) is 2 m/s
D) is –4 m/s
E) cannot be calculated unless the initial position c is given

5. This graph shows the position of a particle as a function of time. What is its instantaneous velocity at $t = 7$s?



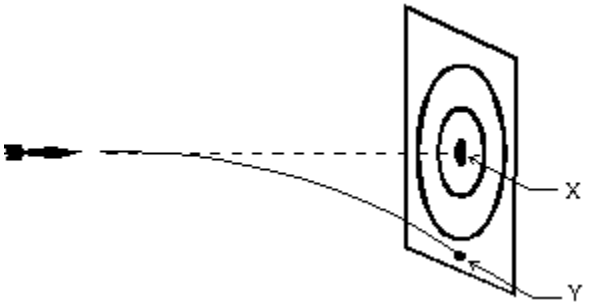
A) 3 m/s
B) -3 m/s
C) 12 m/s
D) -12 m/s
E) Need additional information.

6. A boat is traveling upstream at 14 mph with respect to a river that is flowing at 6 mph (with respect to the ground). A woman runs directly across the boat, from one side to the other, at 6 mph (with respect to the boat). The speed of the woman with respect to the ground is:
A) 10 mph
B) 14 mph
C) 18.5 mph
D) 21 mph
E) 26 mph

7. A stone is tied to a 0.50-m string and whirled at a constant speed of 4.0 m/s in a vertical circle. The acceleration at the bottom of the circle is:
A) 9.8 m/s^2, up
B) 9.8 m/s^2, down
C) 8.0 m/s^2, up
D) 32 m/s^2, up
E) 32 m/s^2, down

8. An airplane flying at a speed of 200 m/s enters a gradual 90° turn, emerging at the same speed it entered the turn, 200 m/s. The turn takes 20.0 seconds to complete. For this turn the magnitude of the average acceleration of the plane is:
A) 0 m/s^2
B) 40 m/s^2
C) 20 m/s^2
D) 14 m/s^2
E) 10 m/s^2

9. A dart is thrown horizontally toward X at 20 m/s as shown. It hits Y 0.1 s later. The distance XY is:



A) 2 m
B) 1 m
C) 0.5 m
D) 0.1 m
E) 0.05 m

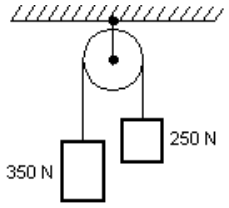
10. An object has a velocity of (5.4 m/s)$\hat{\imath}$ − (4.8 m/s)$\hat{\jmath}$. Over a period of 1.3 s, its velocity changes under constant acceleration to (1.7 m/s)$\hat{\imath}$ + (5.9 m/s)$\hat{\jmath}$. What is this acceleration?

A) −(3.7 m/s)$\hat{\imath}$ + (11 m/s)$\hat{\jmath}$
B) −(2.8 m/s)$\hat{\imath}$ + (8.2 m/s)$\hat{\jmath}$
C) (3.7 m/s)$\hat{\imath}$ + (11 m/s)$\hat{\jmath}$
D) (2.8 m/s)$\hat{\imath}$ + (8.2 m/s)$\hat{\jmath}$
E) −(2.8 m/s)$\hat{\imath}$ + (1.1 m/s)$\hat{\jmath}$

11. When a 40-N force, parallel to the incline and directed up the incline, is applied to a crate on a frictionless incline that is 30° above the horizontal, the acceleration of the crate is 2.0 m/s^2, up the incline. The mass of the crate is:

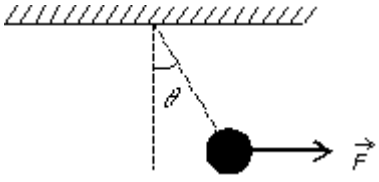
A) 3.8 kg
B) 4.1 kg
C) 5.8 kg
D) 6.2 kg
E) 10 kg

12. Two blocks weighing 250 N and 350 N respectively, are connected by a massless string that passes over a massless, frictionless pulley as shown. The tension in the string is:



A) 210 N
B) 290 N
C) 410 N
D) 500 N
E) 4900 N

13. A ball of weight 1-N on the end of a string is held by a 2-N horizontal force *F*, as shown, so that the string makes an angle θ from the vertical. The tension in the string is:

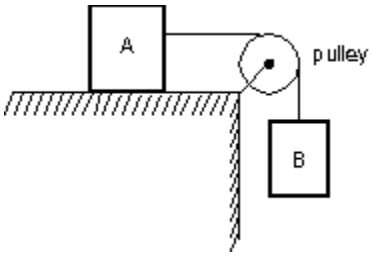


A) $2/\sqrt{5}$ N
B) $2\sqrt{5}$ N
C) $\sqrt{5}$ N
D) 1 N
E) none of these

14. A 24-N horizontal force is applied to a 40-N block initially at rest on a rough horizontal surface. If the coefficients of friction are $\mu_s = 0.5$ and $\mu_k = 0.4$, the magnitude of the frictional force on the block is:

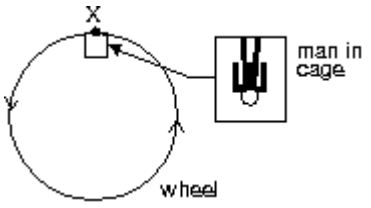
A) 12 N
B) 16 N
C) 20 N
D) 24 N
E) 40 N

15. Block A, with a mass of 50 kg, rests on a horizontal table top. The coefficient of static friction is 0.40. A horizontal string is attached to A and passes over a massless, frictionless pulley as shown. The smallest mass m_B of block B, attached to the dangling end, that will start A moving when it is attached to the other end of the string is:



A) 20 kg
B) 30 kg
C) 40 kg
D) 50 kg
E) 70 kg

16. A giant wheel, 40 m in diameter, is fitted with a cage and platform on which a man can stand. The wheel rotates at such a speed that when the cage is at X (as shown) the force exerted by the man on the platform is equal to his weight. The speed of the man is:



A) 14 m/s
B) 20 m/s
C) 28 m/s
D) 80 m/s
E) 120 m/s

17. At time t = 0 a 2-kg particle has a velocity of (4 m/s) $\hat{\imath}$ – (3 m/s) $\hat{\jmath}$. At t = 3 s its velocity is (2 m/s) $\hat{\imath}$ + (3 m/s) $\hat{\jmath}$. During this time the work done on it was:

A) 4 J
B) –4 J
C) –12 J
D) –40 J
E) (4 J) $\hat{\imath}$ + (36 J) $\hat{\jmath}$

18. When a certain rubber band is stretched a distance x, it exerts a restoring force $F = ax + bx^2$, where a and b are constants. The work done in stretching this rubber band from x = 0 to $x = L$ is:

A) $aL^2 + bLx^3$
B) $aL + 2bL^2$
C) $a + 2bL$
D) bL
E) $aL^2/2 + bL^3/3$

19. A 50-N force is the only force on a 2-kg crate that starts from rest. At the instant the crate has gone 2 m the rate at which the force is doing work is:

A) 2.5 W
B) 25 W
C) 75 W
D) 100 W
E) 500 W

20. A 0.50-kg block attached to an ideal spring with a spring constant of 80 N/m oscillates on a horizontal frictionless surface. When the spring is 4.0 cm longer than its equilibrium length, the speed of the block is 0.50 m/s. The greatest speed of the block is:

A) 0.32 m/s
B) 0.55 m/s
C) 0.71 m/s
D) 0.87 m/s
E) 0.93 m/s

21. A 2.2-kg block starts from rest on a rough inclined plane that makes an angle of 25° with the horizontal. The coefficient of kinetic friction is 0.25. As the block goes 2.0 m down the plane, the mechanical energy of the Earth-block system changes by:

A) 0 J
B) –9.8 J
C) 9.8 J
D) –18 J
E) 18 J

22. Two 4.0-kg blocks are tied together with a short compressed spring between them and thrown into the air. At the highest point of the trajectory they become untied and spring apart. About how far below the highest point is the center of mass of the two-block system 2.0 s later, before either fragment has hit the ground? (Neglect air resistance)
A) 1.2 m
B) 20 m
C) 31 m
D) Can't tell because the velocities of the fragments are not given.
E) Can't tell because the coordinates of the highest point are not given.

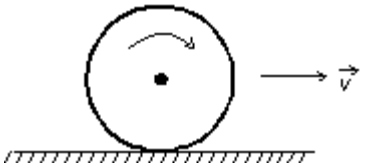
23. A 3.0-kg cart and a 2.0-kg cart approach each other on a horizontal air track. They collide and stick together. After the collision their total kinetic energy is 40 J. The speed of their center of mass is:
A) 0 m/s
B) 2.8 m/s
C) 4.0 m/s
D) 5.2 m/s
E) 8.0 m/s

24. The coordinate of an object is given as a function of time by $\theta = 7t - 3t^2$, where θ is in radians and t is in seconds. Its angular velocity at $t = 3$ s is:
A) −11 rad/s
B) −3.7 rad/s
C) 1.0 rad/s
D) 3.7 rad/s
E) 11 rad/s

25. A pulley with a radius of 3.0 cm and a rotational inertia of 4.5×10^{-3} kg·m^2 is suspended from the ceiling. A rope passes over it with a 2.0-kg block attached to one end and a 4.0-kg block attached to the other. The rope does not slip on the pulley. When the velocity of the heavier block is 2.0 m/s the total kinetic energy of the pulley and blocks is:
A) 2.0 J
B) 12 J
C) 14 J
D) 22 J
E) 28 J

26. A disk with a rotational inertia of 5.0 kg · m^2 and a radius of 0.25 m rotates on a frictionless fixed axis perpendicular to the disk and through its center. A force of 8.0 N is applied tangentially to the rim. If the disk starts at rest, then after it has turned through half a revolution its angular velocity is:
A) 0.57 rad/s
B) 0.64 rad/s
C) 0.80 rad/s
D) 1.6 rad/s
E) 3.2 rad/s

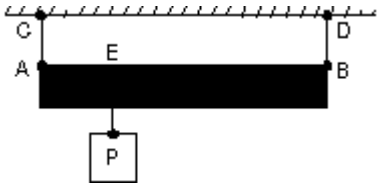
27. A wheel of radius 0.5 m rolls without sliding on a horizontal surface as shown. Starting from rest, the wheel moves with constant angular acceleration 6 rad/s^2. The distance in traveled by the center of the wheel from t = 0 to t = 3 s is:



A) 0 m
B) 27 m
C) 13.5 m
D) 18 m
E) none of these

28. A playground merry-go-round has a radius of 3.0 m and a rotational inertia of 600 kg·m^2. It is initially spinning at 0.80 rad/s when a 20-kg child crawls from the center to the rim. When the child reaches the rim the angular velocity of the merry-go-round is:
A) 0.62 rad/s
B) 0.73 rad/s
C) 0.77 rad/s
D) 0.91 rad/s
E) 1.1 rad/s

29. A uniform rod AB is 1.2 m long and weighs 16 N. It is suspended by strings AC and BD as shown. A block P weighing 96 N is attached at E, 0.30 m from A. The magnitude of the tension force in the string BD is:



A) 8.0 N
B) 24 N
C) 32 N
D) 48 N
E) 80 N

30. Mars has a mass of about 0.1075 times the mass of Earth and a diameter of about 0.533 times the diameter of Earth. The acceleration of a body falling near the surface of Mars is about:
A) 0.30 m/s^2
B) 1.4 m/s^2
C) 2.0 m/s^2
D) 3.7 m/s^2
E) 26 m/s^2

31. A projectile is fired straight upward from Earth's surface with a speed that is half the escape speed. If R is the radius of Earth, the highest altitude reached, measured from the surface, is:
A) $R/4$
B) $R/3$
C) $R/2$
D) R
E) $2R$

33. A particle moves in simple harmonic motion according to $x = 2\cos(50t)$, where x is in meters and t is in seconds. Its maximum velocity is:
A) 100 $\sin(50t)$ m/s
B) 100 $\cos(50t)$ m/s
C) 100 m/s
D) 200 m/s
E) none of these

34. A block attached to a spring undergoes simple harmonic motion on a horizontal frictionless surface. Its total energy is 50 J. When the displacement is half the amplitude, the kinetic energy is:
A) 0 J
B) 12.5 J
C) 25 J
D) 37.5 J
E) 50 J

KEY

1 B	2 D	3 B	4 A	5 B	6 A	7 D	8 D	9 E	10 B	11 C	12 B	13 C
14 B	15 A	16 B	17 C	18 E	19 E	20 C	21 B	22 B	23 C	24 A	25 D	26 D
27 C	28 A	29 C	30 D	31 B	33 C	34 D						