PHYS 1303 Final Exam Example Problems

1.Which quantity can be converted from the English system to the metric system by the conversion factor

$$\frac{5280\ \text{f}}{\text{mi}} \cdot \frac{12\ \text{in}}{\text{f}} \cdot \frac{2.54\ \text{cm}}{1\ \text{in}} \cdot \frac{1\ \text{m}}{100\ \text{cm}} \cdot \frac{1\ \text{h}}{3600\ \text{s}}?$$

a. feet per second
b. feet per hour
c. miles per second
d. miles per hour
e. miles per minute

2.A particle moving with a constant acceleration has a velocity of 20 cm/s when its position is x = 10 cm. Its position 7.0 s later is x = –30 cm. What is the acceleration of the particle?

a. –7.3 cm/s^2
b. –8.9 cm/s^2
c. –11 cm/s^2
d. –15 cm/s^2
e. –13 cm/s^2

3.A rocket, initially at rest, is fired vertically with an upward acceleration of 10 m/s^2. At an altitude of 0.50 km, the engine of the rocket cuts off. What is the maximum altitude it achieves?

a. 1.9 km
b. 1.3 km
c. 1.6 km
d. 1.0 km
e. 2.1 km

4.In a location where the train tracks run parallel to a road, a high speed train traveling at 60 m/s passes a car traveling at 30 m/s in the opposite direction. How long does it take for the train to be 180 m away from the car?

a. 2.0 s
b. 3.0 s
c. 6.0 s
d. 9.0 s
e. 18.0 s

5.At t = 0, a particle leaves the origin with a velocity of 12 m/s in the positive x direction and moves in the xy plane with a constant acceleration of $\left(-2.0\hat{\mathbf{i}} + 4.0\hat{\mathbf{j}}\right)$m/s^2. At the instant the y coordinate of the particle is 18 m, what is the x coordinate of the particle?

a. 30 m
b. 21 m
c. 27 m
d. 24 m
e. 45 m

6.The site from which an airplane takes off is the origin. The x-axis points east; the y-axis points straight up. The position and velocity vectors of the plane at a later time are given by

$$\vec{\mathbf{r}} = (1.61\times10^4\,\hat{\mathbf{i}} + 9.00\times10^3\,\hat{\mathbf{j}})\text{ m and }\vec{\mathbf{v}} = (150\hat{\mathbf{i}} - 21\hat{\mathbf{j}})\ \frac{\text{m}}{\text{s}}.$$

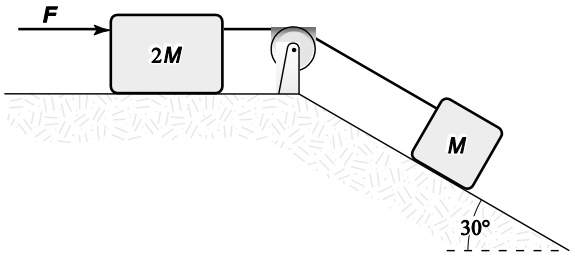
The magnitude, in meters, of the plane's displacement from the origin is

a. 9.14×10^3.
b. 1.61×10^4.
c. 1.84×10^4.
d. $9.14\times10^3 t$.
e. $1.61\times10^4 t$.

7.A 3.0-kg block slides on a frictionless 20° inclined plane. A force of 16 N acting parallel to the incline and up the incline is applied to the block. What is the acceleration of the block?

a. 2.0 m/s^2 down the incline
b. 5.3 m/s^2 up the incline
c. 2.0 m/s^2 up the incline
d. 3.9 m/s^2 down the incline
e. 3.9 m/s^2 up the incline

8.In the figure, if F = 2.0 N and M = 1.0 kg, what is the tension in the connecting string? The pulley and all surfaces are frictionless.



a. 2.6 N
b. 1.1 N
c. 2.1 N
d. 1.6 N
e. 3.7 N

9.A 1.0-kg block is pushed up a rough 22° inclined plane by a force of 7.0 N acting parallel to the incline. The acceleration of the block is 1.4 m/s^2 up the incline. Determine the magnitude of the force of friction acting on the block.

a. 1.9 N
b. 2.2 N
c. 1.3 N
d. 1.6 N
e. 3.3 N

10.A race car travels 40 m/s around a banked (45° with the horizontal) circular (radius = 0.20 km) track. What is the magnitude of the resultant force on the 80-kg driver of this car?

a. 0.68 kN
b. 0.64 kN
c. 0.72 kN
d. 0.76 kN
e. 0.52 kN

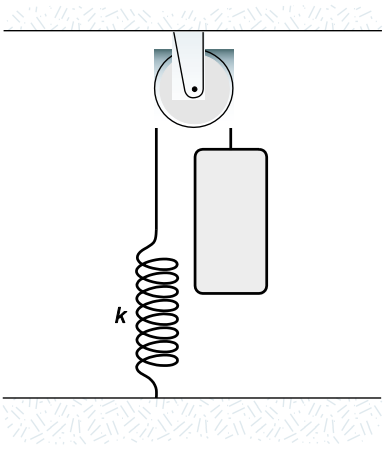
11.A 30-kg child rides on a circus Ferris wheel that takes her around a vertical circular path with a radius of 20 m every 22 s. What is the magnitude of the resultant force on the child at the highest point on this trajectory?

a. 49 N
b. 0.29 kN
c. 0.34 kN
d. 0.25 kN
e. 0.76 kN

12.A 0.60-kg object is suspended from the ceiling at the end of a 2.0-m string. When pulled to the side and released, it has a speed of 4.0 m/s at the lowest point of its path. What maximum angle does the string make with the vertical as the object swings up?

a. 61°
b. 54°
c. 69°
d. 77°
e. 47°

13. A 20-kg mass is fastened to a light spring (k = 380 N/m) that passes over a pulley as shown. The pulley is frictionless, and the mass is released from rest when the spring is unstretched. After the mass has dropped 0.40 m, what is its speed?



a. 2.2 m/s
b. 2.5 m/s
c. 1.9 m/s
d. 1.5 m/s
e. 3.6 m/s

14. The only force acting on a 2.0-kg body moving along the x axis is given by $F_x = (2.0x)$ N, where x is in m. If the velocity of the object at x = 0 is +3.0 m/s, how fast is it moving at x = 2.0 m?

a. 4.2 m/s
b. 3.6 m/s
c. 5.0 m/s
d. 5.8 m/s
e. 2.8 m/s

15. An 80-g particle moving with an initial speed of 50 m/s in the positive x direction strikes and sticks to a 60-g particle moving 50 m/s in the positive y direction. How much kinetic energy is lost in this collision?

a. 96 J
b. 89 J
c. 175 J
d. 86 J
e. 110 J

16. A 3.0-kg ball with an initial velocity of (4**i** + 3**j**) m/s collides with a wall and rebounds with a velocity of (–4**i** + 3**j**) m/s. What is the impulse exerted on the ball by the wall?

a. +24**i** N s
b. –24**i** N s
c. +18**j** N s
d. –18**j** N s
e. +8.0**i** N s

17. At the instant a 2.0-kg particle has a velocity of 4.0 m/s in the positive x direction, a 3.0-kg particle has a velocity of 5.0 m/s in the positive y direction. What is the speed of the center of mass of the two-particle system?

a. 3.8 m/s
b. 3.4 m/s
c. 5.0 m/s
d. 4.4 m/s
e. 4.6 m/s

18. A 4.2-kg object, initially at rest, "explodes" into three objects of equal mass. Two of these are determined to have velocities of equal magnitudes (5.0 m/s) with directions that differ by 90°. How much kinetic energy was released in the explosion?

a. 70 J
b. 53 J
c. 60 J
d. 64 J
e. 35 J

19. A wheel rotates about a fixed axis with an initial angular velocity of 20 rad/s. During a 5.0-s interval the angular velocity increases to 40 rad/s. Assume that the angular acceleration was constant during the 5.0-s interval. How many revolutions does the wheel turn through during the 5.0-s interval?

a. 20 rev
b. 24 rev
c. 32 rev
d. 28 rev
e. 39 rev

20. A wheel rotating about a fixed axis with a constant angular acceleration of 2.0 rad/s^2 starts from rest at t = 0. The wheel has a diameter of 20 cm. What is the magnitude of the total linear acceleration of a point on the outer edge of the wheel at t = 0.60 s?

a. 0.25 m/s^2
b. 0.50 m/s^2
c. 0.14 m/s^2
d. 0.34 m/s^2
e. 0.20 m/s^2

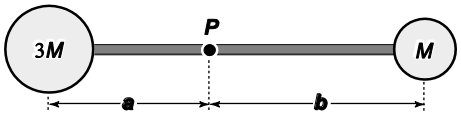
21.A particle whose mass is 2 kg moves in the *xy* plane with a constant speed of 3 m/s in the *x*-direction along the line $y = 5$. What is its angular momentum (in kg $\cdot$ m^2/s) relative to the origin?

a. $-30\,\hat{\mathbf{k}}$
b. $30\,\hat{\mathbf{k}}$
c. $-15\,\hat{\mathbf{k}}$
d. $15\,\hat{\mathbf{k}}$
e. $45\,\hat{\mathbf{k}}$

22.A merry-go-round of radius $R = 2.0$ m has a moment of inertia $I = 250$ kg $\cdot$ m^2, and is rotating at 10 rpm. A child whose mass is 25 kg jumps onto the edge of the merry-go-round, heading directly toward the center at 6.0 m/s. The new angular speed (in rpm) of the merry-go-round is approximately

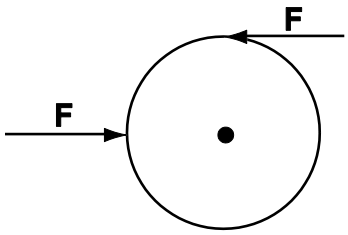
a. 10
b. 9.2
c. 8.5
d. 7.1
e. 6.4

23.The rigid body shown is rotated about an axis perpendicular to the paper and through the point P. If $M = 0.40$ kg, $a = 30$ cm, and $b = 50$ cm, how much work is required to take the body from rest to an angular speed of 5.0 rad/s? Neglect the mass of the connecting rods and treat the masses as particles.



a. 2.9 J
b. 2.6 J
c. 3.1 J
d. 3.4 J
e. 1.6 J

24.Two forces of magnitude 50 N, as shown in the figure below, act on a cylinder of radius 4 m and mass 6.25 kg. The cylinder, which is initially at rest, sits on a frictionless surface. After 1 second, the velocity and angular velocity of the cylinder in m/s and rad/s are respectively



a. $v = 0$; $\omega = 0$.
b. $v = 0$; $\omega = 4$.
c. $v = 0$; $\omega = 8$.
d. $v = 8$; $\omega = 8$.
e. $v = 16$; $\omega = 8$.

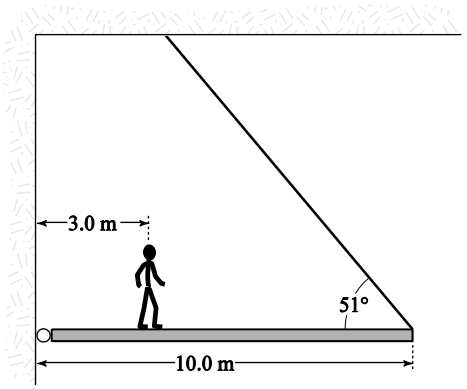
25.A horizontal meter stick supported at the 50-cm mark has a mass of 0.50 kg hanging from it at the 20-cm mark and a 0.30 kg mass hanging from it at the 60-cm mark. Determine the position on the meter stick at which one would hang a third mass of 0.60 kg to keep the meter stick balanced.

a. 74 cm
b. 70 cm
c. 65 cm
d. 86 cm
e. 62 cm

26.The period of a satellite circling planet Nutron is observed to be 84 s when it is in a circular orbit with a radius of 8.0×10^6 m. What is the mass of planet Nutron?

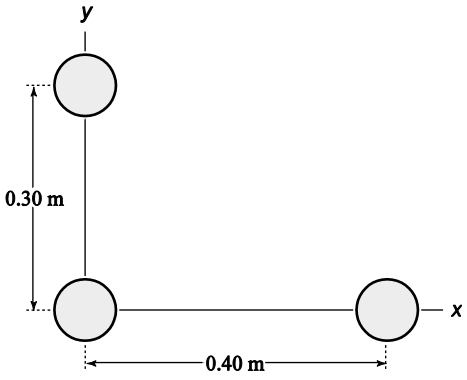
a. 6.2×10^{28} kg
b. 5.0×10^{28} kg
c. 5.5×10^{28} kg
d. 4.3×10^{28} kg
e. 3.7×10^{28} kg

27. The figure shows a uniform, horizontal beam (length = 10 m, mass = 25 kg) that is pivoted at the wall, with its far end supported by a cable that makes an angle of 51° with the horizontal. If a person (mass = 60 kg) stands 3.0 m from the pivot, what is the tension in the cable?



a. 0.83 kN
b. 0.30 kN
c. 0.39 kN
d. 0.42 kN
e. 3.0 kN

28. Three 5.0-kg masses are located at points in the *xy* plane, as shown. What is the magnitude of the resultant force (caused by the other two masses) on the mass at $x = 0$, $y = 0.30$ m?



a. 2.6×10^{-8} N
b. 2.0×10^{-8} N
c. 2.9×10^{-8} N
d. 2.3×10^{-8} N
e. 2.1×10^{-8} N

29. A 50-kg satellite circles the Earth in an orbit with a period of 120 min. What minimum energy is required to change the orbit to another circular orbit with a period of 180 min? (Earth: radius = 6.4×10^6 m, mass = 6.0×10^{24} kg)

a. 2.9×10^8 J
b. 3.5×10^8 J
c. 4.1×10^8 J
d. 4.7 10^8 J
e. 5.9 10^8 J

30. A 2.0-kg projectile moves from its initial position to a point that is displaced 20 m horizontally and 15 m above its initial position. How much work is done by the gravitational force on the projectile?

a. +0.29 kJ
b. –0.29 kJ
c. +30 J
d. –30 J
e. –50 J

31. As a 2.0-kg object moves from $(2\hat{\mathbf{i}}+5\hat{\mathbf{j}})$ m to $(6\hat{\mathbf{i}}-2\hat{\mathbf{j}})$ m, the constant resultant force acting on it is equal to $(4\hat{\mathbf{i}}-3\hat{\mathbf{j}})$ N. If the speed of the object at the initial position is 4.0 m/s, what is its kinetic energy at its final position?

a. 62 J
b. 53 J
c. 73 J
d. 86 J
e. 24 J

32. The motion of a particle connected to a spring is described by $x = 10 \sin(\pi t)$. At what time (in s) is the potential energy equal to the kinetic energy?

a. 0
b. 0.25
c. 0.50
d. 0.79
e. 1.0

33. A body oscillates with simple harmonic motion along the x axis. Its displacement varies with time according to the equation $x = 5 \sin(\pi t + \pi/3)$. The phase (in rad) of the motion at t = 2 s is

a. $7\pi/3$
b. $\pi/3$
c. π
d. $5\pi/3$
e. 2π

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