# Review Problems, Physics 102, Final Exam, Spring 2024
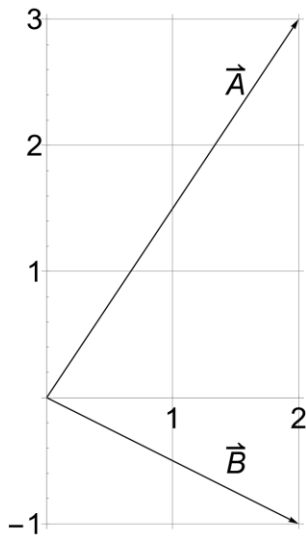
1. The stone is thrown from the ground with an initial velocity of 50 m/s at an angle of 35°. The horizontal and vertical components of its velocity 4 seconds later are closest to:

A) $v_x = 41$ m/s, $v_y = 9$ m/s

B) $v_x = 25$ m/s, $v_y = 18$ m/s

C) $v_x = 41$ m/s, $v_y = -5$ m/s

D) $v_x = 25$ m/s, $v_y = -8$ m/s

**E) $v_x = 41$ m/s, $v_y = -10.5$ m/s**

How much later does it hit the ground?



The above figure which shows two vectors **A** and **B** is used in the following four problems.

2. Find the magnitude of 3**A**+6**B** (select the closest answer)
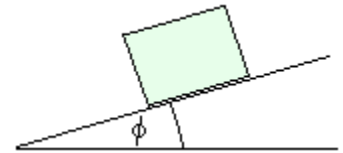
A) 6

B) 12

**C) 18**

D) 24

E) 30

**3.** What is the difference between 103.5 and 102.24 written with the correct number of significant figures?

A) 1
**B) 1.3**
C) 1.26
D) 1.260
E) 1.2600

**4.** A 2-kg block, initially at rest, slides down an inclined plane with constant velocity. Angle of incline is $35^0$. Find the coefficient of kinetic friction.

A) 0.2
B) 0.5
**C) 0.7**
D) 0.8
E) 0.9

**5.** A 38-kg crate is pulled along a horizontal, frictionless floor by a cord that exerts a 180-N tension force at an angle $\theta = 30^0$ as shown . The normal force on the block is closest to

A) 110 N
B) 146 N
C) 185 N
D) 211 N
**E) 282 N**
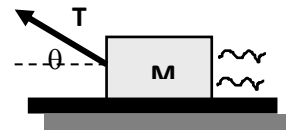
**6.** A 5-kg block is pulled across a horizontal plane. A pulling force F has a magnitude of 24 N and makes an angle of $28^0$ with a horizontal. A 8 N friction force opposes its motion. The block's acceleration is

a. 0.55 m/s$^2$
**b. 2.64 m/s$^2$**
c. 4.29 m/s$^2$
d. 6.75 m/s$^2$
e. 8.00 m/s $^2$
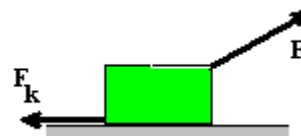
**7.** A car has a mass of 1200 kg and is moving a 60 mi/h. The driver enters a low-speed zone and applies the brakes, resulting in a net backward force of 1800 N. The brakes are held for 10 s. How far does the car travel during this period?

**a. 193 m**
b.  175 m
c.  148 m
d.  120 m
e. 75 m

**8.** Two small objects, with masses $m$ and $M$, are originally a distance $r$ apart, and the magnitude of the gravitational force on each one is $F$.  The masses are changed to $2m$ and $2M$, and the distance is changed to $4r$.  What is the magnitude of the new gravitational force?

A) $F/16$
**B) $F/4$**
C) $16F$
D) $4F$
E) $F/2$

**9.** A 1.0-kg ball moving at 2.0 m/s perpendicular to a wall rebounds perpendicular from the wall at 1.5 m/s.  The impulse of the ball is:

A)   zero
B)   0.5 N·s away from the wall
C)   0.5 N·s toward the wall
**D)   3.5 N·s away from wall**
E)    3.5 N·s toward the wall

**10.** A 4-kg object moves to the right at 8.0 m/s. It collides with a 6-kg object moving at 5 m/s to the left. The collision is perfectly inelastic. What is the speed of the 4 kg object after  the collision?

A) 0 m/s
**B) 0.2 m/s**
C) 4.2 m/s
D) 6.2 m/s
E) 8.2 m/s

**11.** A Ferris wheel rotating at 20 rad/s decelerates with a constant accelration of 5 rad/s$^2$. How many revolutions will it make before coming to rest?

A)  4.0
B)  2.8
**C) 6.4**
D)  3.2
E)  1.5

**12.** A wheel of radius 2 cm has a 4-m cord wrapped around its periphery. Starting from rest, the wheel is given a constant angular acceleration of 1 rad/s$^2$. The cord will unwind in

A)  125 s
B)  85 s
C)  66 s
**D) 20 s**
E)  15 s

**13.** When a ceiling fan rotating with an angular speed of 2.0 rev/s is turned off, a frictional torque of 0.98 Nm slows it to a stop in 4.5 s. What is the moment of inertia of the fan?

**A)  0.35 kgm$^2$**
B)  0.55 kgm$^2$
C)  0.85 kgm$^2$
D)  1.35 kgm$^2$
E)  2.35 kgm$^2$

**14.** An electric motor can accelerate a 2.0-kg grinding wheel in a form of a solid disk of radius 0.20 m from rest to 700 rev/min in 14 s.  Find the torque generated by the motor.

A)  0.07 N·m
B)  0.11 N·m
**C)  0.21 N·m**
D)  0.33 N·m
E)  0.46 N·m

**15.** A figure skater goes into a spin, starting with her arms up and close to her body as shown. When she extends her arms horizontally sometime later the angular speed remains constant or changes and if changes how?

**Ans. her angular velocity decreases.**
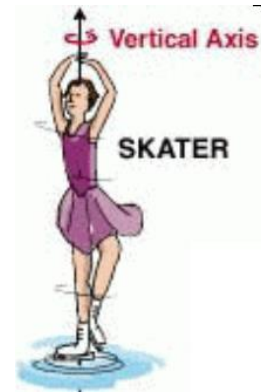
**16.** A pizza together with its pan is rotating about a vertical axis through its center. Its rotational inertia $I = 2.00 \text{ kg.m}^2$ and radius $r = 50.0 \text{ cm.}$ The initial angular speed is **4.00 rad/s**. A **1.00 kg** chunk of Mozzarella cheese is initially at rest over the disk. It drops vertically onto the pizza from above and sticks to the edge. What is the angular speed of the pizza after the cheese becomes stuck to it?

Ans. **3.56 rad/s**
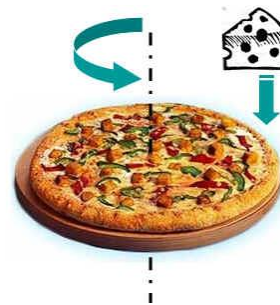
**17.** Find (a) the tension T in the horizontal cable and (b) the magnitude and direction of the force exerted on the strut by the pivot in the arrangement in figure below. Let W be the weight of the suspended crate full of priceless art objects. The strut is uniform and also has weight W.

Ans. **(a) T= 2.60W; (b) F= 3.27W** and **θ=37.6°**

(a)

30.0°
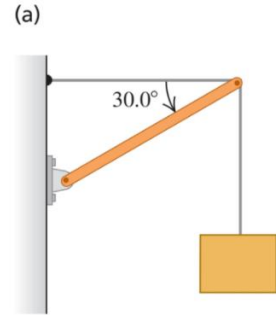
**18.** A tire on a car is turning initially at 500 radians/s. The car brakes and slows to a stop in 20 s. What is the acceleration in Radians/s$^2$?

   a. -500

   b. 0

   c. 25

   d. 700

   **e. -25**

**19.** How much work is required to accelerate a 1000 kg car from 20 m/s to 30 m/s?

A) $0.5 \times 10^5$ J
B) $1.2 \times 10^5$ J
**C) $2.5 \times 10^5$ J**
D) $3.8 \times 10^5$ J
E) $4.5 \times 10^5$ J

**20.** A 1600 – kg car starts from rest at the top of the long driveway that is inclined at $15^0$ with the horizontal. If the average friction force of 1500 N impedes the motion, what is the car's acceleration?

**a. 0.76 m/s$^2$**
b. 1.05 m/s$^2$
c. 1.87 m/s$^2$
d. 1.60 m/s$^2$
e. 2.75 m/s$^2$

**21.** An automobile traveling along a straight road increases its speed from 30.0 m/s to 50.0 m/s in a distance of 180 m. If the acceleration is constant, how much time elapses while the auto moves this distance?

a. 6.00 s
**b. 4.50 s**
c. 3.60 s
d. 4.00 s
e. 9.00 s

**22.** A car moving initially at 36 km/h, travels 174 m in 8 s along a straight line with constant acceleration. The acceleration of the car is:

A) 0. 0 m/s$^2$
B) 0.5 m/s$^2$
C) 1.0 m/s$^2$
**D) 3. 0 m/s$^2$**
E) 6. 0 m/s$^2$

**23.** An airplane propeller starts to turn from rest and speeds up to 2 radians/s after turning 6 Radians. How long does it take, in s .
**a. 6**
b. 4
c. 3
d. 2
e. 1

**24.** A 20 N force **F**, parallel to the incline is required to push a certain crate at acceleration of 1.6 m/s$^2$ up an incline that is Φ= 28$^0$ above the horizontal. What is the mass of the crate?

A) 2.31kg
B) 3.49kg
**C) 3.22kg**
D) 5.84kg
E) 6.04 kg
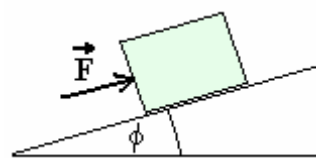
**25.** A 1.0-kg block is pushed up a rough $22^0$ inclined plane by a force of F=7.0 N acting parallel to the incline. The acceleration of the block is 1.4 m/s$^2$ up the incline. Determine the magnitude of the force of friction acting on the block.

**A) 1.9 N**
B)  2.2 N
C)  1.3 N
D)  1.6 N
E) 3.3N
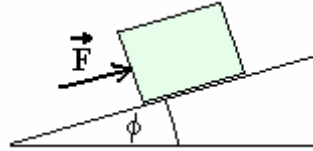
**26.** A 5-kg ball is dropped from a height $y_0$ above the top of a vertical spring whose spring constant is 2000 N/m. The spring is compressed 0.4 m. The height $y_0$ is closest to

**Ans. 2.86 m**
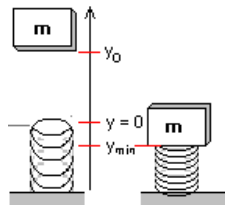
**27.** A 1.5-kg block sliding on a rough horizontal surface is attached to one end of a horizontal spring (k = 200 N/m) which has its other end fixed. If this system is displaced 20 cm horizontally from the equilibrium position and released from rest, the block first reaches the equilibrium position with a speed of 2.0 m/s. What is the coefficient of kinetic friction between the block and the horizontal surface on which it slides?

**Ans. 0.34**

**28.** A solid ball of mass of 0.25 kg rolls without slipping 4 m down an incline that makes an angle of $25^0$ a with a horizontal. If it starts from rest, what is its kinetic energy at the bottom of the incline?

A) 1 J
B) 2 J
**C) 4 J**
D) 6 J
E) 8 J
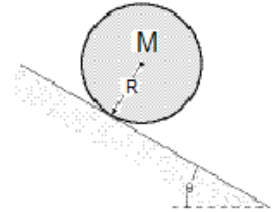


**29.** A basketball is rolling without slipping along a horizontal surface with total kinetic energy 20 J. How much energy (in Joules) is due to the rotational kinetic energy of the ball about its center of mass? Basketballs are hollow shells. ($I = 2/3\ mr^2$.)

A) 10
**B) 8**
C) 13.3
D) 4
E) 12

**30.** An astronaut with mass m= 70 kg, measures her weight to be 140 N on a space ship. What is the value of the effective gravitational field, g in N/kg, at that point?

a. 10

b. 3.5

c. 70

d. 0.5

**e. 2.0**

**31.** A planet has a radius that is 1/3 the radius of the earth. The gravitational field on the surface of that planet is 4 times the gravitational on the earth's surface. What is the ratio of the mass of the planet to the mass of the earth?

     a. 2.5

     b. 8

     **c. 0.2**

     d. 1.0

     e. 0.44