Exam 4--PHYS 201--F15

Multiple Choice (20 pts)
Identify the choice that best completes the statement or answers the question.

1. Consider a point on a spinning wheel rotating with $\alpha = 0 \text{ rad s}^{-2}$. Which of these statements best describes the linear velocity of the point?
   a. the linear velocity equals $\alpha$
   b. the linear velocity is the same as the angular velocity
   c. the linear velocity does not change
   d. the linear velocity is changing constantly

2. An object at rest begins to rotate with a constant angular acceleration. If this object rotates through an angle $\theta$ in time $t$, what angle does it rotate through in twice that time?
   a. $2\theta$
   b. $\theta/2$
   c. $\theta/4$
   d. $4\theta$

3. A figure skater pulls her arms in to decrease her moment of inertia by a factor of two. As a result, she spins twice as fast. What has happened to her rotational energy?
   a. it has increased by a factor of 4
   b. it has increased by a factor of 2
   c. it remains the same
   d. it has decreased by a factor of 2
   e. it has decreased by a factor of 4

4. A solid sphere, hoop, and cylinder all have the same mass and radius. Which is the most difficult to spin?
   a. cylinder
   b. hoop
   c. sphere
   d. all are the same difficulty to spin

5. Consider this object. It consists of two equal length and mass bars. Each dashed line shows an axis of rotation. Which of these describe the moments of inertia for the object?
   a. $I_A > I_B > I_C > I_D$
   b. $I_A > I_B > I_C = I_D$
   c. $I_A > I_B > I_D > I_C$
   d. $I_D > I_C > I_B > I_A$

6. This figure shows wrenches and an applied force, which is represented by the arrow. Rank the torques provided by the wrenches from greatest to least torque.
   a. b $\approx$ c $>$ a $>$ d
   b. c $>$ d $>$ a $>$ b
   c. d $\approx$ c $>$ b $>$ a
   d. d $>$ b $>$ c $>$ a
7. The following figure shows a configuration of an object, lens, and image. What kind of lens has produced this image?

a. flat
b. no lens can create this image
c. concave
d. convex

8. Concave lenses and convex mirrors are what class of optical devices?
   a. converging
   b. diverging
c. neither of these
d. both of these

9. For a single-lens system, virtual images are always on the ______ the object.
   a. opposite side of
   b. same side as

10. You look in a mirror and see an image of your nose that is bigger than your actual nose. Which of these options correctly give the type of mirror and describe the image?
    a. concave mirror, virtual image, upright
    b. convex mirror, virtual image, inverted
    c. convex mirror, real image, inverted
d. flat mirror, virtual image, upright
11. (10 pts) A cylinder has a mass of 3.0 kg and a radius of 2.0 m. It spins about an axis through the center; this figure shows the cylinder from above. A force of 10.0 N acts at the edge of the cylinder at an angle of 30° as shown; a second force of 20.0 N is tangent to the surface of the cylinder. Answer the following questions:

a) What is the net torque on the cylinder?
b) What is the angular acceleration of the cylinder?
c) What is the angular speed for the cylinder after 3.0 seconds?
d) What is the kinetic energy of the cylinder after 3.0 seconds?
12. (10 pts) A ferris wheel travels at an angular speed of 0.1 rev/s; it has a radius of 10 m. A boy of mass 50 kg sits in one of the chairs. What is the normal force acting on the boy at the top of the circular path and at the bottom (Hint: the two normal forces are not the same.)

13. (5pts) A force, \( \vec{F} = 3\hat{i} - 2\hat{k} \), acts on an object at a point which is a distance from the origin of \( x=1\text{m} \) and \( y=2\text{m} \). What is the torque caused by the force?
14. (10 pts) A person stands 4 m to the left of a spherical mirror. The mirror creates an image that is upright and has a magnification of $\frac{1}{2}$.

What type of mirror is this?
What is the focal length of the mirror?
Where is the image located (to the left or right of the mirror)?

15. (10 pts) Two converging lenses, each of focal length 20 cm, are placed 120 cm apart, and an object is placed 40 cm front of the first lens.

Where is the final image formed (how far to the right or left of second lens)?

What is the magnification of the system?
16. (5 pts) Draw, at least, two rays for this convex lens with the object outside of the focal point.

Is the image real or virtual?

Upright or inverted?
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Answer Section

MULTIPLE CHOICE

1. ANS: D  PTS: 1  REF: F15
2. ANS: D  PTS: 1
3. ANS: B  PTS: 1  REF: F15
4. ANS: B  PTS: 1  REF: F15
5. ANS: A  PTS: 1  REF: F15
6. ANS: C  PTS: 1  REF: F15
7. ANS: D  PTS: 1
8. ANS: B  PTS: 1
9. ANS: B  PTS: 1
10. ANS: A  PTS: 1

PROBLEM

11. ANS:
   PTS: 1
12. ANS:
   PTS: 1
13. ANS:
   PTS: 1
14. ANS:
   PTS: 1
15. ANS:
   PTS: 1
16. ANS:
   PTS: 1