Exam 2--PHYS 201--F11

Multiple Choice
Identify the choice that best completes the statement or answers the question.

1. Which of these statements best describe Aristotle’s view of the natural world:
   a. all objects are propelled by a mystical force that emanates from the Earth
   b. all objects have a natural state, which is at rest
   c. objects will continue in motion unless an outside force acts on them
   d. the mass of an object is a measure of its inertia

2. Which of these make up the basic SI units of the newton?
   a. \( \frac{kg}{s^2} \)
   b. \( \frac{kg \cdot m}{s^2} \)
   c. \( \frac{kg^2 \cdot m^2}{s^2} \)
   d. \( \frac{kg \cdot m}{s} \)

3. From rest, we step on the gas of our Subaru, providing a force \( F \) for 4 secs, travelling a distance of 10 meters. If the applied force were only \( \frac{1}{2} F \), how far does the car travel in the same amount of time?
   a. 10 m
   b. 15 m
   c. 5 m
   d. 20 m
   e. 2.5 m

4. A block of mass \( m \) rests on the floor of an elevator that is accelerating upward. What is the relationship between the force due to gravity (\( F_g \)) and the normal force on the block (\( F_N \))?  
   a. \( F_N > F_g \)
   b. \( F_N = F_g \)
   c. \( F_N < F_g \)
   d. it depends on the mass of the block

5. Which of these is a conservative force?
   I. Gravitational force
   II. Frictional force
   III. Electric force
   IV. Normal Force
   a. II & IV
   b. I, III, & IV
   c. I & II
   d. I & III

6. Which is usually larger, kinetic or static friction?
   a. kinetic friction
   b. static friction
   c. they are usually the same
   d. it depends on the mass of the objects
7. In this figure, all of the blocks have a displacement to the right. The magnitude of the force is the same for each block. Which force is doing no amount of work?

- (a)
- (b)
- (c)
- (d)

- a. a
- b. b
- c. c
- d. d

8. A car travels a distance $x$ at acceleration $a$ and does work $W$. If the car travels a distance $2x$ at the same acceleration, what is the work it has done?

- a. $W$
- b. $4W$
- c. $2W$
- d. $\frac{1}{2}W$

9. Which requires more energy: to take a car from $0 \Rightarrow 30$ mi/hr or from $30 \Rightarrow 60$ mi/hr?

- a. $0 \Rightarrow 30$
- b. $30 \Rightarrow 60$
- c. both the same
- d. it depends on the mass of the car

10. Consider this figure. Three blocks of mass $m$ slide down different inclined planes, each beginning at a height $h$. The coefficient of kinetic friction for the inclined planes is 0.3. Which block has the most energy at the bottom of the inclined plane?

- (a)
- (b)
- (c)

- a. a
- b. b
- c. c
- d. all have the same energy
11. You compress a mass on a spring, as in this figure, and release it. At what position does the mass have its largest speed?

[Diagram showing a mass on a spring with positions x=-a and x=0 labeled]

a. x=-a  
   b. x=0  
   c. x=+a  
   d. \( x=\frac{1}{2}a \)

12. Which of these statements is most appropriate for an elastic collision?

a. momentum is conserved  
   b. both energy and momentum are conserved  
   c. energy is conserved  
   d. neither energy or momentum are conserved

13. A uranium nucleus (at rest) undergoes fission and splits into two fragments, one heavy and the other light. Which fragment has the greater speed?

a. the heavy fragment  
   b. the light fragment  
   c. both have the same speed  
   d. it depends on the energy of the fragments

14. A collection of particles has a total momentum of zero. Which of these statements is true?

a. the particles have no mass  
   b. the kinetic energy of the particles must be zero  
   c. the particles are definitely moving  
   d. the kinetic energy of the particles might be zero, but not necessarily

15. An open cart rolls along a frictionless track while it is raining. As it rolls, what happens to the speed of the cart as the rain collects in it? (assume that the rain falls vertically into the box)

a. it speeds up  
   b. it slows down  
   c. it maintains constant speed  
   d. it depends on the initial speed of the cart
Problem

16. (25 pts) Consider this figure. The coefficient of kinetic friction between block #2 and the inclined plane is 0.1. What is the mass of block #1 to create the acceleration given?

\[ |\vec{a}| = 1.0 \frac{m}{s^2} \]

\[ m_2 = 10 \text{ kg} \]

\begin{align*}
F_N &= \underline{\text{N}} \\
f_k &= \underline{\text{N}} \\
F_I &= \underline{\text{N}} \\
m_1 &= \underline{\text{kg}}
\end{align*}
17. (20 pts) This figure shows a mass (1 kg) on a spring, with a spring constant of 550 N/m, that is compressed by 10 cm to the left of its equilibrium position. Immediately to the right of the equilibrium position, there is a region where a frictional force is present; this force is dependent on the position as given below. The region extends 4 cm to the right of the equilibrium position.

\[ F = 5000x^2 \]

a) What is the initial total energy of the system?
b) After release, what is the speed of the block at 5 cm to the left of the equilibrium position?
c) How much energy is lost each time the block goes through the force field region?
d) How many times does the block pass through the equilibrium position before it comes to rest?
18. (15 pts) A force acts on a particle, which is initially at rest; the force is $\vec{F} = (3.0\hat{i} + 4.0\hat{j})N$. The particle is initially at $\vec{d}_i = (0.25\hat{i} + 0.50\hat{j})m$. After $t=2.0$ seconds, the particle is located at $\vec{d}_f = (3.25\hat{i} + 4.50\hat{j})m$.

a) How much work has been done by the force?

b) What is the power provided by this force?

c) What is the mass of the particle? (Hint $x = \frac{1}{2} a_x t^2$.)

d) What is the magnitude of the final velocity for the particle?
19. (10 pts) Two particles collide; their initial conditions are as shown in this figure. After the collision, the second particle, \( m_2 \), travels at 0.5 m/s in the positive-x direction. What is the final velocity of the first particle, \( m_1 \)? Give the answer in vector notation (ie. in \( \hat{i} \hat{j} \) notation).

\[ \vec{v}_{1,i} = (3\hat{i} - 4\hat{j}) \frac{m}{s} \]

\[ |\vec{v}_{2,i}| = 0 \frac{m}{s} \]
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Answer Section

MULTIPLE CHOICE

1. ANS: B PTS: 1
2. ANS: B PTS: 1
3. ANS: C PTS: 1
4. ANS: A PTS: 1
5. ANS: D PTS: 1
6. ANS: B PTS: 1
7. ANS: A PTS: 1
8. ANS: C PTS: 1
9. ANS: B PTS: 1
10. ANS: A PTS: 1
11. ANS: B PTS: 1
12. ANS: B PTS: 1
13. ANS: B PTS: 1
14. ANS: D PTS: 1
15. ANS: B PTS: 1

PROBLEM

16. ANS:

PTS: 1
17. ANS:

PTS: 1
18. ANS:

PTS: 1
19. ANS:

PTS: 1