PHYS 119

PHYSICS I - MECHANICS   17 January 2022

(Final Exam, 75 min.)

Last Name :   Student ID :

First Name :   Signature :

Instructions:

1. Print and encode your name, student ID number, test booklet series, and section on the answer sheet.
   And SIGN it.
2. Print your name, student ID number on the question sheet, test booklet series, and SIGN.
3. Answers to all the questions are to be recorded on the answer sheet.
4. Each question is weighted equally.
5. No cell phones!

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1. A 150-g mass has a velocity $v = 2i + 6j$ m/s at a certain distant. What is its kinetic energy?

   A) 1 J.
   B) 3 J.
   C) 5 J.
   D) 7 J.

2. How large a force is required to accelerate a 1300-kg car from rest to a speed of 20 m/s in a distance of 80 m?

   A) 0.5 kN
   B) 1 kN
   C) 2.25 kN
   D) 3.25 kN

3. Momentum is the product of:

   A) mass and velocity.
   B) mass and acceleration.
   C) velocity and acceleration.
   D) force and velocity.

4. Potential energy is the energy possessed by an object due to:

   A) its momentum.
   B) its position.
   C) its velocity.
   D) its acceleration.

5. The work done against gravity in moving a box with a mass of 5 kilograms through a height of 3 meters is:

   A) 150 Joules.
   B) 150 Newtons.
   C) 15 Joules.
   D) 15 Newtons.

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16. A ball with mass m is thrown vertically upward with an initial velocity $v_0 = \sqrt{gH}$, where g is the gravitational acceleration, and H has the dimension of length. If the ball reaches a maximum height of $2H/5$ with respect to the point, where it is thrown from, what is the work done by the air drag force on the ball until it reaches the maximum height?

   A) $-mgH/10$
   B) $-2mgH/5$
   C) $-mgH$
   D) No work is done on the ball by air drag.

17. A ball is thrown with a speed of 10 m/s at an angle of 37° above the horizontal. It lands on the roof of a building at a point displaced 24 m horizontally from the throwing point. How high above the throwing point is the roof?

   A) 1 m
   B) 3 m
   C) 5 m
   D) 7 m

18. The coefficient of sliding friction between a 900-kg car and pavement is 0.8. If the car is moving at 25 m/s along level pavement when it begins to skid to a stop, how far will it go before stopping?

   A) 40 m
   B) 80 m
   C) 120 m
   D) 160 m

19. A block of mass m is in motion with speed v_0 on a frictionless table to undergo a collision with another block of mass m, which is initially at rest (See Figure). An ideal spring of force constant k is attached to the back end of the block on the right, as shown in the Figure. The spring force is given by $f_{spring} = -kx^2$.

    How much work is done by the spring until it reaches to the maximum compression?

    left   right

    A) $-mv_0^2/4$
    B) $+mv_0^2/4$
    C) $-mv_0^2/2$
    D) $+mv_0^2/2$

20. A box is dragged across a floor by a rope which makes an angle of 60° with the horizontal. The tension in the rope is 100N while the box is dragged 15 m. How much work is done?

    A) 250 J.
    B) 500 J.
    C) 750 J.
    D) 1.5 kJ.

6. A 16-g mass is moving in the +x direction at 30 cm/s while a 4-g mass is moving in the -x direction at 50 cm/s. They collide head-on and stick together. What is their velocity after collision?

   A) 0.09 m/s
   B) 0.14 m/s
   C) 0.25 m/s
   D) 0.55 m/s

7. A particle moves in a circle of constant radius R. If the speed of the particle varies with time t according to the equation $v = C\sqrt{t}$, where C is a positive constant, for what value of t does the acceleration vector make an angle of 45° with the velocity vector?

   A) $R/(\sqrt{2}C)$
   B) $\sqrt{R/2C}$
   C) $\left(\frac{2R}{C}\right)^{1/3}$
   D) $\left(\frac{R}{2C}\right)^{2/3}$

8. A space vehicle in a circular orbit around Earth collides with a small asteroid. After the collision, they stick together and continue the orbital motion. For this collision, which statement is correct?

   A) Only kinetic energy is conserved
   B) Both momentum and kinetic energy are conserved
   C) Neither momentum nor kinetic energy is conserved
   D) Only momentum is conserved

9. A block falls from a height of 0.6 m. It lands on an ideal, massless, and vertical spring with a force constant of 2.4 kN/m. The spring is initially 25 cm high, but it is compressed to a minimum height of 10 cm before the block is stopped and the system is in equilibrium. What is the mass of the block?

   A) 2.5 kg
   B) 3.5 kg
   C) 4.5 kg
   D) 5.5 kg

10. Which of the following is equivalent to a unit of impulse?

    A) meter / second²
    B) kilogram · meter / second
    C) kilogram · meter² · second
    D) kilogram · meter / second²

11. Kinetic energy of an object with mass m and momentum p is:

    A) $p^2/2m$
    B) p^2/m
    c) $mp^2/2$
    d) None of the above.

12. While waiting in his car at a stoplight, an 80-kg man and his car suddenly accelerated to a speed of 5 m/s as a result of a rear-end collision. Assuming the time taken to be 0.3 second. What is the average force exerted on the man by the back of the seat of his car?

    A) 700 N
    B) 900 N
    C) 1100 N
    D) 1300 N

13. A car is accelerating to the right with a given acceleration A. What is the minimum coefficient of static friction μ_s so that the block does not slide?

    A) A/g
    B) mA/g
    C) $(A-g)/g$
    D) g/A

14. A glass of mass m, standing on a table, at the level P₁, is carried a distance h vertically up to the level P₂ and held at that level. How much work is done on the glass by the person carrying it to P₂? (Neglect air resistance)

    A) -mgh
    B) -mgh
    C) +mgh, only if it is carried at a constant speed
    D) -mgh, only if it is carried at a constant speed

15. A ball of mass m, suspended at the end of a massless string of length L, is released from height H (point A in the Figure) and collides elastically, when it is at its lowest point (at point B), with another ball of mass m, which is initially at rest. No friction anywhere. What are the maximum heights each ball (the one on the left and the one on the right) can reach after their second elastic collision?

	h_{max}^{left}	h_{max}^{right}
A)	0	H/2
B)	H/2	H/2
C)	0	H
D)	H	0