FORM A

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PHYSICS 220

$$\pi = 3.14159 \quad G = 6.673 \times 10^{-11} \ m^3/\!\left(kg \cdot s^2\right) \qquad 1N = 1kg\!\left(m/s^2\right)$$

$$g = 9.81 \, m/s^2 = 32 \, ft/s^2 \qquad 1 \, lb = 4.448 \ N \qquad 1 \ mile = 1.609 \ km$$

$$F_{Grav} = G\frac{m_1 m_2}{r^2} \qquad F_{friction} = \mu N \qquad \vec{p} = m\vec{v} \qquad \vec{J} = \vec{I} = \vec{F}\Delta t = \Delta \vec{p}$$

$$x = x_o + \frac{1}{2}\left(v_o + v_f\right)t \qquad v_f = v_o + at \qquad a_c = \frac{v^2}{r} \qquad P^2 \propto a^3$$

$$x = x_o + v_o t + \frac{1}{2}at^2 \qquad v_f^2 = v_o^2 + 2a\left(x - x_o\right)$$

PICK THE BEST ANSWER. QUESTIONS 1 - 25 EACH WORTH 4 POINTS

1) You drive 6.0 km at 50 km/h and then another 6.0 km at 90 km/h. Your average speed over the 12 km drive will be
A) exactly 38 km/h.   B) greater than 70 km/h.   C) equal to 70 km/h.   D) less than 70 km/h.
E) It cannot be determined from the information given because we must also know directions traveled.

2) Which of the following is **NOT** a vector quantity?
A) speed   B) velocity   C) acceleration   D) force   E) linear momentum

3) An auto manufacturer advertises that their car can go "from zero to sixty in eight seconds." This is a description of what characteristic of the car's motion?
A) average acceleration   B) instantaneous speed   C) displacement
D) average speed   E) instantaneous acceleration

4) A ball is thrown downward in the absence of air. After it has been released, which statement concerning its acceleration is correct?
A) Its acceleration is constantly decreasing.   B) Its acceleration is constant.
C) Its acceleration is greater than g.   D) Its acceleration is zero.
E) Its acceleration is constantly increasing.

5) A 10-kg rock and a 20-kg rock are thrown upward with the same initial speed v_o and there is no air resistance. If the 10-kg rock reaches a maximum height h, what maximum height will the 20-kg rock reach?
A) $2h$ B) $h/2$ C) h D) $4h$ E) $h/4$

6) You are in a train traveling on a horizontal track and notice that a piece of luggage starts to slide directly toward the front of the train. From this observation, you can conclude that this train is
A) slowing down.   B) slowing down and changing direction.   C) speeding up.
D) changing direction.   E) speeding up and changing direction.

7) An object is moving with constant non-zero velocity. Which of the following statements about it *must* be true?
A) A constant force is being exerted on it in the direction opposite of motion.
B) A constant force is being exerted on it in the direction of motion.
C) The sum of the forces exerted on the object is zero.
D) Its acceleration is in the same direction as it's velocity.
E) A constant force is being exerted on it perpendicular to the direction of motion.

8) A crate is sliding down an inclined ramp at a constant speed of 0.55 m/s. The vector sum of **ALL** the forces exerted on this crate must point
A) perpendicular to the ramp.   B) down the ramp.   C) vertically downward.
D) up the ramp.   E) None of the above choices is correct.

9) A 75-N box rests on a perfectly smooth (no friction) horizontal surface. The minimum force needed to start the box moving is
A) 750 N.   B) 75 N   C) 7.5 N   D) any horizontal force greater than zero.   E) 0.75 N

10) An object of weight W is in free fall close to the surface of the Earth. The magnitude of the force that the object exerts on the Earth is
A) greater than W.   B) equal to W.   C) less than W.   D) zero.
E) cannot be determined without knowing the relative masses of the object and the Earth

11) For general projectile motion if we neglect air resistance, the horizontal component of a projectile's acceleration
A) continuously increases.   B) first decreases and then increases.   C) continuously decreases.
D) is always zero.   E) remains a non-zero constant.

12) James and John dive from an overhang into the lake below. James simply drops straight down from the edge. John takes a running start and jumps with an initial horizontal velocity of 25 m/s. Assuming no effects of air resistance, when they reach the lake below
A) the splashdown speed of John is larger than that of James.
B) the splashdown speed of James is larger than that of John.
C) the splashdown speed of John must be 25 m/s larger than that of James.
D) the splashdown speed of James must be 9.8 m/s larger than that of John.
E) they will both have the same splashdown speed.

13) A block of mass m sits at rest on a rough inclined ramp that makes an angle θ with the horizontal. What must be true about the normal force F on the block due to the ramp?
A) $F = mg \sin \theta$ B) $F > mg$ C) $F = mg \cos \theta$ D) $F > mg \sin \theta$ E) $F > mg \cos \theta$

14) A person is pushing on a box exerting a force of magnitude P, as shown in the figure. The Earth exerts a force W on the box. *The* push is directed at an angle θ below the horizontal, and the box remains a rest. The box rests on a horizontal surface that has some friction with the box. The normal force on the box due to the floor is equal to
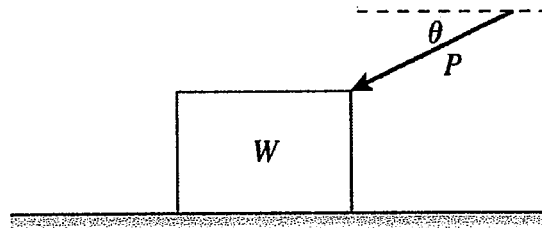
A) $W - P \sin\theta$.   B) $W + P$ C) $W + P\cos\theta$.   D) W.   E) $W + P \sin\theta$.

15) A 200-N sled slides down a frictionless hillside that rises at 37° above the horizontal. What is the magnitude of the force that the hill exerts on the sled parallel to the surface of the hill?
A) 200 N   B) 0 N   C) 120 N   D) 150 N   E) 160 N

16) An object moves in a circular path at a constant speed. Compare the direction of the object's velocity and acceleration vectors.
A) The vectors are perpendicular to each other.   B) The acceleration is zero but the velocity is constant.
C) Both vectors point in the same direction.   D) The vectors point in opposite directions.
E) Depends on the radius

17) You are making a circular turn in your car on a horizontal road when you hit a big patch of ice, causing the force of friction between the tires and the road to become zero. While the car is on the ice, it
A) continues to follow a circular path, but with a radius larger than the original radius.
B) moves along a straight-line path away from the center of the circle.
C) moves along a straight-line path in its original direction.
D) moves along a path that is neither straight nor circular.
E) moves along a straight-line path toward the center of the circle.

18) The reason an astronaut in an Earth satellite feels weightless is that
A) the astronaut is in the state of free fall.
B) the astronaut is beyond the range of the Earth's gravitational pull.
C) the astronaut's acceleration is zero.
D) the astronaut is at a point in space where the effects of the Moon's gravity and the Earth's gravity cancel.
E) this is a psychological effect associated with rapid motion.

19) Two cars go around a banked curve at the proper speed for the banking angle. One car has tires with excellent traction, while the other car has bald slippery tires. Which of these cars is more likely to slide on the pavement as it goes around the curve?
A) the car with the new tires   B) the car with the bald tires   C) Neither car will slide.
D) It depends on their masses   E) Need the coefficient of friction

20) Satellite A has twice the mass of satellite B, and moves at the same orbital distance from the Earth as satellite B. Compare the speeds of the two satellites.
A) The speed of B is one-half the speed of A.   B) The speed of B is equal to the speed of A.
C) The speed of B is twice the speed of A.   D) The speed of B is one-fourth the speed of A.
E) The speed of B is four times the speed of A.

21) A tiger is running in a straight line. If we double both the mass and speed of the tiger, the magnitude of its momentum will increase by what factor?
A) 8   B) 4   C) 16   D) 12   E) 2

22) A rocket explodes into two fragments, one 25 times heavier than the other. The magnitude of the momentum change of the lighter fragment is
A) 1/25 as great as the momentum change of the heavier fragment.
B) the same as the momentum change of the heavier fragment.
C) 1/4 as great as the momentum change of the heavier fragment.
D) 25 times as great as the momentum change of the heavier fragment.
E) 5 times as great as the momentum change of the heavier fragment.

23) A very light Ping-Pong ball moving east at a speed of 4 m/s collides with a very heavy stationary bowling ball. The Ping-Pong ball bounces back to the west, and the bowling ball moves very slowly to the east. On which object is the greater magnitude impulse exerted during the collision?
A) On the bowling ball   B) On the Ping-Pong ball
C) Neither; the same magnitude impulse was exerted on both.
D) It is impossible to tell since the actual mass values are not given.
E) It is impossible to tell since the velocities after the collision are unknown.

24) Identical forces are exerted for the same length of time on two different objects. The magnitude of the change in momentum of the lighter object is
A) exactly equal to the magnitude of the change in momentum of the larger mass object.
B) zero.
C) smaller than the magnitude of the change in momentum of the larger mass object, but not zero.
D) larger than the magnitude of the change in momentum of the larger mass object.
E) There is not enough information to answer the question.

25) Three objects are moving along a straight line as shown in the figure. Taking the positive direction to be to the right, what is the total momentum of this system?

5.00 m/s	4.00 m/s	2.00 m/s
●———→	←———●	●———→
8.00 kg	15.0 kg	3.00 kg
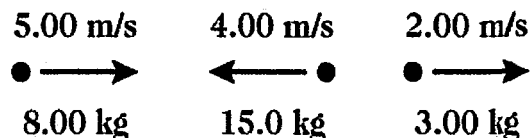
A) -106 kg · m/s   B) 0.00 kg · m/s   C) +14.0 kg · m/s   D) -14.0 kg · m/s   E) +106 kg · m/s

QUESTIONS 26 - 31 EACH WORTH 7 POINTS

26) A car accelerates from 5.0 m/s to 21 m/s at a constant rate of 3.0 m/s^2. How far does it travel while accelerating?
A) 69 m   B) 117 m   C) 41 m   D) 207 m   E) 78 m

27) A cat leaps to try to catch a bird. If the cat's jump was at 60° off the ground and its initial velocity was 2.74 m/s, what is the highest point of its trajectory, neglecting effects of air resistance?
A) 0.19 m   B) 0.29 m   C) 10.96 m   D) 0.58 m   E) 0.1 m

28) A 1000-kg car is slowly picking up speed as it goes around a horizontal unbanked curve whose radius is 100 m. The coefficient of static friction between the tires and the road is 0.35. At what speed will the car begin to skid sideways?
A) 30 m/s   B) 34 m/s   C) 24 m/s   D) 19 m/s   E) 9.3 m/s

29) A 0.140-kg baseball is thrown with a velocity of 27.1 m/s. It is struck by the bat exerting an average force of 5000 N, which results in a velocity of 37.0 m/s in the opposite direction from the original velocity. How long were the bat and ball in contact?
A) 3.07×10^{-2} s   B) 1.79×10^{-3} s   C) 1.28×10^{-2} s   D) 4.30×10^{-3} s   E) 2.80×10^{-4} s

30) As shown in the figure, a 10-kg block on a perfectly smooth horizontal table is connected by a horizontal string to a 63-kg block that is hanging over the edge of the table. What is the magnitude of the acceleration of the 10-kg block when the other block is gently released?
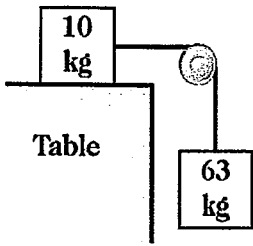
A) 9.0 m/s^2 B) 8.5 m/s^2 C) 7.5 m/s^2 D) 8.1 m/s^2 E) 9.81 m/s^2

31) A block is on a frictionless table, on the Earth. The block accelerates at 3.0 m/s^2 when a 20 N horizontal force is exerted on it. The block and table are set up on the Moon, where the acceleration of objects due to the gravitational attraction is 1.62 m/s^2. The weight of the block on the Moon is closest to
A) 6.8 N.   B) 9.5 N.   C) 8.1 N.   D) 11 N.   E) 5.5 N.

32) The captain of a space ship orbiting planet X discovers that to remain in orbit at 410 km from the planet's center, she needs to maintain a speed of 68 m/s. What is the mass of planet X?
A) 2.8×10^{19} kg   B) 4.2×10^{17} kg   C) 4.2×10^{14} kg   D) 2.8×10^{16} kg   E) 1.9×10^{8} kg