FORM A

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PHYSICS 220

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

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

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

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

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

QUESTIONS 1 - 25 EACH WORTH 4 POINTS

1) When a ball is thrown straight up with no air resistance, the acceleration at its highest point
A) is upward   B) is downward   C) is zero   D) reverses from upward to downward
E) reverses from downward to upward

2) Which of the following is a scaler quantity?
A) velocity   B) force   C) linear momentum   D) mass   E) weight

3) Suppose a ball is thrown straight up and there is no air resistance. What is its acceleration just before it reaches its highest point?
A) zero   B) slightly less than g   C) exactly g   D) slightly greater than g
E) depends on the initial velocity

4) A 10-kg rock and 20-kg rock are dropped from the same height and there is no air resistance. If it takes the 20-kg rock a time T to reach the ground, what time will it take the 10-kg rock to reach the ground?
A) 4T   B) 2T   C) T   D) T/2   E) T/4

5) The motions of a car and a truck along a straight road are represented by the velocity-time graphs in the figure. The two vehicles are initially alongside each other at time t = 0.
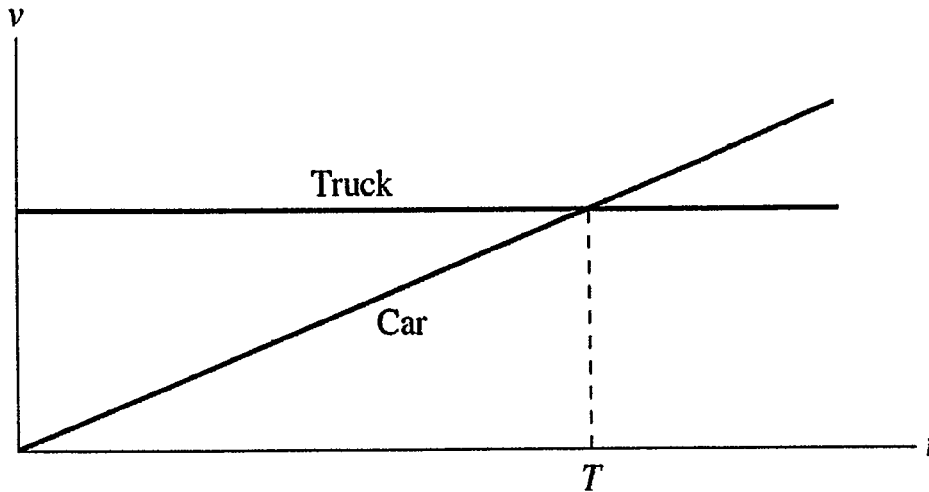
At time T, what is true of the distances traveled by the vehicles since time t = 0?
A) They will have traveled the same distance.   B) The truck will not have moved.
C) The car will have travelled further than the truck.   D) The truck will have travelled further than the car.
E) The car will have travelled further than the truck since it is accelerating.

6) A satellite is in orbit around the Earth. On which one is the greater force exerted?
A) on the satellite because the Earth is so much more massive
B) on the Earth because the satellite has so little mass
C) Exactly the same magnitude of force is exerted on both Earth and the satellite.
D) It depends on the distance of the satellite from Earth.
E) It depends on the mass of the satellite.

7) Bill and his daughter Susan are both standing on identical skateboards (with frictionless ball bearings), initially at rest. Bill weighs three times as much as Susan. Bill pushes horizontally on Susan's back, causing Susan to start moving away from Bill. Just after Bill stops pushing,
A) Susan and Bill are moving away from each other, and Susan's speed is three times that of Bill.
B) Susan and Bill are moving away from each other, with equal speeds.
C) Susan and Bill are moving away from each other, and Susan's speed is one-third that of Bill.
D) Susan is moving away from Bill, and Bill is stationary.   E) Need to know the value of the Normal force.

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

9) The acceleration of objects due to the gravitational force exerted on them is lower on the Moon than on Earth. Which one of the following statements is true about the mass and weight of an astronaut on the Moon's surface, compared to Earth?
A) Mass is less, weight is the same.   B) Mass is the same, weight is less.
C) Both mass and weight are less.   D) Both mass and weight are the same.
E) He is weightless on the Moon.

10) A rock from a volcanic eruption is launched straight up. Which one of the following statements about this rock while it is in the air is correct if you neglect air resistance?
A) On the way up, its acceleration is downward and its velocity is upward, and at the highest point both its velocity and acceleration are zero.
B) On the way down, both its velocity and acceleration are downward, and at the highest point both its velocity and acceleration are zero.
C) Throughout the motion, the acceleration is downward, and the velocity is always in the same direction as the acceleration.
D) The acceleration is downward at all points in the motion.
E) The acceleration is downward at all points in the motion except that is zero at the highest point.

11) A crate is sliding down an inclined ramp at a constant speed of 0.75 m/s. The vector sum of all the forces exerted on this crate must point
A) down the ramp.   B) up the ramp.   C) perpendicular to the ramp.
D) vertically downward.   E) none of the above choices are correct.

12) For general projectile motion, neglecting air resistance, the horizontal component of a projectile's velocity
A) remains zero.   B) remains a constant.   C) continuously increases.
D) continuously decreases.   E) first decreases and then increases.

13) 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. Compare the time it takes each to reach the lake below if we neglect the effects of air resistance.
A) James reaches the surface of the lake first.   B) John reaches the surface of the lake first.
C) James and John will reach the surface of the lake at the same time.
D) Cannot be determined without knowing the mass of both James and John.
E) Cannot be determined without knowing the weight of both James and John.

14) 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) 120 N   C) 160 N   D) 150 N   E) 0 N

15) A person is pushing on a box, exerting a force of magnitude P, as shown in the figure. Earth exerts force W on the box. The push is directed at an angle θ below the horizontal, and the box remains at rest. The box rests on a horizontal floor that has some friction with the box. The friction force exerted by the floor on the box is equal to
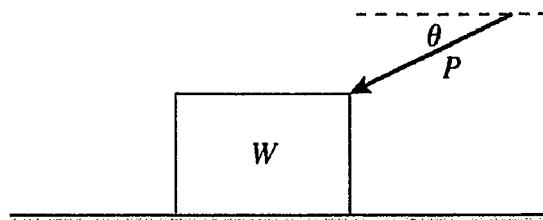
A) P sin θ.   B) P cos θ.   C) 0.   D) P cos θ + W.   E) P + W.

16) 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 force F that the ramp exerts on the block perpendicular to the surface of the ramp?
A) F > mg   B) F > mg cos θ   C) F > mg sin θ   D) F = mg cos θ   E) F = mg sin θ

17) A car goes around a circular curve on a horizontal road at constant speed. What is the direction of the friction force exerted on the car by the road?
A) tangent to the curve in the forward direction
B) tangent to the curve opposite to the direction of the car's motion
C) perpendicular to the curve outward   D) perpendicular to the curve inward
E) there is no friction on the car because its speed is constant.

18) When a car goes around a banked circular curve at the proper speed for the banking angle, what force cause it to follow the circular path?
A) the normal force exerted by the road on the car   B) the friction force exerted by the road on the car
C) the force that Earth exerts on the car
D) no force causes the car to do this because the car is traveling at constant speed and therefore has no acceleration.   E) the force of static friction

19) Halley's Comet is in a highly elliptical orbit around the Sun. Therefore the orbital speed of Halley's Comet, while traveling around the sun,
A) is constant.   B) increases as it nears the Sun.   C) decreases as it nears the Sun.
D) is zero at two points in the orbit.   E) depends on the Earth's orbital speed as the comet approaches.

20) If Earth had twice its present mass but it orbited at the same distance from the sun as it does now, its orbital period would be
A) 4 years.   B) 3 years.   C) 2 years.   D) 1 year.   E) 6 mo.

21) Three cars, car X, car Y, and car Z, begin accelerating from rest at the same time. Car X is more massive than car Y, which is more massive than car Z. The net accelerating force exerted on each car is identical. After 10 seconds, which car has the most amount of momentum?
A) Car X   B) Car Y   C) Car Z
D) They all have the same amount of momentum.   E) Since they are accelerating, there is no momentum.

22) Two small objects, with masses m and M, are originally a distance r apart, and the magnitude of the gravitational force they exert 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

23) 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) smaller than the magnitude of the change in momentum of the larger mass object, but not zero.
B) larger than the magnitude of the change in momentum of the larger mass object.
C) exactly equal to the magnitude of the change in momentum of the larger mass object.
D) zero.   E) There is not enough information to answer the question.

24) 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) 25 times as great as the momentum change of the heavier fragment.
B) the same as the momentum change of the heavier fragment.
C) 1/25 as great as the momentum change of the heavier fragment.
D) 5 times as great as the momentum change of the heavier fragment.
E) 1/4 as great as the momentum change of the heavier fragment.

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

QUESTIONS 26 - 31 EACH WORTH 7 POINTS
26) A motorist makes a trip of 180 miles. For the first 90 miles she drives at a constant speed of 30 mph. At what constant speed must she drive the remaining distance if her average speed for the total trip is to be 40 mph?
A) 45 mph   B) 50 mph   C) 52.5 mph   D) 55 mph   E) 60 mph

27) A cart starts from rest and accelerates uniformly at 4.0 m/s^2 for 5.0 s. It next maintains the velocity it has reached for 10 s. Then it slows down at a steady rate of 2.0 m/s^2 for 4.0 s. What is the final speed of the car?
A) 20 m/s   B) 16 m/s   C) 12 m/s   D) 10 m/s   E) 0 m/s

28) A boy throws a ball with an initial velocity of 25 m/s at an angle of 30° above the horizontal. If you neglect air resistance, how high above the projection point is the ball after 2.0 s?
A) 5.4 m   B) 13 m   C) 25 m   D) 43 m   E) 50 m

29) A flatbed truck is carrying an 800-kg load of timber that is not tied down. The maximum friction force that the truck bed exerts on the load is 2400 N. What is the greatest acceleration that the truck can have without losing its load?
A) 3 m/s^2 B) 30 m/s^2 C) 0.3 m/s^2 D) Need the mass of the truck   E) Need the coefficient of friction

30) A jet plane flying 600 m/s experiences an acceleration of 4.0 g when pulling out of the circular section of a dive. What is the radius of curvature of this section of the dive?
A) 1.2 km   B) 5.8 km   C) 0.64 km   D) 9.2 km   E) 7.0 km

31) A 0.14-kg baseball is dropped from rest from a height of 2.0 m above the ground. What is the magnitude of its momentum just before it hits the ground if we neglect air resistance?
A) 0.28 kg · m/s   B) 0.88 kg · m/s   C) 0.44 kg · m/s   D) 0.62 kg · m/s   E) 1.4 kg · m/s

QUESTION 32 WORTH 8 POINTS
32) A ball thrown horizontally from a point 24 m above the ground, strikes the ground after traveling horizontally a distance of 18 m. With what speed was it thrown, assuming no air resistance?
A) 6.1 m/s   B) 7.4 m/s   C) 8.1 m/s   D) 8.9 m/s   E) 9.1 m/s