Instructions:

1. You **must** write either Version A or version B on your skentron.
2. You must write your section number on the skentron. (Sect 2 – Dzyubenko; Sect 3 – Kang; Sects 4, 5 – Cohn)
3. "Bubble-in" **your name** (last name first) on the skentron.
4. Mark your exam with your answer, and bubble in your answer in the skentron.
5. Return **both** the exam and the skentron.

The following list of formulas might be useful:

- **Speed** = distance/time
- **Average speed** = total distance covered/time interval
- **Acceleration** = change in velocity/time interval
- **Velocity acquired** = acceleration × time

\[
\begin{align*}
\nu &= at \\
\nu &= gt \\
g &= 9.81 \frac{m}{s^2} = 10 \frac{m}{s^2}
\end{align*}
\]

\[
\begin{align*}
d &= \frac{1}{2} at^2 \\
d &= \frac{1}{2} gt^2 \\
F_{net} &= ma
\end{align*}
\]

- **Momentum** = mass × velocity
- **Impulse** = force × time interval = change in (mass × velocity)

\[
(tot \ m\nu)_{before} = (tot \ m\nu)_{after}
\]

- **Work** = Force × distance

\[
\begin{align*}
KE &= \frac{1}{2} m\nu^2 \\
PE &= mgh \\
work &= \Delta KE
\end{align*}
\]

- **Power** = work done / time interval

\[
F = G \frac{m_1 m_2}{d^2} \\
G = 6.7 \times 10^{-11} \frac{Nm^2}{kg^2}
\]
Choose the one alternative that best completes the statement or answers the question.

Name __________________________________

1)  A bullet is fired from a gun. The speed of the bullet will be about the same as the speed of the recoiling gun
   A)  because both velocity and momentum are conserved.
   B)  if the mass of the bullet equals the mass of the gun.
   C)  because velocity is conserved.
   D)  because momentum is conserved.
   E)  none of these.

2)  Two billiard balls having the same mass roll toward each other, each moving at the same speed. What is the combined momentum of the two balls?
   A)  10 kg X m/s
   B)  more information need to determine
   C)  0 kg X m/s

3)  When the distance between two stars decreases by half, the force between them
   A)  increases to twice as much.
   B)  stays the same.
   C)  decreases by one-half.
   D)  increases to four times as much.
   E)  decreases by one-quarter.

4)  A ball tossed vertically upward rises, reaches its highest point, and then falls back to its starting point. During this time the acceleration of the ball is always
   A)  directed downward.
   B)  opposite its velocity.
   C)  directed upward.
   D)  in the direction of motion.
5) The reason the Moon does not crash into the Earth is that the

A) gravitational pull of other planets keeps the Moon up.
B) Earth's gravitational field is weak at the Moon.
C) Moon has a sufficient tangential speed.
D) Moon has less mass than the Earth.
E) none of these.

6) Two objects move toward each other because of gravity. As the objects get closer and closer, the acceleration of each

A) remains constant.
B) increases.
C) decreases.

7) The average speed of a horse that gallops a distance of 10 km in a time of 30 min is

A) 20 km/h.
B) 30 km/h.
C) 10 km/h.
D) more than 30 km/h.

8) A heavy object and a light object are dropped at the same time from rest in a vacuum. The heavier object reaches the ground

A) at the same time as the lighter object.
B) sooner than the lighter object.
C) later than the lighter object.

9) Strange as it may seem, it is just as hard to accelerate a car on the Moon as it is to accelerate the same car on Earth. This is because the

A) weight of the car is independent of gravity.
B) mass of the car is independent of gravity.
C) Nonsense! A car is much more easily accelerated on the Moon than on the Earth.

10) If the radius of the Earth somehow decreased with no change in mass, your weight would

A) increase.
B) decrease.
C) not change.
11) An object falls freely from rest on a planet where the acceleration due to gravity is 20 m/s/s. After 5 s it falls a distance of

A) 500 m.
B) 150 m.
C) 250 m.
D) 100 m.
E) none of these.

12) Suppose a gun were made of a strong but very light material. Suppose also that the bullet is more massive than the gun itself. For such a weapon

A) conservation of momentum would not hold.
B) the target would be safer than the shooter.
C) recoil problems would be lessened.
D) conservation of energy would not hold.
E) both conservation of energy and momentum would not hold.

13) A freight train rolls along a track with considerable momentum. If it rolls at the same speed but has twice as much mass, its momentum is

A) unchanged.
B) zero.
C) doubled.
D) quadrupled.

14) A falling object that has reached its terminal speed continues to gain

A) speed.
B) acceleration.
C) both.
D) neither.

15) A moving object on which no forces are acting will continue to move with constant

A) impulse.
B) momentum.
C) acceleration.
D) all of these.
E) none of these.

16) The amount of gravitational force that acts on the space shuttle while in orbit is

A) almost as much as the shuttle’s weight on the Earth’s surface.
B) the same as the shuttle’s weight on the Earth’s surface.
C) nearly zero.
17) A 4-kg ball has a momentum of 12 kg \(\times\) m/s. What is the ball's speed?

A) 3 m/s 
B) 4 m/s 
C) 12 m/s 
D) 48 m/s 
E) none of these

18) A 1-N apple falls to the ground. The apple hits the ground with an impact force of about

A) 9.8 N. 
B) 4 N. 
C) 1 N. 
D) 2 N. 
E) not enough information given to say.

19) Consider two planets in space that gravitationally attract each other. If the masses of both planets is doubled, and the distance between them is also doubled, then the force between them is

A) twice as much. 
B) one-quarter. 
C) half as much. 
D) four times as much. 
E) none of these.

20) Careful: On the surface of Jupiter, where the acceleration due to gravity is about three times that of Earth, a 100-kg rock would have a mass of about

A) 300 kg. 
B) 100 kg. 
C) 900 kg. 
D) 600 kg.

21) Two objects move toward each other because of gravity. As the objects get closer and closer, the force between them

A) remains constant. 
B) decreases. 
C) increases.

22) According to Newton, the greater the masses of interacting objects, the

A) greater the gravitational force between them. 
B) less the gravitational force between them. 
C) greater the force between them by the square of the masses.
23) An object is placed exactly halfway between the Earth and the Moon. The object will fall to
ward the
A) Moon.
B) Earth.
C) neither of these.

24) Passengers in a high-flying jumbo jet feel their normal weight in flight, while passengers in
the orbiting space shuttle do not. This is because passengers in the space shuttle are
A) above the Earth’s atmosphere.
B) beyond the main pull of Earth’s gravity.
C) without support forces.
D) all of these.
E) none of these.

25) A truck is moving at constant velocity. Inside the storage compartment, a rock is dropped
from the midpoint of the ceiling and strikes the floor below. The rock hits the floor
A) exactly below the midpoint of the ceiling.
B) ahead of the midpoint of the ceiling.
C) more information is needed to solve this problem.
D) behind the midpoint of the ceiling.
E) none of these.

26) Compared with the mass of a certain object on Earth, the mass of the same object on the
Moon is
A) less.
B) the same.
C) more.

27) The Earth’s gravitational field extends
A) only above and beyond the Earth’s surface and cancels inside the Earth.
B) both inside and outside the Earth and throughout the entire universe.
C) neither of these.

28) The force on an apple hitting the ground depends upon
A) whether or not the apple bounces.
B) the time of impact with the ground.
C) the speed of the apple just before it hits.
D) all of these.
29) A 5-kg fish swimming at a speed of 1 m/s swallows an absent-minded 1-kg fish at rest. The speed of the larger fish after lunch is

A) 1/2 m/s.
B) 5/6 m/s.
C) 2/5 m/s.
D) 1 m/s.
E) 6/5 m/s.

30) A heavy truck and a small truck roll down a hill. Neglecting friction, at the bottom of the hill, the heavy truck will have greater

A) momentum.
B) speed.
C) acceleration.
D) all of these.
E) none of these.

31) If the mass of the Earth somehow increased with no change in radius, your weight would

A) stay the same.
B) increase also.
C) decrease.

32) A very massive object A and a less massive object B move toward each other under the influence of gravitation. Which force, if either, is greater?

A) both forces are the same
B) the force on B
C) the force on A

33) Compared with a 1-kg block of solid iron, a 2-kg block of solid iron has the same

A) mass.
B) weight.
C) volume.
D) all of these.
E) none of these.

34) A kilogram is a measure of an object's

A) mass.
B) weight.
C) center of mass.
D) force.
E) gravity.
35) The two measurements necessary for calculating average speed are

A) distance and acceleration.
B) velocity and distance.
C) distance and time.
D) velocity and time.
E) acceleration and time.

36) A car accelerates from rest at 2 m/s/s. What is its speed 3 s after the car starts moving?

A) 6 m/s
B) 3 m/s
C) 4 m/s
D) 2 m/s
E) none of these

37) While a car travels around a circular track at constant speed, its

A) velocity is zero.
B) acceleration is zero.
C) both of these.
D) none of these.

38) Inside a freely falling elevator, there would be no

A) apparent weight for you.
B) gravitational force on you.
C) both of these.
D) none of these.

39) In which case would you have the largest mass of gold? If your chunk of gold weighed 1 N on the

A) Earth?
B) planet Jupiter?
C) Moon?

40) If the Sun were twice as massive,

A) the pull of the Earth on the Sun would double.
B) its pull on the Earth would double.
C) both of these.
D) neither of these.