Answer all questions, beginning each new question in the space provided. Show all work. Show all formulas used for each problem prior to substitution of numbers. Label diagrams and include appropriate units for your answers. Write your name and section number at the top of each page in the space provided and write the name of your section instructor in the place provided in the cover sheet. You may use an alphanumeric calculator (one which exhibits physical formulas) during the exam as long as you do not program any formulas into memory. By using an alphanumeric calculator you agree to allow us to check its memory during the exam. Simple scientific calculators are always appropriate!

A formula sheet will be given out separately.
(Please take it with you at the end of the exam or throw it in a waste basket.)

Be Prepared to Show your Student ID Card

Score on each problem:

I. (25) ___

II. (25) ___

III. (25) ___

IV. (25) ___

Total Score (out of 100 pts) ___
Part I. (5 points each) Put a circle around the letter that you think is the best answer.

I-1 Two objects of the same mass move along the same line in opposite directions. The first mass is moving with speed \( v \). The objects collide, stick together, and move with speed \( 0.100v \) in the direction of the velocity of the first mass before the collision. What was the speed of the second mass before the collision?

A) \( 1.20v \)
B) \( 10.0v \)
C) \( 0.900v \)
D) \( 0.800v \)
E) \( 0.00v \)

I-2 A baseball is thrown vertically upward and feels no air resistance. As it is rising

A) both its momentum and its mechanical energy are conserved.
B) its momentum is not conserved, but its mechanical energy is conserved.
C) both its momentum and its kinetic energy are conserved.
D) its kinetic energy is conserved, but its momentum is not conserved.
E) its gravitational potential energy is not conserved, buts its momentum is conserved.

I-3 A 1.0-kg block and a 2.0-kg block are pressed together on a horizontal frictionless surface with a compressed very light spring between them. They are not attached to the spring. After they are released and have both moved free of the spring

A) the lighter block will have more kinetic energy than the heavier block.
B) the heavier block will have more kinetic energy than the lighter block.
C) both blocks will both have the same amount of kinetic energy.
D) both blocks will have equal speeds.
E) the magnitude of the momentum of the heavier block will be greater than the magnitude of the momentum of the lighter block.
I-4 A 3.00-kg ball swings rapidly in a complete vertical circle of radius 2.00 m by a light string that is fixed at one end. The ball moves so fast that the string is always taut and perpendicular to the velocity of the ball. As the ball swings from its lowest point to its highest point

A) the work done on it by gravity and the work done on it by the tension in the string are both equal to \(-118 \text{ J}\).

B) the work done on it by gravity is \(-118 \text{ J}\) and the work done on it by the tension in the string is \(+118 \text{ J}\).

C) the work done on it by gravity is \(+118 \text{ J}\) and the work done on it by the tension in the string is \(-118 \text{ J}\).

D) the work done on it by gravity is \(-118 \text{ J}\) and the work done on it by the tension in the string is zero.

E) the work done on it by gravity and the work done on it by the tension in the string are both equal to zero.

I-5 Two objects, one of mass \(m\) and the other of mass \(2m\), are dropped from the top of a building. When they hit the ground

A) both of them will have the same kinetic energy.

B) the heavier one will have twice the kinetic energy of the lighter one.

C) the heavier one will have four times the kinetic energy of the lighter one.

D) the heavier one will have \(\sqrt{2}\) times the kinetic energy of the lighter one.
Part II (25 points)

An astronaut (130 kg including space suit) is on a space capsule (1700 kg). The astronaut pushes off using her hands and acquires a speed of 2.50 m/s. (Use the frame of reference as that of the capsule before the push-off.)

A) Draw two labeled diagrams (include coordinate system) – one before and one after the push-off.

B) Determine the velocity of the space capsule after the push-off.

C) If the push lasts 0.500 s, determine the average force that the astronaut exerted on the capsule.

D) Determine the kinetic energy of the astronaut after the push-off.

E) Determine the impulse on the astronaut.
A 1.00 kg block starts from rest at point A on a frictionless quadrant (AB) of a circle with a radius of 2.00 m. The track from point B to point C is 3.00 m long and has a coefficient of kinetic friction of 0.25. The section of the track (CD) is frictionless.

A) Determine the velocity of the block at point B.

B) Determine the thermal energy produced as the block slides from point B to point C.

C) Determine the velocity of the block when it gets to point C.

D) If the spring compresses a maximum amount of 0.20 m, determine the spring constant (k).
Part IV (25 points)

A 1000-kg elevator starts from rest and accelerates upward at 1.0 m/s² for 10 m.

A) Draw a labeled diagram of the physical situation including the forces on the elevator.

B) Determine the amount of work done by the gravitational force on the elevator.

C) Determine the amount of work done by the tension in the cable.

D) Using the work-kinetic energy theorem, determine the kinetic energy of the elevator after it has moved 10 m.

E) Determine the speed of the elevator when it has moved up only 7.0 m from its starting point. Hint: Consider the relationship between the work done and the displacement.