

Exam II

Spring 2004
Serway & Jewett, Chapters 6-10

PART I: QUALITATIVE

Fill in the bubble for the correct answer on the answer sheet. next to the number.

NO PARTIAL CREDIT: SUBMIT ONE ANSWER ONLY

Note that in qualitative multiple choice questions, sometimes one answer is clearly correct, while the others are clearly incorrect. However, with some questions you must choose the best or most complete answer.

Note also that even though this section is qualitative, the formula sheet may be useful for some questions.

20 problems, 3 pts each =60 pts =50% of exam

- 1) The constant "k" in Hooke's Law ($F = -kx$ in equation form) tells the:
 - a) strength of a field
 - b) stiffness of a spring
 - c) size of a displacement
 - d) speed of an object
 - e) mass of an object

- 2) A teacher lifts a book with mass M to a height h . The amount of work done on the book **by gravity** is:
 - a) Mgh
 - b) $2Mgh$
 - c) 0
 - d) $-Mgh$
 - e) $-2Mgh$

- 3) The dot product of the two vectors $\vec{F} = 6\hat{i} + 4\hat{j}$ and $\vec{d} = 1\hat{i} + 2\hat{j}$ is:
 - a) $6\hat{i} + 8\hat{j}$
 - b) $12\hat{i} + 4\hat{j}$
 - c) 13
 - d) 14
 - e) 9.44

- 4) Two people are analyzing the energy and power needed to raise a bucket full of water from the bottom of a well. Which measurement is necessary to measure power, but could be omitted to measure energy?
 - a) the mass of the rope
 - b) the mass of the bucket
 - c) the time it took to raise the bucket
 - d) the depth of the well
 - e) the mass of the water in the bucket

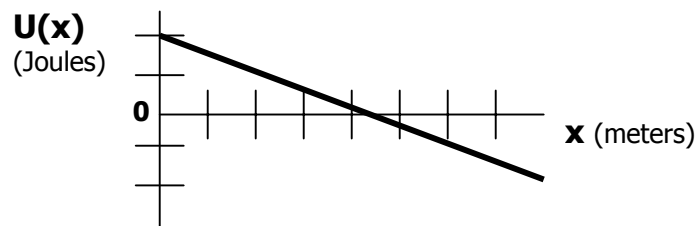
5) The gravitational potential energy of an object is mgh : mass times acceleration due to gravity ($g=9.8 \text{ m/s}^2$) times the distance above or below:

- a) the surface of the earth
- b) some reference point of your choosing
- c) the highest point in a system
- d) sea level
- e) the lowest point in a system

6) A non-conservative force changes:

- a) kinetic energy to potential energy
- b) potential energy to kinetic energy
- c) work to kinetic energy
- d) kinetic energy to heat
- e) heat to potential energy

7) According to the potential diagram below, an unconstrained object placed at $x=3 \text{ m}$ would move:



- a) Up (+y)
- b) Down (-y)
- c) Left (-x)
- d) Right (+x)
- e) Down (-y) and to the right (+x)

8) An unpowered, open-topped wagon is initially rolling at a constant velocity along a level, horizontal, frictionless road. It starts to rain, and drops fall straight down into the wagon where they collect. Over time, the rain causes the momentum of the wagon to:

- a) increase
- b) decrease
- c) remain constant
- d) not enough information given

9) Which of the following statements is **true**?

- a) The center of mass of an object must lie within the object
- b) The center of mass of two objects is always halfway between them
- c) An object hung from its center of mass would balance
- d) A plane passing through the center of mass must have equal mass on both sides
- e) A force applied at the center of mass causes an object to rotate around its center of mass.

10) Two children start at the center of a merry-go-round and walk toward the outer edge. During this process, the moment of inertia of the child and merry-go-round system:

- a) increases
- b) decreases
- c) stays constant
- d) increases, then decreases
- e) decreases, then increases

11) A ball on a rope swings in a circle with radius R . If the angular velocity ω remains constant while R doubles, the linear velocity of the ball:

- a) doubles
- b) is halved
- c) is 4 times as large
- d) is $\frac{1}{4}$ as large
- e) stays constant

12) Two toy cars have total masses that are equal and wheels with identical shape and diameter. One car's wheels are made of metal and mass twice as much as the other car's wheels, which are made of plastic. The two unpowered cars roll without slipping down a slope where resistive forces are equal. At the bottom of the slope, which car has the highest speed?

- a) The metal wheeled car
- b) The plastic wheeled car
- c) Both cars have the same speed
- d) Depends on the mass of the cars
- e) Depends on the angle of the slope

13) The correct direction for a torque vector is:

- a) always \hat{k}
- b) in the direction of the acting force
- c) in a plane containing both the force vector and center of rotation
- d) perpendicular to a plane containing both the force vector and center of rotation
- e) parallel to the moment arm

14) An object with radius R rolls without slipping such that it has a linear velocity v . The object's angular velocity:

- a) cannot be determined from this information
- b) is greater than its linear velocity
- c) is equal to the velocity times the radius
- d) is equal to the velocity divided by the radius
- e) is equal to the velocity plus the radius

15) The equation $\sum W = \tau(\Delta\theta) = \frac{1}{2}I\omega_f^2 - \frac{1}{2}I\omega_i^2$ is a statement of:

- a) conservation of momentum
- b) the work-kinetic energy theorem for rotation
- c) conservation of torque
- d) the parallel axis theorem
- e) a rotational kinematic equation

16) The symbol used for the rotational equivalent of mass is:

- a) θ
- b) ω
- c) α
- d) I
- e) τ

17) A ball with mass 0.5 kg hits a wall with a velocity of 2 m/s and rebounds with a velocity of -2 m/s. The net change in momentum is:

- a) 2 kg·m/s
- b) 1 kg·m/s
- c) 0 kg·m/s
- d) -1 kg·m/s
- e) -2 kg·m/s

- 18) Which of the following is the best example of an elastic collision?
- a) Two cars are seriously damaged in a head on-collision
 - b) A piece of clay hits a wall and sticks
 - c) A moving railroad car makes a loud connection with a stationary car
 - d) A ball bounces to half the height from which it was dropped
 - e) Two marbles collide and bounce away from each other

19) Two skydivers with equal masses jump out of a plane, and neither parachute opens. Both reach the same terminal velocity. Skydiver 1 lands (does not bounce) on a cement road. Skydiver 2 lands in the ocean, plunging to a depth of 45 ft while slowing to a stop. Skydiver 2 has a better chance of survival is because he experiences a smaller:

- a) impulse
- b) change in momentum
- c) force
- d) change in kinetic energy
- e) change in velocity

20) The kinetic energy of an object is:

- a) always greater than or equal to zero
- b) equal to the total mechanical energy of a system
- c) always greater than the potential energy
- d) measured in kg m/s
- e) always equal to the work done by gravity

Part II: QUANTITATIVE

Mark the bubble for the correct answer on the answer sheet. Use the backs of these test pages for scratch work.

**PARTIAL CREDIT POSSIBLE: Select one (1), two (2), or three (3) answers
6 points if you mark the single correct answer
4 points if the correct answer is among your two choices
2 points if the correct answer is among your three choices**

10 problems, 6 pts each = 60 pts = 50% of exam

21) A mass stands 15.0 cm from the center of a turntable rotating at 45.0 rev/min. The minimum coefficient of static friction between the mass and turntable is:

- a) .151
- b) .333
- c) .339
- d) .353
- e) cannot be determined without the mass

22) A force $\vec{F} = 3.2x\hat{i}$ N acts on an object. How much work would be done by the force in moving this object from the origin to $x=3.50$ m?

- a) 11.2 J
- b) 12.3 J
- c) 17.9 J
- d) 19.6 J
- e) 39.2 J

23) A block with a mass of 1.50 kg is sliding along a level, frictionless surface at a constant velocity of 3.10 m/s when it meets an uncompressed spring. The spring compresses 11.4 cm before the block stops. What is the spring constant?

- a) 1.26 N/m
- b) 1110 N/m
- c) 40.8 N/m
- d) 555 N/m
- e) 358 N/m

24) A potter's wheel is spinning at an angular speed 11.6 rad/s when it is turned off. It then decelerates at 1.65 rad/s^2 until it stops. Through what angle does it turn before stopping?

- a) 7.03 rad
- b) 19.1 rad
- c) 40.8 rad
- d) 49.4 rad
- e) 81.5 rad

25) A system of 3 masses (described below) is spun around the y axis. Calculate the appropriate moment of inertia (I_y).

Mass 1: 210 g ($x=1, y=-3$) **Mass 2:** 450 g ($x=-2, y=5$) **Mass 3:** 730 g ($x=0, y=4$)

- a) $1.4 \text{ kg}\cdot\text{m}^2$
- b) $2.0 \text{ kg}\cdot\text{m}^2$
- c) $5.2 \text{ kg}\cdot\text{m}^2$
- d) $5.8 \text{ kg}\cdot\text{m}^2$
- e) $25 \text{ kg}\cdot\text{m}^2$

26) A train car with mass 6820 kg is moving at 7.50 m/s when it collides and connects with a stationary car with mass 5380 kg. The velocity of the connected cars after the collision is:

- a) 4.19 m/s
- b) 5.91 m/s
- c) 7.50 m/s
- d) 9.51 m/s
- e) 17.0 m/s

27) A 0.600 kg object is attached to a 0.750 m string and swung in a VERTICAL circle. If the tangential speed at the top of the circle is 4.60 m/s, the tension in the string at that moment is:

- a) 11.0 N
- b) 16.9 N
- c) 18.4 N
- d) 22.8 N
- e) 28.2 N

28) A merry-go-round with $I=765 \text{ kg m}^2$ spins on a frictionless bearing. A 32.5 kg child then sits at its outer edge, 1.75 m from the center. If a father applies a tangential force of 185 N on the same outer edge, what is the net angular acceleration of the merry-go-round?

- a) 2.42 rad/s^2
- b) .423 rad/s^2
- c) .383 rad/s^2
- d) .374 rad/s^2
- e) .208 rad/s^2

29) A 1.73 kg block is initially moving at 1.44 m/s. It slides 2.70 m down a ramp angled 55 degrees above the ground. The ramp/block interface has $\mu_k=0.190$. What speed does the block have at the end of its slide?

- a) 6.73 m/s
- b) 6.45 m/s
- c) 6.30 m/s
- d) 4.62 m/s
- e) 4.57 m/s

30) A solid cylinder ($I=\frac{1}{2}MR^2$) starts from rest and rolls without slipping. Starting at the top of a ramp angled 32.5 degrees above the horizontal, it rolls through a 3.00 m section of the ramp. Its linear velocity at the bottom of this section is:

- a) 3.97 m/s
- b) 4.59 m/s
- c) 5.62 m/s
- d) 6.26 m/s
- e) Cannot be determined without the mass