Exit Exam

Mechanics

1. Which of the following statement is correct about work done on a system by a constant force?

a) the applied force and the displacement have the same direction
b) if the applied force makes an angle with the displacement, then only the component of the force perpendicular to the displacement contribute to the work done
c) the work done is given by $W = F\Delta r\ sin\theta$
d) none

2- Which of the following units correspond to work done?

a) N.m
b) Kg. m^2/ s^2
c) Joule
d) All

3- Which formula should be used to calculate the net work done if the system cannot be modeled as a particle (for example, if the system is deformable)?

a) $\sum W = W_{ext} = \int (\sum \vec{\mathbf{F}}) \cdot \mathrm{d}\,\vec{\mathbf{r}}$

b) $W \approx \sum_{x_i}^{x_f} F_x\, \Delta x$

c) $\sum W = W_{ext} = \sum_{forces} \left(\int \vec{\mathbf{F}} \cdot d\vec{\mathbf{r}} \right)$

d) All

4- Which one of the following statement is correct regarding Hook's law for a spring of spring constant k?

a) The distance by which the spring stretches is proportional to the square of the applied force

b) the restoring force and the stretching displacement have opposite directions
c) the applied force and the stretching displacement have opposite direction
d) a and c

5- Which statement is true about work-energy theorem?

a) It says that the net work done on a system is equal to the change in the potential energy of the system
b) It states that the net work done on a system is equal to the change in the kinetic energy of the system
c) It implies that if there is a net external work done on the system then there will be impulse
d) None

6- Which statement is false about elastic potential energy?

a) Elastic potential energy is potential energy stored in deformed elastic materials
b) The net work done in deforming a material is equal to the change in elastic potential energy of the deformed material
c) The elastic potential energy function associated with the block–spring system is defined by $u_s = \frac{1}{2}kx^2$
d) none

7- One of the following statement about conservative forces is incorrect, which one?

a) The work done by a conservative force on a particle moving between any two points is dependent of the path taken by the particle
b) The work done by a conservative force on a particle moving through any closed path is zero.
c) The work done by a conservative force along a straight line is smaller than the one along curved line
d) a and c

8- Among the forces listed below choose the correct example of non-conservative force.

a) Gravitational force
b) Electric force
c) Magnetic force
d) Frictional force

9- One of the following sentences is false about linear momentum, which one?

a) Linear momentum is a vector quantity
b) Its direction is along the velocity (**v)**, and its SI unit is Kg. m/s
c) The linear momentum of a system of particles is equal to the product of the total mass *M* of the system and the velocity of the center of mass
d) All

10- Which sentence is the definition of Impulse-Momentum theorem?

a) The change in the momentum of a particle is equal to the impulse of the net force acting on the particle
b) If the net torque is zero then the total angular moment is constant
c) If the net force on the object is zero then the velocity will be zero as well
d) none

11- Which sentence is incorrect regarding conservation of linear momentum?

a) Total linear momentum of a system becomes zero when the net force on the system is constant
b) Total linear momentum of a system becomes zero when the net torque is zero
c) If the net force on the system is zero, then the total linear momentum will be constant
d) All except c

12- One of the following sentences is true about center of mass of an object

a) It is the point at which the entire mass of the object is concentrated
b) It is also called center of gravity
c) It is always located at the surface of the object

d) a and b

13- Which statement false about elastic collision?

a) It is a collision where the total linear moment of the system is conserved
b) It is a collision where the total kinetic energy of the system remain the same before and after the collision
c) It does not involve any deformation of the colliding objects
d) none

14- If a ball moving at some velocity collides head-on with a stationary ball of equal mass, then which of the following statements is correct?

a) Ball 1 (initially moving) stops dead in its tracks and ball 2 (initially at rest) takes off with the initial speed of ball 1
b) Ball 1 (initially moving) stops dead in its tracks and ball 2 (initially at rest) takes off with twice the initial speed of ball 1
c) Both balls move in the same direction at the same speed
d) all

15- In the previous question what will happen if the moving ball is much lighter than the stationary ball?

a) Ball 1 simply bounces back along its incoming path, its speed essentially unchanged
b) Initially stationary ball 2 moves forward at a high speed
c) Initially stationary ball 2 moves forward at a low speed
d) a and c

16- Which one of the following collision is an example of inelastic collision?

a) A rubber ball bouncing back from a hard wall
b) Two marble balls colliding without producing any sound or heat
c) Two cars crashing on one another and sticking together
d) a and c

17- Which one of the following system is an example of system of variable mass?

a) A stationary car
b) A rocket propelling upward
c) A moving car
d) b and c

18- What is the name of the following equation, $v_f - v_i = v_{rel}\, ln\frac{M_i}{M_f}$?

a) second rocket equation
b) first rocket equation
c) equivalence of mass
d) second law of thermodynamics

19- Which one of the following formulas does not represent instantaneous angular velocity?

a) $\omega = \lim_{\Delta t \to 0} \frac{\Delta\theta}{\Delta t}$
b) $\omega = \lim_{\Delta t \to \infty} \frac{\Delta\theta}{\Delta t}$
c) $\omega = \frac{d\theta}{dt}$
d) none

20- One of the following choices is the SI unit of angular acceleration, which one?

a) rad/s^2
b) per second
c) s^{-2}
d) all

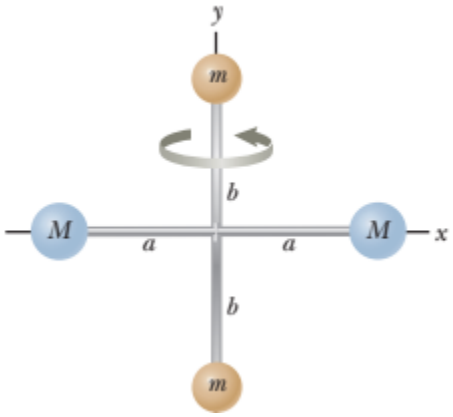
21- Which one of the following equation describes motion under constant angular acceleration?

a) $\omega_f = \omega_i + \alpha t$
b) $\theta_f = \theta_i + \omega_i t + \frac{1}{2}\alpha t^2$
c) $\omega^2{}_f = \omega^2{}_i + 2\alpha(\theta_f - \theta_i)$
d) all

22- Which one of the following statement is false regarding rotational kinetic energy?

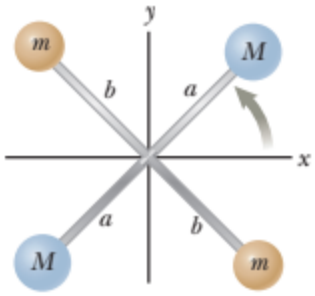
a) It is directly proportional to the moment of inertia of the rotating object
b) It is inversely proportional to the square of speed of the speed
c) It is directly proportional to the square of the angular velocity
d) none

23- Four tiny spheres are fastened to the ends of two rods of negligible mass lying in the *xy* plane to form an unusual baton as shown in the figure below. We shall assume the radii of the spheres are small compared with the dimensions of the rods. If the system rotates about the *y* axis as shown in the figure below with an angular speed ω, find the moment of inertia and the rotational kinetic energy of the system about this axis in that order.



a) $2Ma^2$ and $\frac{1}{2}\ Ma^2$
b) $2/3\ mb^2$ and $3mb^2\omega^2$
c) $-Ma^3\omega^2$ and mb^2
d) $2Ma^2$ and $Ma^2\omega^2$

24- Suppose the system in the previous question rotates in the *xy* plane about an axis (the *z* axis) through the center of the baton as shown in the figure below. Calculate the moment of inertia and rotational kinetic energy about this axis in that order.



a) $(2Ma^2 + 3mb^2)$ and $(Ma^2+3/2\ mb^2)\omega^2$

b) $(2Ma^2 + 2mb^2)$ and $(Ma^2+ mb^2)\omega^2$

c) $(-Ma^2 + 3mb^2)$ and $(Ma^2-3\ mb^2)\omega^2$

d) none

25- Which one of the following is the moment of inertia of solid sphere of mass M and radius R ?

a) $2/5\ MR^2$

b) $-1/3\ MR^3$

c) MR^2

d) $½\ MR^2$

26- What is the name of the theorem represented by the formula given below?

$$I = I_{COM} + Mh^2$$

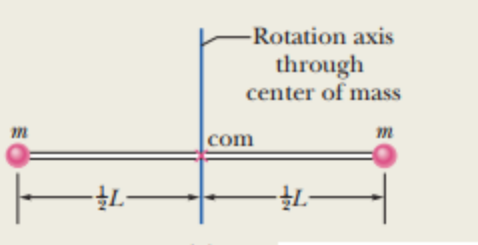
a) Parallel -axis theorem

b) Divergence theorem

c) Curl theorem

d) all

27- The figure below shows a rigid body consisting of two particles of mass *m* connected by a rod of length *L* and negligible mass. What is the rotational inertia I_{com} about an axis through the center of mass, perpendicular to the rod as shown?



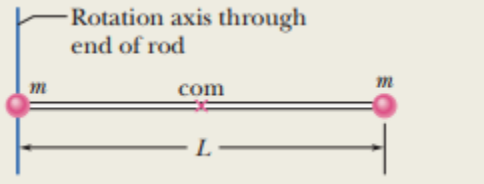
a) ½ mL^3

b) ½ mL^2

c) mL^2

d) all

28- What is the rotational inertia *I* of the body described in the previous question about an axis through the left end of the rod and parallel to the first axis as shown in the figure below?



a) mL^2

b) ½ mL^2

c) $-mL^4$

d) none

29- Which one of the following statement is correct about torque τ?

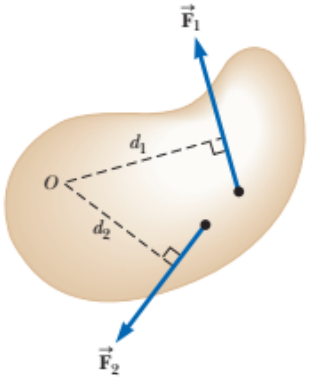
a) It is rotational effect of net force applied to an object

b) $\tau = r \times F$

c) It becomes maximum when the applied force is parallel to the distance from the axis

d) a and b

30- What is the net torque of the system shown in the figure below?



a) $F_1d_1+F_2d_2$
b) $F_1d_1-F_2d_2$
c) $2F_2d_2$
d) $-1/2\ F_1d_1$

31- Which one of the following statement is true about angular momentum?

a) It is a measure of how difficult it is to slow down or speed up an object moving around a curved path
b) It is a vector quantity
c) It is a measure of how difficult it is to slow down or speed up an object moving along a straight path
d) a and b

32- Which one the following equations represent angular impulse-angular momentum theorem?

a) $L = r \times P$
b) $\Delta L_{tot} = \int (\sum \tau_{ext}) dt$
c) $F = ma$
d) all

33- If an object, initial at rest, rolls down a cliff after it has been pushed by applied force, what will be the total kinetic energy of the object?

a) $K_{tot} = \frac{1}{2}mv^2$
b) $K_{tot} = \frac{1}{2}I\omega^2$

c) $K_{tot} = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$

d) $K_{tot} = \frac{1}{2}mv^2 - \frac{1}{2}I\omega^2$

34-Which one of the following equations represent work-energy theorem for rotational motion?

a) $W_{ext} = \Delta K = \frac{1}{2}I({\omega_f}^2 - {\omega_i}^2)$

b) $W_{ext} = \Delta K = \frac{1}{2}m({v_f}^2 - {v_i}^2)$

c) $W_{ext} = \Delta K = \frac{1}{2}I({\omega_i}^2 - {\omega_f}^2)$

d) none

35- Conservation of angular momentum states that;

a) if the net torque on a system is zero, the total angular momentum will be constant
b) if the one of the many torques applied on the system is zero, the total angular momentum will be constant
c) if the net force on a system is zero, the net angular momentum will be constant
d) all

36- Which one of the following relations between linear and angular quantities is false?

a) $s = \theta r$
b) $v = \omega r$
c) $a_r(radial\ acceleration) = \omega^2 r$
d) $a_t(tangential\ acceleration) = \alpha r$
e) none

37- Which one of the following statements about simple harmonic motion is correct?

a) It is a periodic motion in which the position of the oscillator is described in terms sine or cosine function
b) It is a non-periodic motion with time varying amplitude
c) It an oscillatory motion where the restoring force is always inversely proportional to the displacement
d) all

38- Identify the SI unit of frequency

a) hertz
b) s^{-1}
c) cycle per second
d) all

39- During simple harmonic motion, where does the velocity becomes maximum?

a) At the maximum displacement points
b) Between the maximum displacement points and the equilibrium point
c) At the equilibrium point
d) none

40- Among the following choices which one is an example of simple harmonic motion?

a) A spring-mass system on a frictionless table
b) Simple pendulum with angle greater than 10^0
c) Both a and b
d) None

41- According to Hook's law;

a) The applied force is inversely proportional to the amount of stretching of the spring
b) The restoring force is always in opposite direction to the dispalacement
c) The ratio of the applied force and the amount of starching of the spring is always constant
d) b and c

42- Which one of the following is correct about period of simple pendulum

a) The period is directely proportional to the length of the pendulum
b) It is independent of the mass of the pendulum
c) The periods of two pendulums located at different geographical locations will be different
d) all

43- When does the simple pendulum becomes simple harmonic oscillator?

a) when the mass of the bob becomes very large
b) when the mass of the bob becomes very small
c) when length of the pendulum is smaller then 20 cm
d) when the angle of the pendulum relative to some normal line is smaller than 10^0

44- when does the period of the physical pendulum becomes the same as that of simple pendulum?

a) when the length of the simple pendulum and the distance between the pivot and center of mass of the physical pendulum becomes equal
b) when the entire mass of the physical pendulum is considered to be concentrated ate the center of oscillation
c) their period can never be equal
d) none

45- Which statement is true regarding spring-mass system?

a) the restoring force of the spring is conservative
b) the kinetic energy of the system belongs to the block (mass)
c) the elastic potential energy of the system belongs to the spring
d) all

46- Which statement is false regarding resonance?

a) the applied periodic force is in phase with the velocity of the oscillator
b) the amplitude decreases exponentially
c) the angular frequency of the applied periodic force matches one of the natural angular frequencies of the oscillator
d) none

47- Which laws of motion are appropriate for extended objects

a) Newton's laws of motion
b) Euler's laws of motion
c) Kepler's laws of motion

d) all

48- Which one of the following examples of force is non-contact force?

a) electromagnetic forces
b) frictional force
c) drag force
d) none

49- Which laws of motion are appropriate for point masses?

a) Hook’s law
b) Pascal law
c) Euler’s laws
d) Newton’s laws

50- Which one of the following forces is type of inverse-square forces?

a) gravitational force
b) coulomb force
c) a and b
d) none