Physics 1135 Version B

Fall 2023

Rec Sec______

Answer Sheet
EM Mini-Test
& Final Exam

Print LAST Name: ___Solution_________

First Name: ___________________

Remove this page from your exam when you begin. Write clearly in the space provided on this *Answer Sheet* the *letter* which you believe to be the *best* answer to each question.

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ONLY THIS ANSWER SHEET will be looked at for scoring. Make sure your chosen answers are on it and do not leave any answer space blank.

Neither calculators nor notes can be used during the test.

EM Mini-Test Score =

Final-Exam Score =

Mini-Test Responses (10 pts each)

Em - 1)___A___

Em - 2)___A___

Em - 3)___D___

Em - 4)___C___

Em - 5)___D___

Em - 6)___B___

Em - 7)___B___

Final-Exam Responses (10 pts each)

1)__D____	11)__C____	21)__C____
2)__D____	12)__C____	22)__D____
3)__C____	13)__B____	23)__B____
4)__A____	14)__B____	24)__D____
5)__C____	15)__A____	25)__A____
6)__B____	16)__C____	
7)__B____	17)__A____	
8)__B____	18)__A____	
9)__D____	19)__D____	
10)__B____	20)__D____	

End-Material Mini Test

Em-1. A traveling wave on a string is given by $y(x,t) = \frac{1}{3}\sin(x+60t)$ in SI units. The maximum transverse speed of a particle on the string equals:

A) 20 m/s B) 2 m/s C) 0.5 m/s D) 0.1 m/s

Em-2. Two loudspeakers, A and B, emit sinusoidal waves in phase that have wavelength λ. The speakers are facing each other, separated by a distance 5λ. At what **maximum** distance in front of a speaker, and on the line connecting them, can you observe of **constructive** interference?

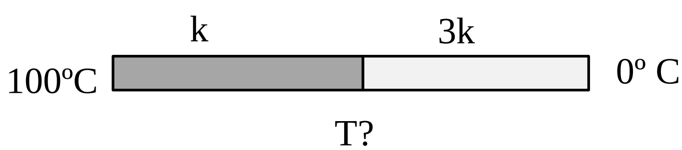
A) 4.5λ B) 2λ C) 4λ D) λ

Em-3. You are tuning a string of your violin with the mass m and length L. To get a fundamental frequency f, how much tension force you need to apply to the string?

A) $1/2Lmf^2$ B) $2Lmf^2$ C) $2Lm^2f$ D) $4Lmf^2$

Em-4. A biker is moving towards a vertical cliff at (1/100)-th of the speed of sound. He honks his horn which emits sounds of a frequency f. What is the frequency of the echo he hears reflected from the cliff?

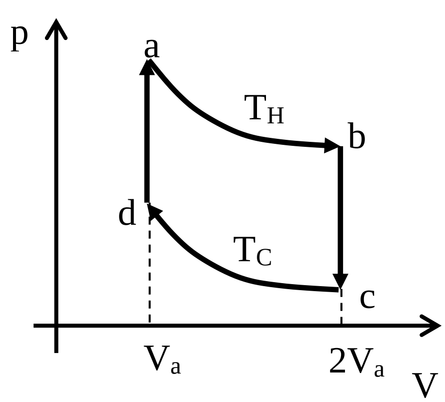
A) $(99/100)f$ B) $(100/99)f$ C) $(101/99)f$ D) $(99/101)f$



Em-5. A rod of uniform cross-section consists of two equal-length segments of two different materials. The left half of the rod has thermal conductivity k, and the right half has thermal conductivity 3k. The left end of the rod is at temperature 100ºC, and the right end is at temperature 0ºC.

When steady state is reached, the temperature at the boundary between the materials equals

A) 75ºC B) 50ºC C) 66ºC D) 25ºC



Questions Em6 and Em 7 refer to the cycle in the figure.

Em-6. Which of the following quantities is NOT zero?

A) The change in internal energy during the process a-b.
B) The net heat flowing into the gas during the cycle a-b-c-d-a.
C) The work during process b-c.
D) The change in internal energy during the complete cycle a-b-c-d-a.

Em-7. A monatomic ideal gas goes through cycle **a-b-c-d-a** as shown in the figure to the right. Processes **a-b** and **c-d** are isothermal and occur at temperatures T_H and T_C, respectively. The total work done by the gas over the complete cycle is:

A) $\frac{3}{2}nR(T_H - T_C)\ln 2$ B) $nR(T_H - T_C)\ln 2$
C) $\frac{3}{2}nR(T_H - T_C)$ D) $\frac{1}{2}(T_H + T_C)V_a$

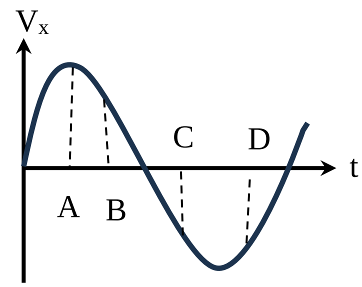
Final Exam

Ignore air resistance for all problems.

1. A child throws a ball at 30º above the horizontal. When the ball reaches its maximum height,
A) its acceleration and speed are both zero.
B) its acceleration is zero, but its speed is not zero.
C) its speed is zero, but its acceleration is not zero.
D) its acceleration and speed are both not zero.

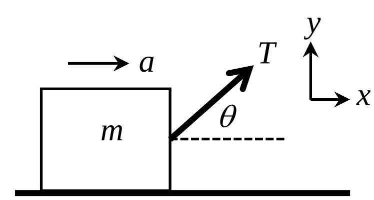
2. The y-component of an object's position is given as a function of time by $y(t) = b + ct^2 - dt^3$ where b, c, and d are **positive** constants. What can be said about the position, velocity, and acceleration in the y-direction at time $t = 0$?
A) $y = 0$, $v_y = 0$, and $a_y < 0$ B) $y > 0$, $v_y < 0$, and $a_y > 0$
C) $y > 0$, $v_y = 0$, and $a_y = 0$ D) $y > 0$, $v_y = 0$, and $a_y > 0$

3. The motion of a particle is described by the v_x-t diagram at the right. Which of the following is **true**?
A) The particle is at rest at A.
B) The particle is moving in the negative x-direction at B.
C) The particle is speeding up at C.
D) The particle is moving in the positive x-direction at D.



4. Frodo the cat is asleep on a horizontal shelf. The reaction force to the normal force acting on Frodo is
A) the force by Frodo on the shelf.
B) the force of gravity by Frodo on the Earth.
C) the weight force acting on Frodo.
D) There is no reaction force because Frodo is at rest.

5. A block of mass m is pulled at a constant acceleration a along a frictionless surface by a massless rope that makes an angle θ above the horizontal. If the magnitude of the tension force acting on the block by the rope is T, which of the following is **true**?
A) $\Sigma F_x = 0$ B) $\Sigma F_x = T cos\theta + ma$
C) $\Sigma F_y = 0$ D) $\Sigma F_y = T sin\theta + mg$



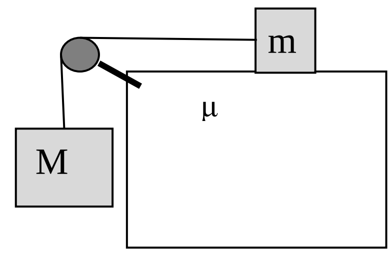
6. A block of mass M is moving on a horizontal surface with speed V when it enters a rough surface and stops after traveling a distance L. What is the magnitude of the friction force between block and surface?
A) $\frac{MV^2}{L}$ B) $\frac{MV^2}{2L}$ C) $\frac{2MV^2}{L}$ D) $\frac{3MV^2}{2L}$

7. An object is tied to a string and moves in a horizontal circle. The tension in the string is T. If the period and radius are doubled, the new tension will be
A) ¼ T B) ½ T C) T D) 2T

8. Two objects having masses m and M are connected to each other as shown in the figure and are released from rest. The surface of the table is rough with a coefficient of friction μ. The pulley and cord have negligible mass and are frictionless. The acceleration of the system is

A) (M-m)μg/(M+m) B) (M-μm)g/(M+m)

C) (M+μm)g/(M-m) D) (M-μm)g/(M+ μm)



9. The potential energy of a force is given as $U(x)=ax^2 + bx^3+c$. The x-component of the force is

A) $\frac{1}{3} ax^3 + \frac{1}{4} bx^4$ B) $-\frac{1}{3} ax^3 - \frac{1}{4} bx^4$ C) $2ax + 3bx^2$ D) $-2ax - 3bx^2$

10. A block of mass M sits on a vertical spring of force constant k that is compressed a distance S from its equilibrium length. The block is then released from rest and shoots up, leaving the spring behind. The speed of the block when it reaches height H above the starting position is

A) $(2gH)^{1/2}$ B) $(kS^2/M - 2gH)^{1/2}$ C) $(\frac{1}{2} kS^2/(Mg))^{1/2}$ D) $(kS^2/M + 2gH)^{1/2}$

11. An incline makes an angle θ with the horizontal. A constant pushing force F that is directed **parallel to the incline** pushes a block of mass M up the incline by a distance L along the incline. The work done by the pushing force equals

A) $FL \cos\theta$ B) $FL \sin\theta$ C) FL D) $(F - Mg \sin\theta) L$

12. A conservative force acts on a particle. We can conclude:

A) The force must be constant.

B) The acceleration of the particle will be zero.

C) The work done by the force on the particle depends only on initial and final position.

D) The particle cannot change its direction.

13. Planet A and planet B have the same radii. Planet A has an escape speed that is twice the escape speed from Planet B. If planet B has mass M, planet A has mass

A) 16 M B) 4 M C) 2 M D) ¼ M

14. Satellite A orbits a planet with speed V. Satellite B is three times as massive as satellite A and orbits at the same distance from the center of the planet. What is the speed of satellite B?

A) ⅓V B) V C) 3V D) 9V

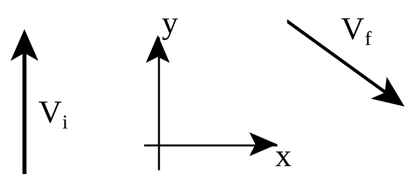
15. A baseball initially traveling with speed V_i in the positive y-direction is hit by a bat, which changes the ball's velocity to V_f as shown in the figure. The impulse delivered to the ball by the bat has

A) positive x-component, negative y-component.

B) positive x-component, positive y-component.

C) negative x-component, negative y-component.

D) negative x-component, positive y-component.



16. A ball of mass m made of clay moves in the positive x-direction with velocity v. Another ball, of the same mass, coming up from behind with velocity $3v$ in the positive x-direction, is colliding with the first ball. The balls stick together after the collision. What is the speed of the combined object?

A) $2mv$ B) v C) $2v$ D) $3v$

17. A ball is floating in water of density ρ with ⅓ of its volume is above the water surface. The density of the ball equals

A) $\frac{2}{3}\rho$ B) $\frac{1}{3}\rho$ C) $^3/2\ \rho$ D) 3ρ

18. A disk of mass *M* and radius *R*, a hoop of mass 2*M* and radius *R*, and a ball of mass *M* and radius 2*R* are rolling without slipping on a horizontal surface. They have the same linear speed. Which have the same angular speed?

A) disk and hoop B) disk and ball C) hoop and ball D) disk, hoop and ball

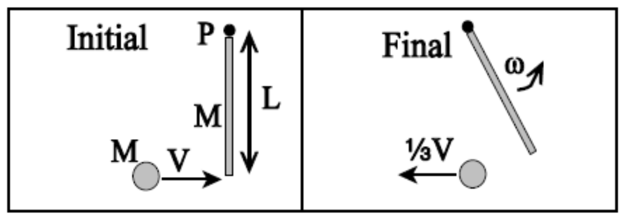
19. A spherical shell of mass *M* and radius *R* (moment of inertia $\frac{2}{3}MR^2$) is placed at the top of an incline of height *H*. It is released from rest and rolls without slipping. At the bottom of the incline, the shell has speed

A) $(3gH)^{½}$ B)$(4gH/3)^{½}$ C)$(10gH/7)^{½}$ D)$(6gH/5)^{½}$

20. The moment of inertia of a disk of mass *M* and radius *R* about its center of mass is $\frac{1}{2}MR^2$. The moment of inertia of the disk about an axis at its rim equals:

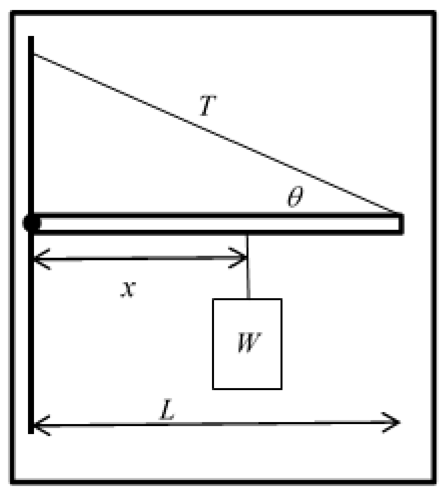
A) $\frac{1}{2}MR^2$ B) MR^2 C) $\frac{2}{3}MR^2$ D) $^3/2MR^2$

21. A ball of mass *M*, moving with speed *V*, strikes the end of a motionless, uniform stick of mass *M* and length *L*. After the collision, the stick is rotating about the pivot point *P* as shown, and the ball rebounds with speed $\frac{1}{3}V$. The moment of inertia of the stick about *P* is $\frac{1}{3}ML^2$. The angular speed ω of the stick is:



A) V B) V/L C) $4V/L$ D) $2V/L^2$

22. In the figure, a bar of length *L* is attached by a frictionless hinge to a wall and held horizontal by a rope that makes an angle θ with the bar. The bar is uniform and has weight *W*. A mass of weight *W* is suspended a distance *x* from the hinge. If the tension *T* in the rope equals 2*W*, *x* must be equal to: (Hint: use torques)



A) L B) $\frac{1}{2}L$ C) $L(\sin\theta - 1)$ D) $L(2\sin\theta - \frac{1}{2})$

23. A small ball at the end of a massless string is undergoing small oscillations. If the mass of the ball is increased by a factor of 4, the period of the oscillation

A) is halved B) remains unchanged
C) is doubled D) increases by a factor of 4

24. The position of an object is given by $x(t) = A\cos(\omega t + \varphi)$ where *t* is the time and *A*, φ and ω are constants. Which of the following statements about this object is **true**?

A) The acceleration of the object always points towards the point $x = A$.
B) The magnitude of the acceleration is a maximum when $x = 0$.
C) The kinetic energy of the object is a minimum when $x = 0$.
D) The object is momentarily at rest at $x = A$.

25. The speed of an object that undergoes simple harmonic oscillations equals one half its maximum speed. What is the ratio of potential to kinetic energy?

A) 3 B) C C) 1 D) ½

The Physics 1135 instructors wish you a wonderful winter break!