Physics 1145 Fall 2022 Final Exam (4 pages)

Name:____Solution_____December 13, 2022 Total Score:___120__/120

Write clearly in the space provided on this Answer Sheet the letter which you believe to be the best answer to each question found on the following pages. Only answers on this page will be graded.

Each question is worth 5 points.

1)__A___	9)__D___	17)_A____
2)__D___	10)_B____	18)_D____
3)__D___	11)_C____	19)_C____
4)__D___	12)_A____	20)_D____
5)__C___	13)_A____	21)_D____
6)__B___	14)_B____	22)_C____
7)__C___	15)_B____	23)_B____
8)__A___	16)_B____	24)_ABCD____

Starting Equations:

$x = x_i + v_{ix}\Delta t + \frac{1}{2}\, a_x(\Delta t)^2$ $v_x = v_{ix} + a_x\Delta t$ $v_x{}^2 = v_{ix}{}^2 + 2\, a_x(x - x_i)$

$y = y_i + v_{iy}\Delta t + \frac{1}{2}\, a_y(\Delta t)^2$ $v_y = v_{iy} + a_y\Delta t$ $v_y{}^2 = v_{iy}{}^2 + 2\, a_y(y - y_i)$

$\sum F_x = ma_x$ $\sum F_y = ma_y$ $f_S \le \mu_S N$ $f_k = \mu_k N$ g= 9.8m/s^2

$a_c = \frac{v^2}{R}$ $v = \frac{2\pi R}{T}$=ωR $\omega = 2\pi f = \frac{2\pi}{T}$ $F_G = \frac{GmM}{r^2}$ $F_{Sx} = -kx$

$\tau = rF\sin\theta$ $\sum \tau = I\alpha$ $v = \omega r$ $a = \alpha r$ $I = \sum_i m_i r_i^2$ $L = I\omega$

$\vec{p} = m\vec{v}$ $\vec{J} = \vec{F}_{avg}\Delta t$ $\vec{P}_f - \vec{P}_i = \vec{J}_{ext}$ $W = Fd\cos\theta$ $\Delta E = W$

$K = \frac{1}{2}mv^2$ $U_{grav} = mgy$ $U_{spring} = \frac{1}{2}kx^2$ $\Delta E_{th} = f_k\Delta x$ $P = W/\Delta t = Fv$

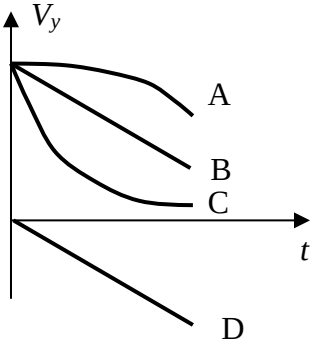
For all problems: Neglect air resistance.

1. You are traveling in an elevator at a constant speed downward. The magnitude of your acceleration is

A) 0 B) – g C) (g – a) D) g

2. Raisin the cat drops a ball from her cat tree. The v_y-t graph of the ball's motion is given by which plot letter in the graph at the right? The y-axis is directed upwards.

A) A B) B C) C D) D



3. A ball is thrown with an initial speed at θ=20° above the horizontal.
When it has reached its maximum height, which quantity is the same as just after launch?

A) speed B) velocity C) vertical component of velocity
D) horizontal component of velocity

4. An object is moving in a circle of a given radius at constant speed. Which is true about the object?

A) Its velocity is constant. B) Its acceleration is zero.
C) Its acceleration is directed parallel to the velocity vector.
D) The faster the object, the greater its acceleration.

5. An airplane flies horizontally with a speed V at height H above the ground. A package is dropped from the airplane and hits the ground time T after it was dropped. (Neglect air resistance). The height H equals:

A) VT B) gT C) $\frac{1}{2}gT^2$ D) $V^2/(2g)$

6. For the package in problem 6: How far did the package move **horizontally** during time T after it is released? (Neglect air resistance.)

A) H B) VT C) $VT-gT^2/2$ D) $(H^2+V_o^2T^2)^{1/2}$

7. The net force acting on an object is constant. Which is true? The object…

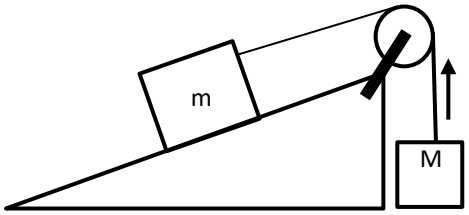
A)… has to move at constant speed. B) … has to move in a straight line.
C) … has constant acceleration. D) …. has zero acceleration.

8. A flat puck is moving in a circle on a horizontal frictionless table. It is held in its orbit by a string. The puck takes one second to complete a full circle. The tension in the string equals 6N. If the puck went around one circle in two seconds, what would be the tension in the string?

A) 1.5N B) 3N C) 12N D) 24N

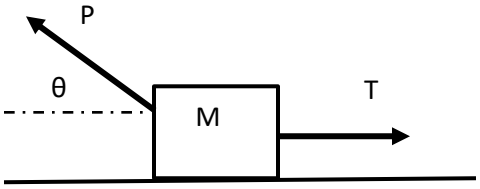
9. A crate is suspended from a vertical rope. The tension in the rope is largest when the crate is
A) moving up with constant velocity B) moving down with constant velocity
C) moving down and speeding up D) moving up and speeding up

10. Mass m on a frictionless incline is connected to mass M by a rope that runs over a massless, frictionless pulley. M moves upwards and is speeding up. We know that the tension T in the rope:



A) T=M *a* B) T>Mg C) T=Mg D) TMg

11. Two forces are acting on a crate of mass *M* that is moving across a frictionless horizontal floor: a constant force of magnitude *P* that is directed an angle θ above the horizontal, and a horizontal force of magnitude *T*, as shown in the figure.
If the crate moves at constant speed, *T* equals:



A) $P-Mg$ B) $P \sin\theta$ C) $P \cos\theta$ D) $P \sin\theta + Mg$

12. For the crate in problem 11, the normal force equals:
A) $Mg - P \sin\theta$ B) $Mg - T$ C) $P + Mg$ D) $P \sin\theta + Mg$

13. 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.

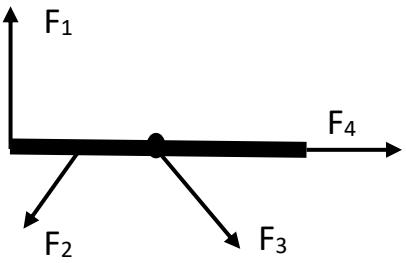
14. The gravitational force of a star on an orbiting planet 1 is F_1. The gravitational force of the star on Planet 2, which has twice the mass of planet 1 and orbits at twice the distance from the star, is F_2. The ratio F_2/F_1 equals
A) $^1/_4$ B) $^1/_2$ C) 1 D) 2

15. Satellite A orbits a planet with speed v. Satellite B, orbiting the planet at the same distance, has twice the mass as satellite A. The speed of satellite B is
A) 2v B) v C) ½v D) ¼ v

16. You are using a spring scale with a force constant 200 N/m and initial length 5 cm to weigh a package. The spring stretches **to** a length of 10 cm. The mass of the package is approximately
A) 100g B) 1 kg B) 2kg D) 10 kg

17. The potential energy of the stretched spring in question 16 equals
A) 0.25 J B) 10 J C) 20 J D) 2,500 J

18. Four forces are acting on a beam that can rotate about an axle through its center. Which of the forces do not produce a torque?

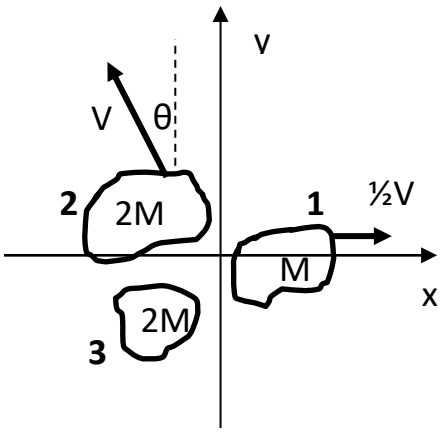


A) 1&4 B) 1&3 C) 2 D) 3&4

19. A soccer ball of mass M is traveling with a speed V in the positive x-direction. After being kicked by a player's foot, the ball travels in the opposite direction with a speed of $2V$. What was the x-component of the impulse delivered to the ball by the foot?

A) $-MV$ B) MV C) $-3MV$ D) $2MV$

20. A firecracker of mass $5M$ which was initially at rest explodes into three fragments. Fragment 1 of mass M moves in the positive x-direction with speed $\frac{1}{2}V$. Fragment 2 of mass $2M$ moves with speed V at an angle θ left of the positive y-axis as shown in the figure. Fragment 3 has mass $2M$. The y- component of the velocity of fragment 3 equals:



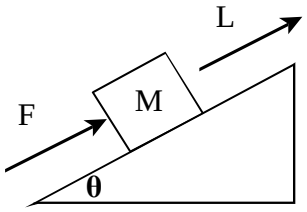
A) $V(\sin\theta - \frac{1}{4})$ B) $V(2\sin\theta + \frac{1}{2})$

C) $-2V\sin\theta$ D) $-V\cos\theta$

21. A spring gun shoots out a ball with a certain kinetic energy. When the spring is compressed two times the distance it was on the first shot, the kinetic energy of the ball is

A) reduced by factor of four B) halved C) doubled D) quadrupled

22. 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) $(F - Mg\sin\theta)L$

23. 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) $(kS^2/M + 2gH)^{1/2}$

24. It has been suggested that, in keeping with tradition, the last question of the Final exam should be a freebie. Do you agree?

A) Yes!!! B) No, I want more. C) Yes. I believe in fairness D) Is the test over already?