Physics 1145 Fall 2021 Final Exam (4 pages)

Name:__solution________________ **December 15, 2021** **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)_B____	17)_A____
2)__B___	10)_B____	18)_D____
3)__D___	11)_C____	19)_B____
4)__A___	12)_A___	20)_A____
5)__A___	13)_D____	21)_C____
6)__B___	14)_D____	22)_C____
7)__B___	15)_C____	23)_B____
8)__B___	16)_C____	24)_ABCD____

Starting Equations:

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

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

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

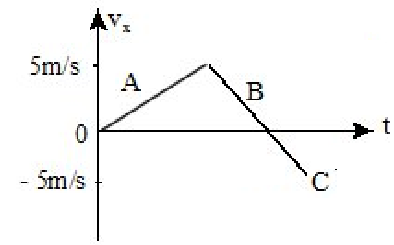
$a_c = \frac{v^2}{R}$ $\quad v = \frac{2\pi R}{T}=\omega R$ $\quad \omega = 2\pi f = \frac{2\pi}{T}$ $\quad F_G = \frac{GmM}{r^2}$ $\quad F_{Sx} = -kx$

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

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

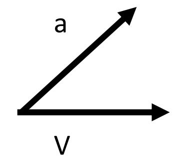
$K = \frac{1}{2}mv^2$ $\quad U_{grav} = mgy$ $\quad U_{spring} = \frac{1}{2}kx^2$ $\quad \Delta E_{th} = f_k\Delta x$ $\quad P = W/\Delta t = Fv$

1. The motion of an object is described by the v_x-t-diagram at the right. During which segment(s) of the motion is the object speeding up?



A) A and C　　B) B　　C) B and C

2. A particle is moving with velocity V. At a particular instant, it experiences an acceleration a as shown in the figure. We know that the particle is:



A) only speeding up　　B) speeding up and changing direction of motion.
C) only slowing down　　D) slowing down and changing direction of motion

3. 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.

4. A ball is kicked from the ground with an initial velocity *V* at 30° above the horizontal. At the top of its trajectory, the ball's velocity and acceleration are:
A) at right angles to one another　　B) in opposite directions
C) in the same direction　　D) both zero

5. A ball is launched from ground level with speed V at angle θ above the horizontal. It reaches a maximum height of
A) $(V \sin \theta)^2/(2g)$　　B) V^2/g　　C) $(V \cos \theta)^2/(2g)$　　D) $2g/V^2$

6. The ball in problem 5 hits the level ground after covering a horizontal distance D. The time it takes the ball to hit the ground is equal to
A) D/V　　B) $D/(V\cos \theta)$　　C) $(2gD)^{½}$　　D) $(2DV\cos \theta)^{½}$

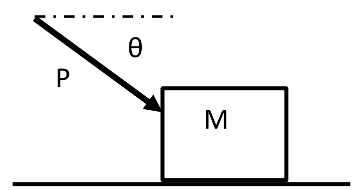
7. A flying mosquito collides head-on with a standing elephant. The magnitude of the force exerted by the mosquito on the elephant is _______________ the magnitude of the force exerted by the elephant on the mosquito during the collision:
A) smaller than　　B) equal to　　C) larger than　　D) not enough information

8. The net force acting on an object is constant. Which is true?
A) The direction of the velocity remains constant.
B) The magnitude of the acceleration is constant.
C) The speed of the object remains constant.
D) The object has to move in a straight line

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

10. You are standing on a scale in an elevator. In which of the following situations does the scale show more than your actual weight? The elevator is moving…
A)…downwards at constant speed B) …upwards and speeding up
C) …downwards and speeding up D)… upwards and slowing down

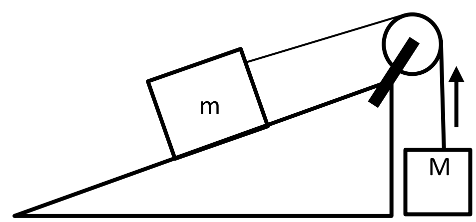
11. A heavy crate of mass M rests on a rough horizontal surface with coefficient of static friction μ between the surface and the crate. You are pushing on it with force magnitude *P* at an angle 2 >0 **with the horizontal**. The crate does not move. You then know that the magnitude *f* of the frictional force satisfies



A) $f > P$ B) $f = P$ C) $f < P$ D) $f = \mu Mg$

12. The normal force on the crate in problem 11 equals:
A) $P \sin\theta + Mg$ B) *P* sin 2 C) Mg D) $P + Mg$

13. Mass *m* on a frictionless incline is connected to mass *M* by a rope that runs over a massless, frictionless pulley. *M* accelerates upwards. We know that the tension T in the rope:



A) $T=Ma$ B) $T<Mg$ C) $T=Mg$ D) $T>Mg$

14. The free-fall acceleration on planet X is 20 m/s^2. The radius and mass of planet Z are half the radius and mass of planet X. The free-fall acceleration on planet Z equals, in m/s^2,
A) 5 B) 10 C) 20 D) 40

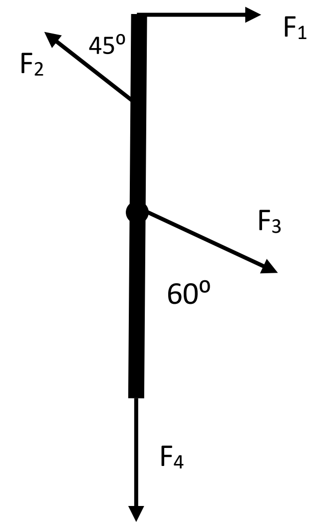
15. Satellite A orbits a planet with speed *V*. Satellite B is half as massive as satellite A and orbits at the same distance from the center of the planet. What is the speed of satellite B?
A) ¼*V* B) ½*V* C) *V* D) 2*V*

16. A 3 kg weight is suspended from a spring, stretching it by 3 cm. The spring constant of the spring is about
A) 1 N/m B) 3N/cm C) 10 N/cm D) 30N/cm

17. You try to put a merry-go-round into rotation by applying a force of fixed magnitude at the rim. Two children sit on the merry-go round. You will achieve the largest angular acceleration if
A) the kids sit close to the center B) the kids sit at the rim on opposite sides
C) the kids sit at the rim, next to each other D) it does not matter where the kids sit

18. Four forces are acting on a beam that can rotate about an axle through its center, as shown in the figure. Which of the forces produce **NO** torque with respect to the axle?

A) 1 and 4 B) 1 and 2 C) 1, 3 and 4 D) 3 and 4



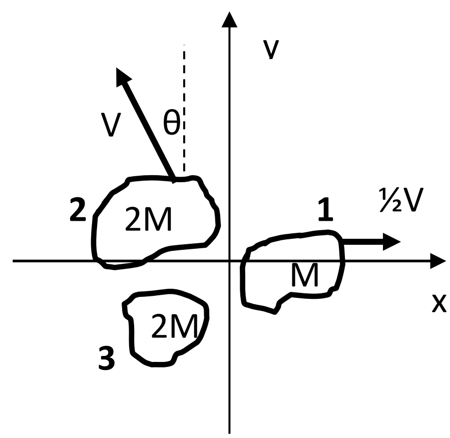
19. A soccer ball of mass M is traveling with a speed V in the positive *x*-direction. After being kicked by a player's foot, the ball travels in the opposite direction with a speed of 2V. What was the *x*-component of the impulse delivered to the ball by the foot?

A) 2MV B) − 3MV C) − MV D) 3 MV

20. A firecracker of mass 5*M* which was initially at rest explodes into three fragments. Fragment 1 of mass *M* moves in the positive *x*-direction with speed ½*V*. Fragment 2 of mass 2*M* moves with speed *V* at an angle θ left of the positive *y*-axis as shown in the figure. Fragment 3 has mass 2*M*. The *x*- component of the velocity of fragment 3 equals:

A) V (sin θ - ¼) B) V (2 sin θ + ½)

C) 2.5 V D) −V cos θ



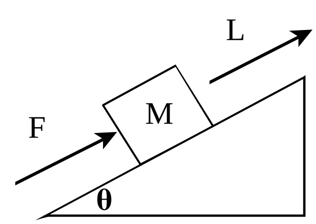
21. A spring gun shoots out a ball with a certain speed. When the spring is compressed twice the distance it was on the first shot, the launch speed is

A) reduced by factor of 4 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 θ B) *FL* sin θ

C) *FL* D) (*F* - *M*g sin θ) *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 maximum height reached by the block equals

A) kS/(Mg) B) $(kS^2/(2Mg)$ C) $(\frac{1}{2} kS^2 Mg)^{1/2}$ D) S

24. You have earned an easy last question. Which do you plan to do over the holidays?

A) sleep late B) relax C) forget all my Physics D) all of the above