Physics 1145 Fall 2023 Final Exam (4 pages)

Name:__Solution_____ December 13, 2023 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)_A____	17)__C___
2)_C____	10)_B____	18)__B___
3)_B____	11)_D____	19)__B___
4)_C____	12)_A____	20)__A___
5)_B____	13)_C____	21)__C___
6)_B____	14)_D____	22)__A___
7)_C____	15)_D____	23)__A___
8)_D____	16)_D____	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 $\omega = 2\pi f = \frac{2\pi}{T}$ $F_G = \frac{GmM}{r^2}$ $F_{Sx} = -kx$

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

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

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

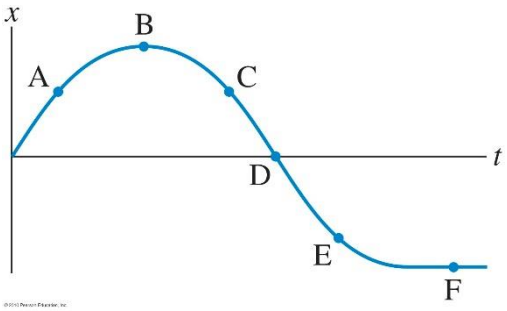
For all problems: neglect air resistance.

1. A particle is moving along a straight line. The slope of the velocity vs time graph at a particular time gives the particle's

A) instantaneous acceleration at that time B) average speed

C) position at that time D) displacement

2. The motion of an object is described by the *x*-*t*-diagram at the right. Which of the following is true?



A) The object moves to the left at A.

B) The object has its highest speed at B.

C) The object moves to the left at C.

D) The object stops at D.

3. Raisin the cat is running in a circle with constant speed. Her acceleration is

A) zero B) towards the center of the circle C) tangent to the circle

D) away from the center of the circle

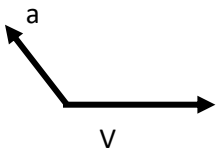
4. A cliff diver jumps off a cliff with a horizontal velocity of magnitude V_o at a height H above the water. What time does it take for the diver to hit the water after he leaves the cliff?

A) H / V_o B) $2V_o$ /g C) $(2H / g)^{½}$ D) $[V_o+(V_o^2 +2gH)^{½}]/g$

5. For the diver in question 4, what is their speed just before they hit the water?

A) V_o B) $(V_o^2 + 2gH)^{½}$ C) $(2gH)^{½}$ D) V_o /g

6. 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) slowing down and changing direction of motion.

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

7. You are standing on a scale in an elevator. In which of the following situations does the scale show less than your actual weight? The elevator is moving…

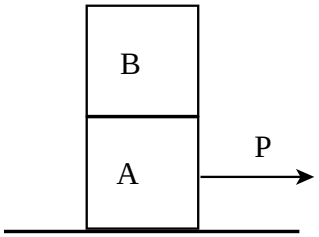
A)…upwards at constant speed B) …upwards and speeding up

C) …downwards and speeding up D)… downwards and slowing down

8. A particle rotates in a circle with centripetal acceleration a. If the period is halved without changing the radius, the new acceleration will be

A) ¼ a B) ½ a C) 2a D) 4a

9. Block A is on a frictionless horizontal surface. An identical block B is on top of block A. A constant horizontal force of magnitude P is exerted on block A, pushing it to the right. Block B rides on block A without slipping. The frictional force on block B is:

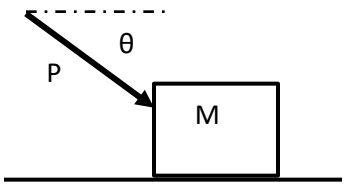


A) static, to the right B) static, to the left
C) kinetic, to the right D) zero

10. Dr. Vojta's cats Frodo (weight 14 lbs) and Raisin (weight 8 lbs) are playing. Frodo jumps and collides with Raisin. The magnitude of the force Frodo exerts on Raisin is _____ the magnitude of the force Raisin exerts on Frodo:

A) smaller than B) equal to C) larger than D) not enough information

11. A crate of mass *M* is pushed across a frictionless horizontal floor by a force *P* that makes an angle θ with the horizontal. The normal force equals:

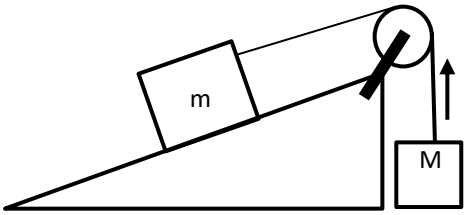


A) $P \sin\theta$ B) Mg C) $P + Mg$ D) $P \sin\theta + Mg$

12. The total force acting on an object is constant. Which is true?

A) The magnitude of the acceleration is constant.
B) The direction of the velocity remains constant.
C) The speed of the object remains constant.
D) At no instant during its motion can the object have zero speed.

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



A) T=0 B) T<Mg C) T=Mg D) T>Mg

14. The mass of a certain planet is two times the mass of the Earth. Its radius is twice the radius of the earth. The free fall acceleration on this planet is:

A) 4g B) 2g C) g D) ½ g

15. If the mass of the moon were doubled but it stayed in its present orbit, the orbital speed would

A) halve. B) double. C) quadruple. D) stay the same.

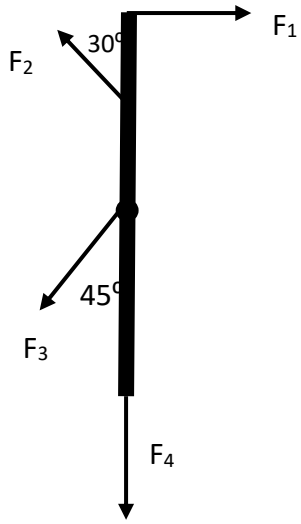
16. A 3 kg weight is suspended from a spring, stretching it by 3 cm. The spring constant of the spring is about

A) 1 N/m B) 3N/cm C) 30 N/cm D) 10N/cm

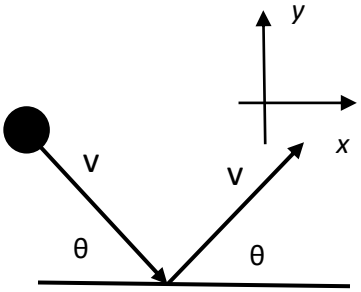
17. A spring is compressed a certain distance and shoots out a ball with a certain speed. In order to double the launch speed, the distance by which the spring is compressed must be

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

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 a **non-zero** torque with respect to the axle?



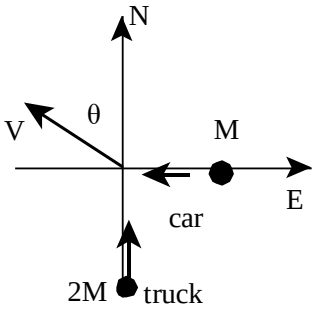
A) all of them B) 1 and 2
C) 1, 2 and 3 D) 1, 2, and 4



19. A ball of mass *m* hits the horizontal floor with speed *v* and bounces off the floor with the same speed. The angle of incidence equals the angle of rebound. The impulse delivered to the ball by the floor is

A) zero. B) in the *y*-direction.
C) equal to $m\vec{v}$. D) in the *x*-direction.

20. A car of mass *M* that is traveling West collides with a truck of mass 2*M* that is traveling North. The **fused** wreckage moves with speed *V* at an angle θ West of North as shown in the figure. The initial speed of the car just before the collision was:



A) 3Vsin θ B) 3Vcos θ
C) ⅓Vsin θ D) ⅔Vcosθ

21. The work done by a force on an object is zero. This is the case if the force is

A) constant. B) parallel to the displacement.
C) perpendicular to the displacement D) the force of friction

22. Two air track carts of masses *M* and 4*M*, respectively, compress a spring. The system is released from rest. The spring drops to the ground after it has expanded. The heavy cart acquires a final speed v. What is the final speed of the lighter cart?

A) 4v B) ¼ v C) 2 v
D) can't determine without knowing spring constant and initial compression

23. A block of mass M sits on a vertical spring that is compressed a distance S from its equilibrium length. The block is then released from rest and it shoots up, leaving the spring behind. It reaches a maximum height of H. The spring constant equals

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

24. If you looked at the old Final, you saw that there was a free question at the end. Did you expect you would get one too?

A) no B) yes C) expect-no, but I hoped D) Is this the free question?