

Instructor(s): *Matcheva/Sabin*

## PHYSICS DEPARTMENT

Exam 1

February 1, 2010

PHY 2048

Name (print, last first): \_\_\_\_\_

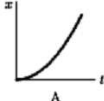
Signature: \_\_\_\_\_

*On my honor, I have neither given nor received unauthorized aid on this examination.***YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.**

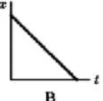
- (1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number).** Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY.** Code your UFID number on your answer sheet.
- (2) Print your name on this sheet and sign it also.
- (3) Do all scratch work anywhere on this exam that you like. **Circle your answers on the test form.** At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout.
- (4) **Blacken the circle of your intended answer completely, using a #2 pencil or blue or black ink.** Do not make any stray marks or some answers may be counted as incorrect.
- (5) **Hand in the answer sheet separately.**

Where needed use  $g = 9.80 \text{ m/s}^2$ 

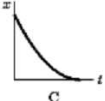
1. A solid sphere has a uniform mass density of  $4.1 \text{ kg/m}^3$ . If the total mass of the sphere is  $137.3 \text{ kg}$ , the radius of the sphere is about:
  - (1) 2.0 m
  - (2) 1.0 m
  - (3) 3.0 m
  - (4) 0.5 m
  - (5) 4.0 m
  
2. A particle moves along the  $x$  axis from  $x_i$  to  $x_f$ . Of the following values of the initial and final coordinates, which results in the displacement with the largest magnitude?
  - (1)  $x_i = -8 \text{ m}$ ,  $x_f = 8 \text{ m}$
  - (2)  $x_i = 8 \text{ m}$ ,  $x_f = 12 \text{ m}$
  - (3)  $x_i = -8 \text{ m}$ ,  $x_f = -16 \text{ m}$
  - (4)  $x_i = -8 \text{ m}$ ,  $x_f = 4 \text{ m}$
  - (5)  $x_i = 8 \text{ m}$ ,  $x_f = -4 \text{ m}$
  
3. A car traveling at a constant speed starts at point A, goes 50 km in a straight line to point B, immediately turns around, and returns to point A (in a straight line). The time for this round trip is 2 hours. The magnitude of the average velocity of the car for this round trip is:
  - (1) zero
  - (2) 50 km/hr
  - (3) 100 km/hr
  - (4) 200 km/hr
  - (5) 25 km/hr
  
4. Which of the five graphs of position,  $x$ , versus time,  $t$ , represents the motion of an object whose speed is increasing with time?
 



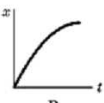
A




B



C

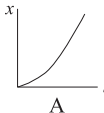


D

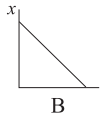


E

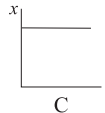
  - (1) A
  - (2) B
  - (3) C
  - (4) D
  - (5) E
  
5. Two automobiles are moving at a constant speed in the same direction along the positive  $x$ -axis. One automobile is moving at 40 km/h faster than the other. If the faster automobile is 160 kilometers behind the slower automobile, they will meet in:
  - (1) 4.0 hr
  - (2) 1.6 hr
  - (3) 2.7 hr
  - (4) 8.0 hr
  - (5) 16.0 hr

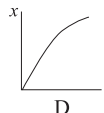
6. If  $|\vec{A} + \vec{B}|^2 = |\vec{A}|^2 + |\vec{B}|^2$  and neither  $\vec{A}$  nor  $\vec{B}$  vanish, then:
- (1)  $\vec{A}$  is perpendicular to  $\vec{B}$
  - (2)  $\vec{A}$  and  $\vec{B}$  are parallel and in opposite directions
  - (3)  $\vec{A}$  and  $\vec{B}$  are parallel and in the same direction
  - (4) the angle between  $\vec{A}$  and  $\vec{B}$  is  $45^\circ$
  - (5) the angle between  $\vec{A}$  and  $\vec{B}$  is  $60^\circ$
7. If  $\vec{A} + \vec{B} = 2\vec{C}$ ,  $\vec{A} - \vec{B} = \vec{C}$ , and the magnitude of  $\vec{C}$  is  $|\vec{C}| = 2$ , then what is the value of the dot product  $\vec{A} \cdot \vec{B}$ ?
- (1) 3
  - (2) zero
  - (3) 4
  - (4) 6
  - (5) 2
8. If  $\vec{A} \times \vec{B} = \vec{C}$  and if  $\vec{A}$  is in the positive y-direction and  $\vec{C}$  is in the positive z-direction, then  $\vec{B}$  is:
- (1) in the negative x-direction
  - (2) in the positive x-direction
  - (3) in the negative z-direction
  - (4) in the positive z-direction
  - (5) in the negative y-direction
9. Starting at time  $t = 0$ , an object moves along a straight line. Its coordinate in meters is given by  $x(t) = 48t - t^3$ , where  $t$  is in seconds. What is the acceleration of the object when it momentarily stops (*i.e.*, velocity = 0 with  $t > 0$ )?
- (1)  $-24 \text{ m/s}^2$
  - (2)  $24 \text{ m/s}^2$
  - (3)  $-12 \text{ m/s}^2$
  - (4)  $-12 \text{ m/s}^2$
  - (5) zero
10. Which of the above five graphs of position,  $x$ , versus time,  $t$ , represents the motion of an object moving with a constant nonzero speed?
- 

A

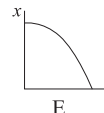


B



C
- 

D



E
- (1) B
  - (2) A
  - (3) C
  - (4) D
  - (5) E
11. An object is released from rest at  $t = 0$  near the surface of the Earth. How far does it fall during the first second of its fall (*i.e.*, from  $t = 0 \text{ s}$  to  $t = 1 \text{ s}$ )?
- (1) 4.9 m
  - (2) 9.8 m
  - (3) 14.7 m
  - (4) 19.6 m
  - (5) 24.5 m
12. A motorist drives along a straight road at a constant speed of 60 m/s. At time  $t = 0$  she passes a parked motorcycle police officer. The officer takes off after her at  $t = 0$  and accelerates according to the formula  $a(t) = bt$ , where  $t$  is the time and  $b$  is a positive constant. What is the speed of the police officer when he reaches the motorist?
- (1) 180 m/s
  - (2) 240 m/s
  - (3) 160 m/s
  - (4) 120 m/s
  - (5) need to know  $b$
13. A boy whirls a stone with mass  $M$  in a horizontal circle of radius  $R$  and at height  $h$  above level ground. The string breaks, and the stone flies off horizontally and strikes the ground after traveling a horizontal distance  $D$ . If  $D = 4R$  and  $h = 2R$ , what is the tension in the string when it broke?
- (1)  $4Mg$
  - (2)  $2Mg$
  - (3)  $Mg$
  - (4)  $6Mg$
  - (5)  $Mg/2$

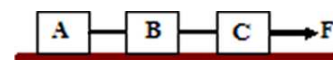
14. Near the surface of the Earth, a startled armadillo leaps vertically upward at time  $t = 0$ , at time  $t = 0.5$  s, it is a height of 0.98 m above the ground. At what time does it land back on the ground?

(1) 0.9 s                      (2) 1.2 s                      (3) 0.7 s                      (4) 1.5 s                      (5) 1.0 s

15. When a certain force is applied to the standard kilogram, its acceleration is  $5 \text{ m/s}^2$ . When the same force is applied to another object, its acceleration is one-fifth as much. The mass of the object is:

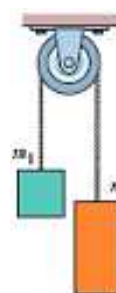
(1) 5 kg                      (2) 0.2 kg                      (3) 1 kg                      (4) 10 kg                      (5) 0.5 kg

16. Three blocks (A,B,C), each having mass  $M_A = M$ ,  $M_B = 2M$ ,  $M_C = M$  are connected by strings on a horizontal frictionless surface as shown in the figure. Block C is pulled to the right by a horizontal force of magnitude  $F$  that causes the entire system to accelerate. What is the magnitude of the net horizontal force acting on block B due to the strings?



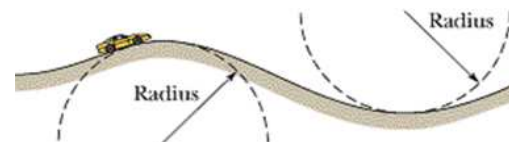
(1)  $F/2$                       (2)  $F/3$                       (3)  $2F/3$                       (4) zero                      (5)  $F$

17. The figure shows two blocks with masses  $m_1$  and  $m_2$  connected by a cord (of negligible mass) that passes over a frictionless pulley (also of negligible mass). If  $m_2 = 5m_1$ , what is the magnitude of the acceleration of block 2 when released from rest?



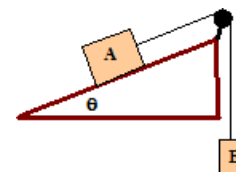
(1)  $2g/3$   
 (2)  $g/2$   
 (3)  $g/3$   
 (4)  $g/5$   
 (5)  $g/4$

18. In the figure, a car is driven at speed  $v_1$  over a circular hill and then into a circular valley with the same radius, but with speed  $v_2$ . At the top of the hill, the normal force on the driver from the car seat is zero and the driver's mass is  $M$ . If  $v_2 = 2v_1$ , what is the magnitude of the normal force on the driver from the seat when the car passes through the bottom of the valley?



(1)  $5 Mg$                       (2)  $2 Mg$                       (3)  $Mg$                       (4)  $0.5 Mg$                       (5) zero

19. The mass of block A is  $M_A$  and the mass of block B is  $M_B$ , and the angle  $\theta$  is  $30^\circ$ , as shown in the figure. If block A is at rest, and if  $M_A = M_B$ , what is the minimum static coefficient of friction such that it will remain at rest after it is released?



(1) 0.577                      (2) 0.385                      (3) 0.192                      (4) 0.333                      (5) 0.144

20. Near the surface of the Earth, a car is traveling at a constant speed  $v$  around a flat circular race track with a radius of 50 m. If the coefficients of kinetic and static friction between the car's tires and the road are  $\mu_k = 0.1$ ,  $\mu_s = 0.4$ , respectively, what is the maximum speed the car can travel without slipping?

(1) 14 m/s                      (2) 28 m/s                      (3) 196 m/s                      (4) 22 m/s                      (5) 7 m/s