King Fahd University of Petroleum and Minerals

Department of Physics

PHYS101-051

MAJOR 1 EXAM

<u>Test Code</u>: 000

(*"A" is the correct answer in all questions*)

17 October 2005 in Building 54

Exam Duration: 2hrs (from 9:00pm to 11:00pm)

Name:	
Student Number:	
Section Number:	

1. The mass of 1.0 cm^3 of gold is 19.3 g. What is the mass of a solid cube of gold having a side of 0.70 cm?
   A) 6.6×10^{-3} kg
   B) 9.1×10^{-2} kg
   C) 3.6×10^{-3} kg
   D) 0.11 kg
   E) 21 kg

2. A helicopter at height h (m) from the surface of the sea is descending at a CONSTANT SPEED v (m/s). The time it takes to reach the surface of the sea can be found from:
   A) $-h = -v\,t$
   B) $h = ½\,g\,t^2$
   C) $-h = ½\,g\,t^2$
   D) $h = v\,t – ½\,g\,t^2$
   E) $-h = -v\,t – ½\,g\,t^2$

3. A particle starts from rest at t = 0 s. Its acceleration as a function of time is shown in Fig. 1. What is its speed at the end of the 6.0 s?

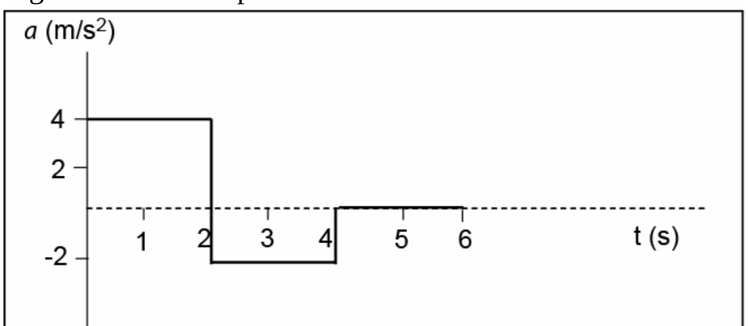

Fig. 1

   A) 4.0 m/s
   B) 0 m/s
   C) 12 m/s
   D) 2.0 m/s
   E) -12 m/s

4. The position of a particle x(t) as a function of time (t) is described by the equation: $x(t) = 2.0 + 3.0\,t – t^3$, where x is in m and t is in s. What is the maximum positive position of the particle on the x axis?
   A) 4.0 m
   B) 2.0 m
   C) 3.0 m
   D) 1.0 m
   E) 5.0 m

5. A stone is thrown vertically downward from a building with an initial speed of 2.0 m/s. It reaches the ground after 5.0 s. What is the height of the building?
   A) 130 m
   B) 60 m
   C) 180 m
   D) 120 m
   E) 140 m

6. Three vectors $\vec{A}$, $\vec{B}$, and $\vec{C}$ are such that: $\vec{C} = \vec{A} + \vec{B}$, $\vec{B} = 5\hat{i}$ nd $\vec{C} = 5\hat{j}$ Find the angle between $\vec{A}$ and $\vec{B}$.
   A) 135°
   B) 120°
   C) 270°
   D) 150°
   E) 45°

7. A man walks 4.65 km West, then 12.7 km in the direction 30° West of North and finally 11.0 km due East. The man is now at
   A) 11.0 km due North
   B) 12.7 km due West
   C) 4.65 km due South
   D) 15.6 km in the direction 45° West of North
   E) back to where he started

8. If vector $\vec{A}$ has the magnitude of 3.0 m and makes an angle 30° with the +x-axis, then the vector $\vec{B} = -2\vec{A}$ is:
   A) $\vec{B} = -5.2\hat{i} - 3.0\hat{j}\,(\text{m})$
   B) $\vec{B} = 5.2\hat{i} + 3.0\hat{j}\,(\text{m})$
   C) $\vec{B} = -5.2\hat{i} + 3.0\hat{j}\,(\text{m})$
   D) $\vec{B} = 5.2\hat{i} - 3.0\hat{j}\,(\text{m})$
   E) $\vec{B} = -3.0\hat{i} - 5.2\hat{j}\,(\text{m})$

9. A ball is thrown with a velocity $\vec{v}_o = 3.0\hat{i} + 5.0\hat{j}\,(\text{m/s})$ from the ground. Its velocity just before it strikes the ground is:
   A) $\vec{v} = 3.0\hat{i} - 5.0\hat{j}\,(\text{m/s})$
   B) $\vec{v} = 3.0\hat{i} + 5.0\hat{j}\,(\text{m/s})$
   C) $\vec{v} = 3.0\hat{i}\,(\text{m/s})$
   D) $\vec{v} = 5.0\hat{j}\,(\text{m/s})$
   E) $\vec{v} = -5.0\hat{j}\,(\text{m/s})$

10. A ball is kicked from the ground with an initial speed of 20 m/s at an angle of 45°. A player 60 m away starts running to catch the ball at that instant (see Fig 2). What must be his average speed (v) if he has to catch the ball just before it hits the ground?

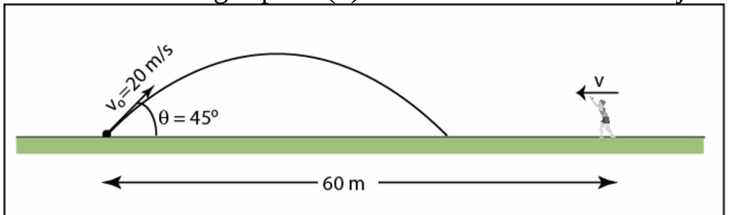

Fig. 2

A) 6.6 m/s
B) 10 m/s
C) 20 m/s
D) 2.0 m/s
E) 15 m/s

11. The position of a particle as a function of time is given by $\vec{r} = 3.0t\,\hat{i} + 2.0t^2\,\hat{j}$. Find the angle between the velocity and acceleration of the particle at t =5.0 s.
A) 8.5°
B) 0°
C) 90°
D) 45°
E) 78°

12. Car A is moving towards East with speed 15.0 m/s and car B is moving towards West with speed 25.0 m/s, both relative to the ground. Find the velocity of car B relative to car A.
A) 40.0 m/s towards West
B) 5.00 m/s towards West
C) 5.00 m/s towards North
D) 40.0 m/s towards East
E) 40.0 m./s towards South

13. Two forces $\vec{F}_1$ & $\vec{F}_2$ are acting on a 3.0 kg box in the x-y plane. Fig. 3 shows only $\vec{F}_1$ and the acceleration $\vec{a}$ of the box. Find $\vec{F}_2$

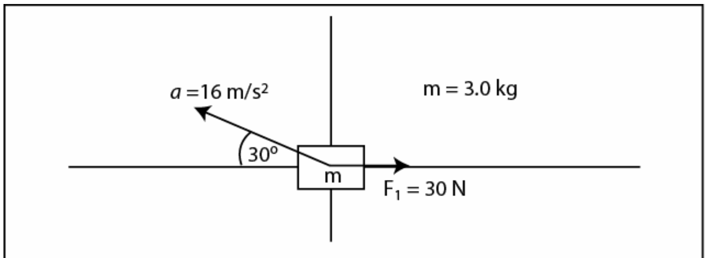

Fig. 3

A) $\left(-72\hat{i}+24\hat{j}\right)N$

B) $\left(-72\hat{i}-24\hat{j}\right)N$

C) $\left(72\hat{i}+24\hat{j}\right)N$

D) $\left(-36\hat{i}-48\hat{j}\right)N$

E) $\left(-36\hat{i}+48\hat{j}\right)N$

14. A block of mass m_1=5.7 kg on a frictionless 30° inclined plane is connected by a cord over a massless, frictionless pulley to a second block of mass m_2=3.5 kg hanging vertically as shown in Fig 4. The acceleration of m_2 is:

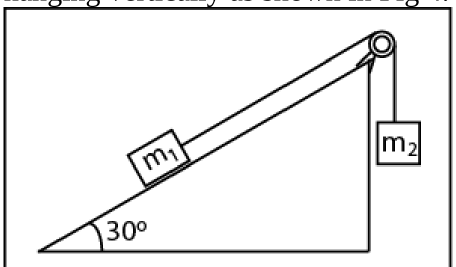

Fig. 4

A) 0.69 m/s^2 downward
B) 0.54 m/s^2 upward
C) 0.36 m/s^2 downward
D) 0.78 m/s^2 upward
E) 0.93 m/s^2 downward

15. Fig.5 shows a block A of mass 6.0 kg and block B of 8.0 kg connected by a rigid rod of negligible mass. Force $\vec{F}_a = (16N)\hat{i}$ acts on block A; force $\vec{F}_b = -(30N)\hat{i}$ acts on block B. The tension (T) in the rod is: (Neglect friction)

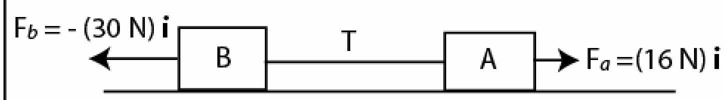

Fig. 5

A) 22 N
B) 30 N
C) 16 N
D) 46 N
E) 14 N

16. A 5.0-kg mass is held at an angle θ from the vertical by a horizontal force F=15 N as shown in Fig 6. The tension (T) in the string supporting the mass (in Newton) is:

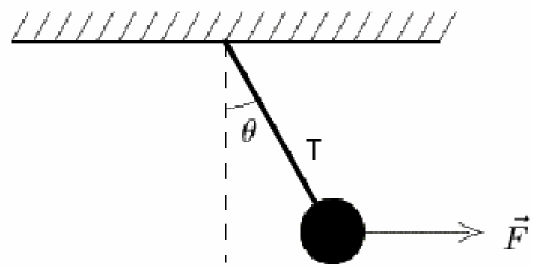

Fig. 6

A) 51
B) 2/ cos θ
C) cos θ/2
D) cos θ
E) 0

17. A 0.20-kg stone is attached to a string and whirled in a circle of radius r = 0.60 m on a horizontal frictionless surface as shown in Fig. 7. If the stone makes 150 revolutions per minute, the tension (T) in the string is:

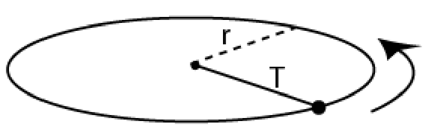

Fig. 7

A) 30 N
B) 0.20 N
C) 0.90 N
D) 1.96 N
E) 0.03 N

18. A block of mass M slides on a horizontal surface. Which of the following would increase the magnitude of the frictional force on the block?
    A) Increasing M
    B) Keeping M constant but decreasing the surface area of contact
    C) Keeping M constant but increasing the surface area of contact
    D) Decreasing M
    E) None of the other answers

19. A box of mass m is sliding down a rough inclined plane (which makes an angle of 30° with the horizontal and has a coefficient of kinetic friction = μ_k) at a constant acceleration g/4 (where g = 9.8 m/s^2). Find μ_k .
    A) 0.29
    B) 0.16
    C) 2.15
    D) 0.11
    E) 0.64

20. A 5.0 kg block is sliding on a rough horizontal plane (μ_k=0.10) under the effect of a horizontal force F. Fig. 8 shows the velocity (v) of the block as a function of time (t). Calculate F.

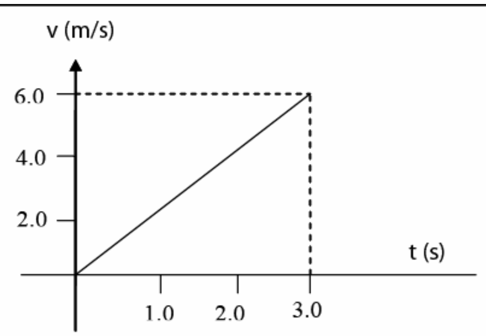

Fig. 8

    A) 15 N
    B) 5.0 N
    C) 10 N
    D) 1.0 N
    E) 30 N

PHYS101 First Major Exam Formula Sheet

$$y = cx^n; \qquad \frac{dy}{dx} = cnx^{n-1}$$

Motion in One Dimension

$$v = \frac{dx}{dt}; \qquad a = \frac{dv}{dt}; \qquad v_{avg} = \frac{\Delta x}{\Delta t}; \qquad a_{avg} = \frac{\Delta v}{\Delta t}$$

Motion with Constant Acceleration

$v = v_o + at$		$x - x_o = v_o t + \frac{1}{2}at^2$
$v^2 = v_o^2 + 2a(x - x_o)$	$x - x_o = \frac{1}{2}(v + v_o)t$	$x - x_o = vt - \frac{1}{2}at^2$

Free Fall

$$a = -g; \qquad g = 9.8 m/s^2$$

Vectors

$$\vec{a}\cdot\vec{b} = ab\cos\phi \qquad \left|\vec{a}\times\vec{b}\right| = ab\sin\phi$$

Motion in Two Dimensions

$$\vec{v} = \frac{d\vec{r}}{dt}; \qquad \vec{a} = \frac{d\vec{v}}{dt}$$

$$\vec{r} - \vec{r}_o = \vec{v}_o t + \frac{1}{2}\vec{a}t^2; \qquad \vec{v} = \vec{v}_o + \vec{a}t$$

Projectile Motion

$a_x = 0$	$x - x_o = v_o \cos\theta_o t$
$a_y = -g = -9.80\ \text{m/s}^2$	$y - y_o = v_o \sin\theta_o t - \frac{1}{2}gt^2$
$H = v_o^2 \sin^2\theta_o / 2g$	$R = v_o^2 \sin 2\theta_o / g$

Uniform Circular Motion

$$a = \frac{v^2}{r}$$

$$T = \frac{2\pi r}{v}$$

Relative Motion

$$\vec{v}_{PA} = \vec{v}_{PB} + \vec{v}_{BA}$$

$$\vec{v}_{AB} = \text{velocity of A relative to B} = -\vec{v}_{BA}$$

Newton's Second Law

$$\sum\vec{F} = m\vec{a} \quad\Rightarrow\quad \sum F_x = \text{ma}_x; \quad \sum F_y = \text{ma}_y$$

Friction

$$f_{s,\max} = \mu_s N; \quad f_k = \mu_k N$$

Answer Key

1. A
2. A
3. A
4. A
5. A
6. A
7. A
8. A
9. A
10. A
11. A
12. A
13. A
14. A
15. A
16. A
17. A
18. A
19. A
20. A