King Fahd University of Petroleum and Minerals

Department of Physics

PHYS101-052
MAJOR 1 EXAM
Test Code: **100**

25 March 2006
Exam Duration: 2hrs (from 6:00pm to 8:00pm)

Name:	
Student Number:	
Section Number:	

1. A nucleus of volume 3.4 x 10^3 fm^3 and mass of 1.0x 10^2 u has a density of:
   (1 fm = 10^{-15} m, 1 u = 1.7 x 10^{-27} kg)
   A) 5.0×10^{16} kg/m^3
   B) 1.0×10^3 kg/m^3
   C) 3.4×10^{14} kg/m^3
   D) 12×10^3 kg/m^3
   E) 3.6×10^{13} kg/m^3

2. An object starts from rest at the origin and moves along the x axis with a constant acceleration of 4 m/s^2. Its average velocity as it goes from x = 2 m to x = 18 m is:
   A) 1 m/s
   B) 2 m/s
   C) 6 m/s
   D) 5 m/s
   E) 8 m/s

3. Two cars are 150 km apart and traveling toward each other. One car is moving at 60. km/h and the other is moving at 40. km/h. In how many hours will they meet?
   A) 2.5 h
   B) 2.0 h
   C) 1.9 h
   D) 1.5 h
   E) 1.2 h

4. The coordinate of a particle in meters is given by $x(t) = 16t - 3.0t^3$, where the time t is in seconds. The particle is momentarily at rest at time=
   A) 0.75 s
   B) 1.3 s
   C) 5.3 s
   D) 7.3 s
   E) 9.3 s

5. A stone and a ball are thrown vertically upward with different initial speeds: 20 m/s for the stone and 10 m/s for the ball. If the maximum height reached by the ball is H then the maximum height reached by the stone is:
   A) 4 H
   B) 2 H
   C) H
   D) H/2
   E) H/4

6. If $\vec{A} = \hat{i} + \hat{j}$ and $\vec{B} = \hat{i} - \hat{j}$ then:
   A) A and B must be parallel and in the same direction
   B) A and B must be parallel and in opposite directions
   C) magnitude of A is not the same as magnitude of B
   D) the angle between A and B must be 60°
   E) the angle between A and B must be 90°

7. Let $\vec{A} = 2.0\hat{i} - 3.0\hat{k}$ and $\vec{B} = 2.0\hat{i} + \hat{k}$ .The vector $\vec{D} = \left(\vec{A} - \vec{B}\right) \times \vec{A}$ is:
   A) $2.0\hat{i} - 3.0\hat{k}$
   B) $4.0\hat{i} - 2.0\hat{k}$
   C) $-12\hat{i}$
   D) $\hat{j} + \hat{k}$
   E) $-8.0\hat{j}$

8. In Fig 1, $\vec{A} = \left(12m, 60°\right)$ and $\vec{B} = \left(8m, 300°\right)$. The x component of $\left(\vec{A} - \vec{B}\right)$ is:
   A) 8 m
   B) 10 m
   C) 2 m
   D) 14 m
   E) 15 m

9. The plane shown in Fig 2, is in a level flight at a height of 490 m and a speed of 50 m/s when a package was released. The horizontal distance between the release point and the point where the package strikes the ground is:
   A) 150 m
   B) 300 m
   C) 980 m
   D) 500 m
   E) 100 m

10. An object moves with a constant acceleration $\vec{a} = -8.0\hat{i} + 7.0\hat{j}$ m/s^2. At t=0 the velocity $\vec{v}_o$ is $40\hat{i}$ m/s. The velocity at time t = 5.0 s is:
   A) $-40\hat{i} + 35\hat{j} \quad m/s$
   B) $-40\hat{i} - 35\hat{j} \quad m/s$
   C) $35\hat{j} \quad m/s$
   D) $40\hat{i} - 35\hat{j} \quad m/s$
   E) $40\hat{i} + 35\hat{j} \quad m/s$

11. An object is moving on a circular path of radius 3.0 meters at a constant speed. The time required for one revolution is 4.7 s. The acceleration of the object is:
    A) 0.216 m/s^2
    B) 5.36 m/s^2
    C) 0.756 m/s^2
    D) 1.36 m/s^2
    E) zero

12. Fig 3 shows a boat is sailing at 12 km/h 30° W of N relative to a river that is flowing East (E) at 6.0 km/h relative to ground. As observed from the ground, the boat is sailing:
    A) due N
    B) 30° E of N
    C) 30° W of N
    D) 45° E of N
    E) due W

13. A 5.0-kg mass is suspended by a string from the ceiling of an elevator that is moving downward with constant acceleration of 2.8 m/s^2. The tension in the string is:
    A) 49 N
    B) 35 N
    C) 50 N
    D) 12 N
    E) 63 N

14. A 3.0-kg block slides on a frictionless 37° incline plane. A vertical force of 15 N is applied to the block (see Fig 4). The acceleration of the block is:
    A) 3.8 m/s^2 up the incline
    B) 5.9 m/s^2 up the incline
    C) 2.9 m/s^2 down the incline
    D) 8.7 m/s^2 down the incline
    E) 4.4 m/s^2 down the incline

15. Two blocks of mass m_1 = 5.0 kg and m_2 = 10. kg are connected by a massless rod and slide on a frictionless 30° incline as shown in Fig 5. The tension in the rod is:
    A) 38 N
    B) 62 N
    C) 98 N
    D) 49 N
    E) zero

16. A 2.3-N weight is suspended by a string from a ceiling and held at an angle θ from the vertical by 4.0-N horizontal force F as shown in Fig 6. The tension in the string is:
    A) 4.0 N
    B) 0.5 N
    C) 6.3 N
    D) 4.6 N
    E) 1.7 N

17. A block rests on a rough incline and has coefficients of friction $\mu_k = 0.20$ and $\mu_s = 0.30$. If the incline angle increases, at what angle does the block start moving?
    A) 11.3°
    B) 16.7°
    C) 33.7°
    D) 35.8°
    E) 56.3°

18. A car is moving in a horizontal circular track of radius R=50.0 m. The coefficient of static friction between the car wheels and the track is $\mu_s = 0.250$. What would be the car speed at which the car starts sliding out side the track?
    A) 49.4 m/s
    B) 33.0 m/s
    C) 54.5 m/s
    D) 11.1 m/s
    E) 45.4 m/s

19. A 5.0-kg block is at rest on a rough horizontal surface. The coefficient of static friction between the block and the surface is $\mu_s = 0.4$. If a horizontal force of 15.0 N is acted on the block, what would be the magnitude of the friction force?
    A) 15.0 N
    B) 19.6 N
    C) 12.0 N
    D) 14.0 N
    E) 18.5 N

20. Three equal mass blocks each of mass =2.0 kg can move together over a horizontal frictionless surface. Two forces, $\vec{F}_1 = 40\hat{i}\ N$ and $\vec{F}_2 = -10\hat{i}\ N$ are applied on the three masses system as shown in the Fig 7. The net force on the middle mass is:
    A) $-20\hat{i}\ N$
    B) $30\hat{i}\ N$
    C) $10\hat{i}\ N$
    D) $5\hat{i}\ N$
    E) $40\hat{i}\ N$

Figures - phys1011-052

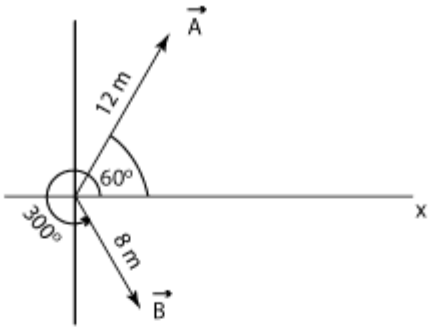

Figure 1

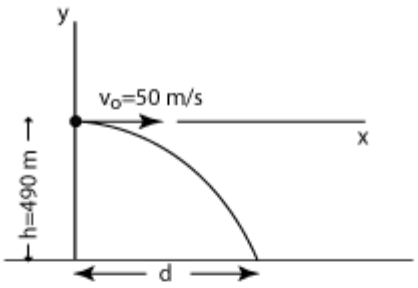

Figure 2

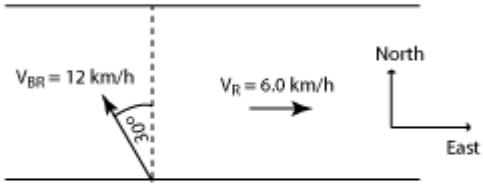

Figure 3

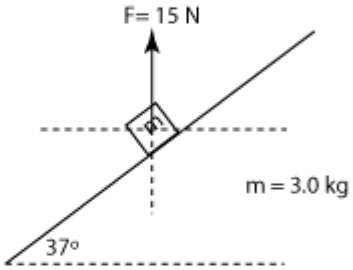

Figure 4

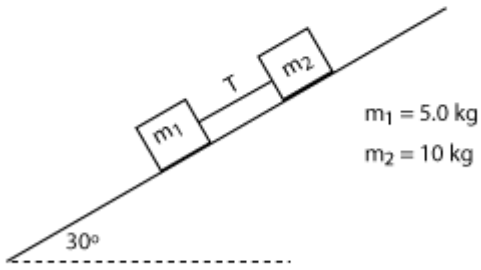

Figure 5

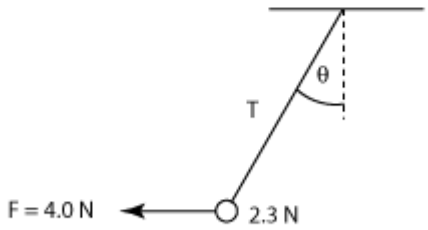

Figure 6

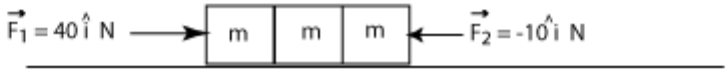

Figure 7

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 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

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

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

Newton's Second Law

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

Friction

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

Answer Key

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