

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

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 $x = 2 \text{ m}$ to $x = 18 \text{ m}$ 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 $60. \text{ km/h}$ and the other is moving at $40. \text{ km/h}$. 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 and B must be parallel and in the same direction
 - A and B must be parallel and in opposite directions
 - magnitude of A is not the same as magnitude of B
 - the angle between A and B must be 60°
 - 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 $\vec{D} = (\vec{A} - \vec{B}) \times \vec{A}$ is:
- $2.0\hat{i} - 3.0\hat{k}$
 - $4.0\hat{i} - 2.0\hat{k}$
 - $-12\hat{i}$
 - $\hat{j} + \hat{k}$
 - $-8.0\hat{j}$
8. In Fig 1, $\vec{A} = (12\text{m}, 60^\circ)$ and $\vec{B} = (8\text{m}, 300^\circ)$. The x component of $(\vec{A} - \vec{B})$ is:
- 8 m
 - 10 m
 - 2 m
 - 14 m
 - 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:
- 150 m
 - 300 m
 - 980 m
 - 500 m
 - 100 m
10. An object moves with a constant acceleration $\vec{a} = -8.0\hat{i} + 7.0\hat{j} \text{ m/s}^2$. At $t=0$ the velocity \vec{v}_0 is $40\hat{i} \text{ m/s}$. The velocity at time $t = 5.0 \text{ s}$ is:
- $-40\hat{i} + 35\hat{j} \text{ m/s}$
 - $-40\hat{i} - 35\hat{j} \text{ m/s}$
 - $35\hat{j} \text{ m/s}$
 - $40\hat{i} - 35\hat{j} \text{ m/s}$
 - $40\hat{i} + 35\hat{j} \text{ m/s}$

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 $m_1 = 5.0 \text{ kg}$ and $m_2 = 10. \text{ kg}$ 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, $\vec{F}_1 = 40\hat{i} \text{ N}$ and $\vec{F}_2 = -10\hat{i} \text{ N}$ are applied on the three masses system as shown in the Fig 7. The net force on the middle mass is:
- A) $-20\hat{i} \text{ N}$
 - B) $30\hat{i} \text{ N}$
 - C) $10\hat{i} \text{ N}$
 - D) $5\hat{i} \text{ N}$
 - E) $40\hat{i} \text{ N}$

Figures - phys1011-052

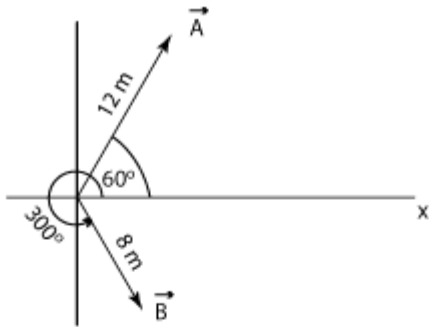


Figure 1

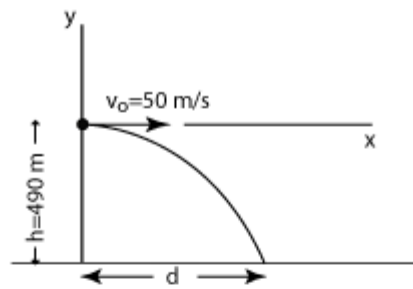


Figure 2

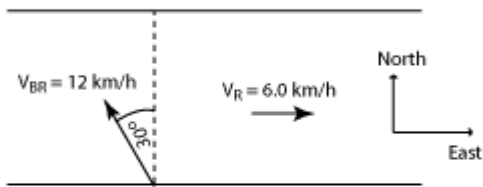


Figure 3

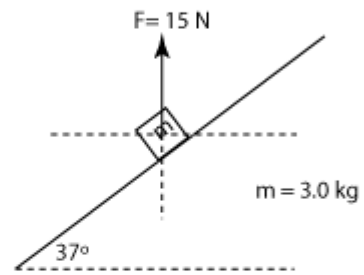


Figure 4

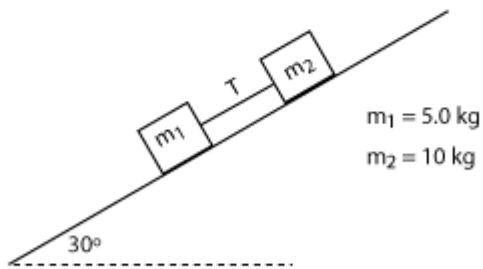


Figure 5

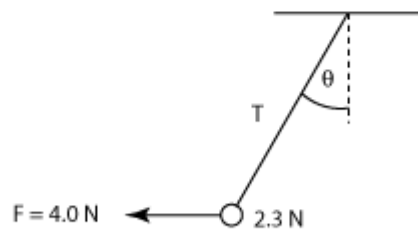


Figure 6

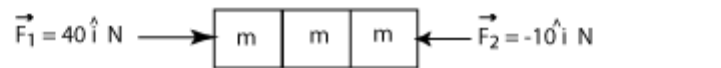


Figure 7

PHYS101 First Major Exam Formula Sheet

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

Motion in One Dimension

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

Motion with Constant Acceleration

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

Free Fall

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

Vectors

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

Motion in Two Dimensions

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

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

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

$$\sum \vec{F} = m\vec{a} \Rightarrow \sum F_x = ma_x; \quad \sum F_y = ma_y$$

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