Review

Chapters

1-6

1. A nucleus of volume 3.4×10^3 fm^3 and mass of 1.0×10^2 u has a density of:
(1 fm = 10^{-15} m, 1 u = 1.7×10^{-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

$$\rho = \frac{m}{V} = \frac{1.0\times 10^2 u}{3.4\times 10^3\ fm^3} \times \left(\frac{1\,fm}{10^{-15} m}\right)^3 \times \left(\frac{1.7\times 10^{-27} kg}{1u}\right) = 5.0\times 10^{16} kg/m^3$$

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

$$v_{avg} = \frac{v_1 + v_2}{2} \quad (1)$$

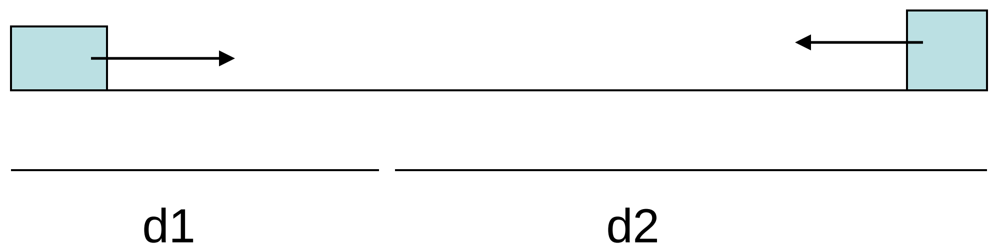
where,

$$v_1^{\ 2} = v_0^{\ 2} + 2ax_1 = 2ax_1 \quad \rightarrow v_1 = \sqrt{2ax_1}$$

$$v_2^{\ 2} = v_0^{\ 2} + 2ax_2 = 2ax_2 \quad \rightarrow v_2 = \sqrt{2ax_2}$$

$$subsitute\ in\ (1) \quad to\ get\ v_{avg} = 8\ m/s$$

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



$$d_1 = v_1 t = 40t, \quad d_2 = v_2 t = 60t$$

$$d_1 + d_2 = 150 \triangleright 40t + 60t = 150 \triangleright t = \frac{150}{100} = 1.5\,h$$

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

$$v = \frac{dx}{dt} = 16 - 9.0t^2 = 0 \rightarrow t = \sqrt{\frac{16}{9.0}} = \frac{4.0}{3.0} = 1.3\ s$$

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

$$v^2 = v_0^2 - 2gy \rightarrow y = \frac{v_0^2}{2g} \rightarrow y \, \alpha \, v_0^2$$

$$\frac{y_s}{y_b} = \left(\frac{v_{0s}}{v_{0b}}\right)^2 = \left(\frac{20}{10}\right)^2 = 4 \rightarrow y_s = 4H$$

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°

$$A.B = (i + j).(i - j) = 1 - 1 = 0 \rightarrow \textit{the answer is } E$$

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) $-8.0\hat{j}$

$$A - B = -4k$$

$$\left(A - B\right) \times A = -4k \times (2i - 3k) = -4k \times 2i = -8j$$

8. In Fig 1, $\vec{A} = (12m, 60°)$ and $\vec{B} = (8m, 300°)$. The x component of $(\vec{A} - \vec{B})$ is:

A) 8 m
B) 10 m
C) 2 m
D) 14 m
E) 15 m

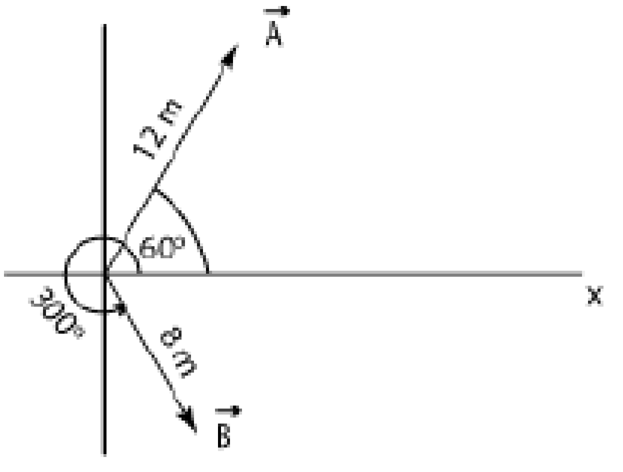


Figure 1

$$(A - B)_x = A_x - B_x$$

$$12\cos(60) - 8\cos(300) = 2\ m$$

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

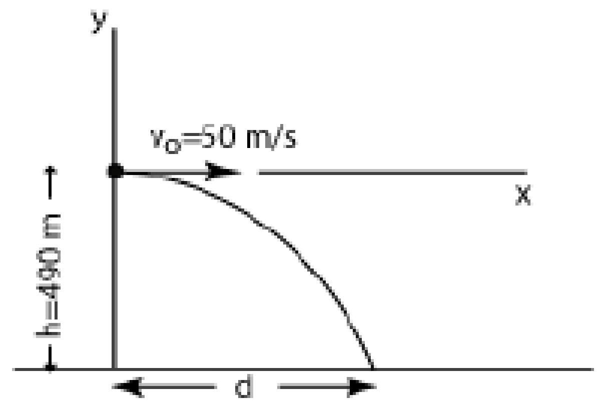


Figure 2

$$on\ y-axis:$$

$$v_0 = 0,\ y = -490\ m,\ a = -g \rightarrow t = ?$$

$$y = v_0 t - \tfrac{1}{2} g t^2 \rightarrow -490 \times 2 = -9.8 t^2 \rightarrow t = 10\ s$$

$$on\ x-axis:$$

$$x = v_x t = 50 \times 10 = 500\ m$$

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) $40\hat{i} + 35\hat{j}\quad m/s$

$$\vec{v} = \overrightarrow{v_0} + \vec{a}t = 40i + 5.0(-8.0i + 7.0\,j)$$

$$= 40i - 40i + 35\,j = 35\,j$$

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

$$r = 3.0 \quad T = 4.7s$$

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

$$then \quad a = \frac{v^2}{r} = 5.36\ m/s^2$$

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

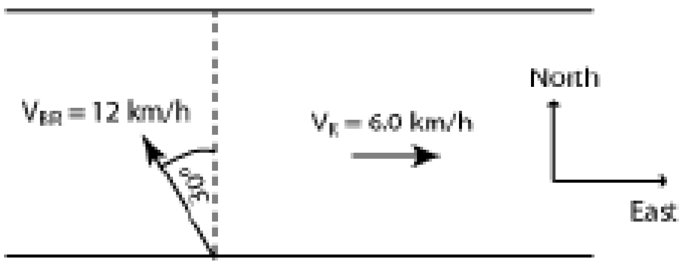


Figure 3

$$v_{BR} = -12\sin(30)i + 12\cos(30)j = -6i + 10j$$

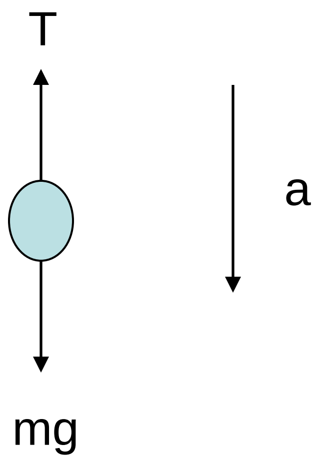
$$v_{RG} = 6i$$

$$v_{BG} = ?$$

$$v_{BG} = v_{BR} + v_{RG} = 10j \quad (that\ is\ due\ north)$$

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

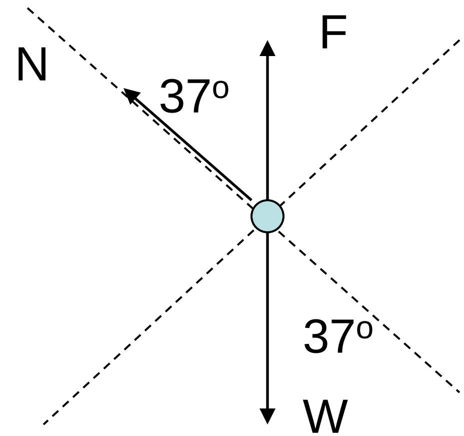


$$mg - T = ma$$

$$T = m(g - a) = 5.0(9.8 - 2.8) = 35\,N$$

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/s² up the incline
B) 5.9 m/s² up the incline
C) 2.9 m/s² down the incline
D) 8.7 m/s² down the incline
E) 4.4 m/s² down the incline



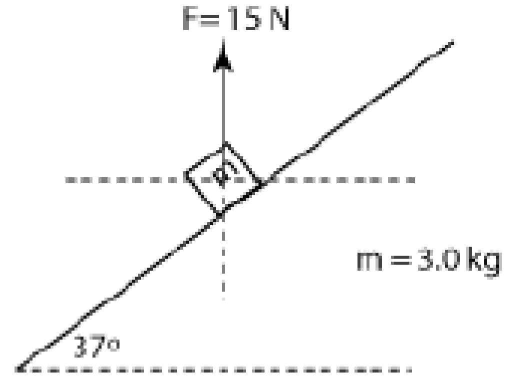


Figure 4

$$F_x = 15\sin(37) = 9.0\ N$$

$$W_x = 3.0 \times 9.8 \times \sin(37) = 18\ N$$

$$Net\ force\ is\ down\ F_{net\ x} = W_x - F_x = 9.0\ N$$

$$acceleration\ is\ down = \frac{F_{net\ x}}{m} = \frac{9.0}{3.0} = 3.0\ m/s^2$$

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

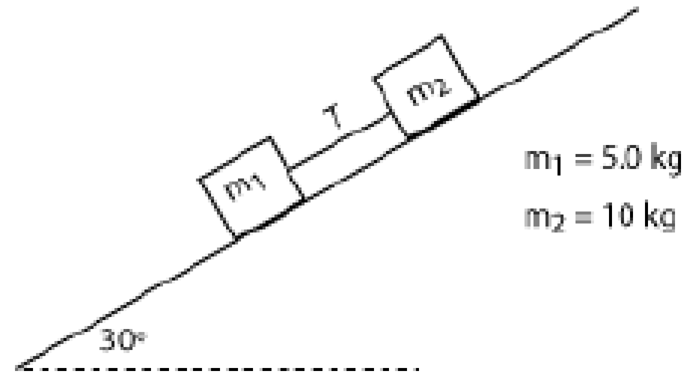
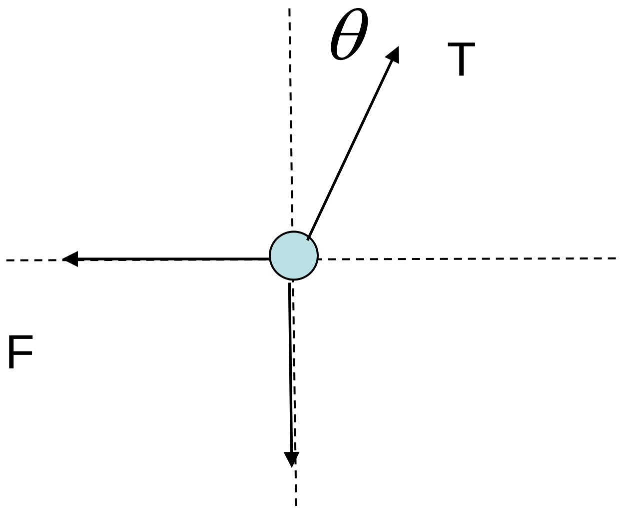


Figure 5

T=0

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



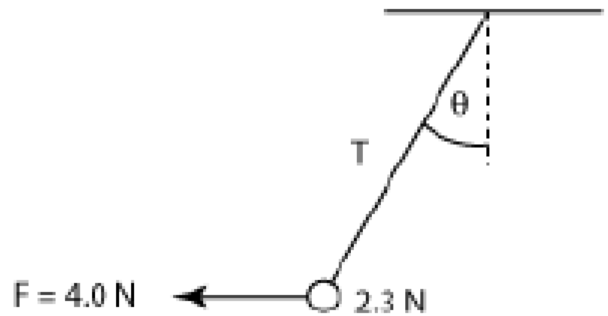


Figure 6

$$T\ \cos(\theta) = mg$$

$$T\ \sin(\theta) = F$$

$$\tan(\theta) = \frac{F}{mg} \rightarrow find\ \ \theta \rightarrow then\, T$$

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°

$$\tan(\theta) = \mu_s = 0.30$$

$$\theta = 16.7^o$$

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

$$f_s = \frac{mv^2}{R}$$

$$f_s = f_{s,\max} = \mu_s N = \mu_s mg$$

$$\frac{mv^2}{R} = \mu_s mg \rightarrow find\ v$$

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

$$f_{s,\max} = \mu_s N = \mu_s mg = 0.4 \times 5.0 \times 9.8 = 19.6\ N$$

$$F \text{ less than } f_{s,\max} \rightarrow f_s = F = 15.0\ N$$

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) $40\hat{i}\ N$

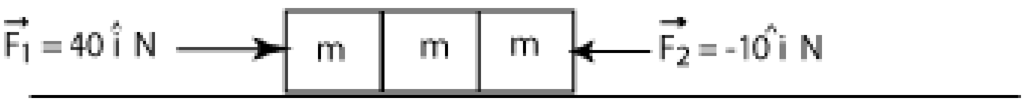


Figure 7

$$a = \frac{F_{net}}{M} = \frac{40i - 10i}{3 \times 2.0} = \frac{30i}{6.0} = 5.0i$$

$$F\left(on\ the\ middle\ mass\right) = ma = 2.0 \times 5.0i = 10i$$