Skill 21 – Force Vectors, Resultant, Equilibrant - Practice Questions

48. 2kg object experiences three concurrent forces.

5N to the right 10N to the left 3N to the right

+ right

5 N (−10N) 3N

Simplify by -
- combine same direction
- combine same axis

a. What is the net force acting on the 2 kg object?

$5N + (-10N) + 3N = -2N$ → 2N left

b. What is the magnitude and direction of the acceleration?

$a = \frac{F_{Net}}{m} = \frac{-2N}{2kg} = -2 m/s^2$ → $2 m/s^2$ left

49. A force of 20 N acts at an angle of 30 degrees. What are the horizontal and vertical components of the force?

$F_A = 20N$, $\theta = 30°$

$F_{Ax} = ?$ $F_{Ax} = F_A \cos\theta = 20N \cos 30° = 17.3N$

$F_{Ay} = ?$ $F_{Ay} = F_A \sin\theta = 20N \sin 30° = 10N$

50. A force acts at an angle of 60 degrees. The horizontal component of the force is 20N. What is the magnitude of the applied force (resultant)?

$\theta = 60°$

$F_{Ax} = 20N$

$F_A = ?$

$F_{Ax} = F_A \cos\theta$

$F_A = \frac{F_{Ax}}{\cos\theta} = \frac{20N}{\cos 60°} = 40N$

51. A 5N force east and 10N force west act concurrently on an object. What is the net force acting on the object?

$F_{x1} = 5N$

$F_{x2} = -10N$

$F_{Net} = F_{x1} + F_{x2} = 5N + -10N = -5N$

5N west

52. A force of 10 N north and 3 N west act concurrently on an object. What is the resultant of these forces? What is the equilibrant of these forces?

Q2 $F_y = 10N$, $F_x = -3N$, $F = ?$ magnitude & direction

$F_{net} = \sqrt{F_y^2 + F_x^2}$

$= \sqrt{(10N)^2 + (-3N)^2}$

$= \sqrt{100N^2 + 9N^2} = \sqrt{109N^2} = 10.44N$ resultant

$\theta = \tan^{-1}\left(\frac{F_y}{F_x}\right) = \tan^{-1}\left(\frac{10N}{3N}\right) = 73.3°$ above west $= 106.7°$

Equilibrant = 10.44N @ 286.7°

53. If a pair of dogs on leashes pull on the person they are walking, with a force of 100N west and 150N north, what is the equilibrant force required to keep the person at rest?

$F_x = -100N$

$F_y = 150N$

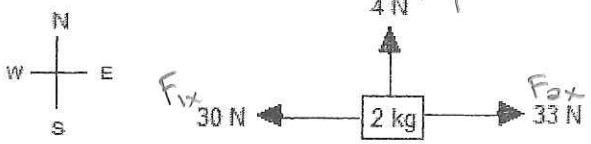
$F = \sqrt{F_x^2 + F_y^2} = \sqrt{(100N)^2 + (150N)^2} = 180.3N$

$\theta = \tan^{-1}\left(\frac{F_y}{F_x}\right) = \tan^{-1}\left(\frac{150N}{-100N}\right) = -56.3°$ in Q2 or $123.7°$

equal in magnitude opposite in direction

$73.3° Q4$

54. The following diagram (**an overhead view**) shows 3 forces acting on a block having a mass of **2 kg**. Determine the acceleration (magnitude and direction) of the mass as a result of the 3 forces.



$F_{netx} = F_{ix} + F_{ox} = -30N + 33N = 3N$

$F_{nety} = F_{iy} = 4N$

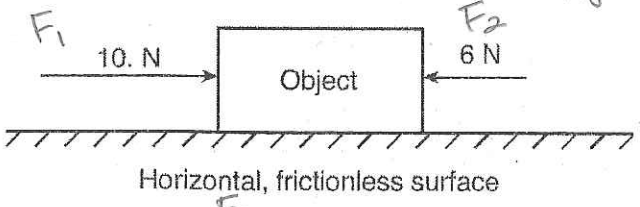
$F = \sqrt{F_x^2 + F_y^2} = \sqrt{(3N)^2 + (4N)^2} = 5N$

$\theta = \tan^{-1}\left(\frac{F_y}{F_x}\right) = \tan^{-1}\left(\frac{4N}{3N}\right) = 53.13°$

$a = \frac{F_{Net}}{m} = \frac{5N}{2kg} = 2.5 m/s^2 @ 53.13°$

Skill 21-Force Vectors

55. Two forces act concurrently on an object on a horizontal, frictionless surface, as shown in the diagram below.



+right

Equilibrium means $F_{Net} = 0$

So $F_{Net} = F_1 + F_2 + F_3$

$0 = 10N + (-6N) + F_3$

$F_3 = -4N$

What additional force, when applied to the object, will establish equilibrium?

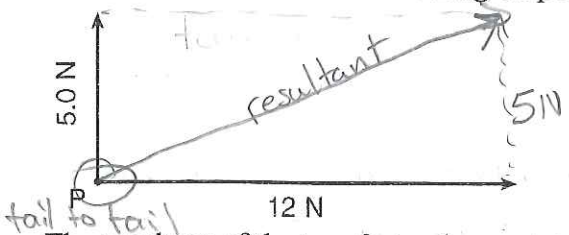
A) 16 N toward the right
B) 16 N toward the left
C) 4 N toward the right
D) 4 N toward the left

56. Two 20.-newton forces act concurrently on an object. What angle between these forces will produce a resultant force with the greatest magnitude?

A) 0°
B) 45°
C) 90.°
D) 180.°

0° means same direction

57. The diagram below represents a 5.0-newton force and a 12-newton force acting on point P.



The resultant of the two forces has a magnitude of

~~A) 5.0 N~~
~~B) 7.0 N~~
~~C) 12 N~~
D) 13 N

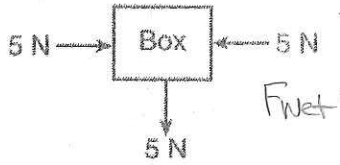
~~5N + 12N = 17N~~ hypotenuse must be bigger than either side

$F = \sqrt{F_x^2 + F_y^2} = \sqrt{(5N)^2 + (12N)^2}$

$= 13N$

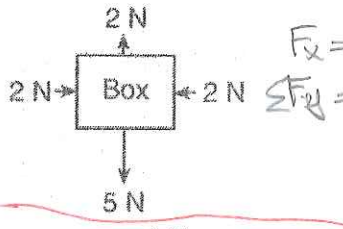
58. Which diagram represents a box in equilibrium?

A)



$F_{Net} = 5N$ South

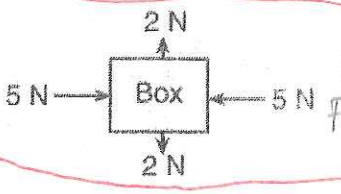
B)



$F_x = 2N + 2N$

$\Sigma F_y = -5N + 2N = -3N$

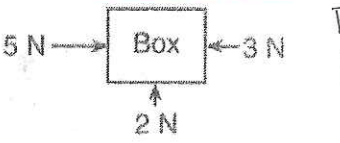
C)



$F_x = 5N + -5N = 0$

$F_y = 2N + -2N = 0$

D)



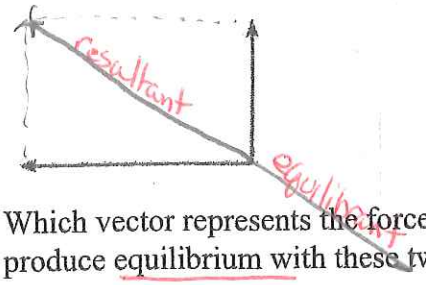
$F_x = 2N$

$F_y = 2N$

$F_{Net} = \sqrt{(2N)^2 + (2N)^2}$

Skill 21-Force Vectors

59. The diagram below represents two concurrent forces.



Which vector represents the force that will produce equilibrium with these two forces?

→ means equilibrant

A)

B)

C)

equilibrant is equal magnitude but opposite direction (180°) from resultant

D)

60. Which combination of three concurrent forces acting on a body could *not* produce equilibrium?

A) 1 N, 3 N, 5 N
B) 2 N, 2 N, 2 N
C) 3 N, 4 N, 5 N
D) 4 N, 4 N, 5 N

The combination of any 2 vectors should have a max sum (0°) or min sum (180°) that includes the 3rd

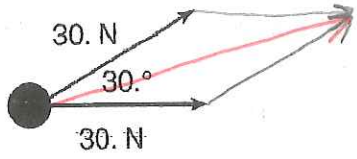
A) 1N & 3N max = 4N min = 2N can't be 5N
1N & 5N max = 6N min = 4N can't be 3N
3N & 5N max = 8N min = 2N can't be 1N

But
C) 3N + 4N = 1 N up to 7N (5N ok)
B) 2N + 2N = 4N to 0N (2N ok)
D) 4N + 4N = 8N to 0N (5N ok)

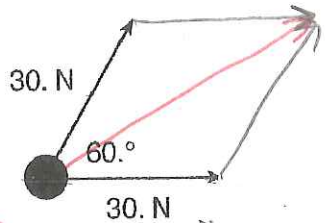
61. Two 30.-newton forces act concurrently on an object. In which diagram would the forces produce a resultant with a magnitude of 30. newtons?

all set up tail to tail

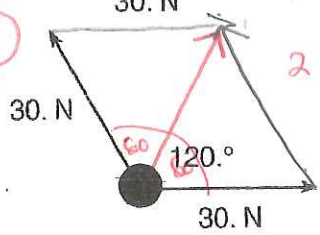
A)



B)

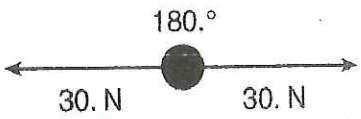


C)



2 equilateral triangles 30N each side

D)



0

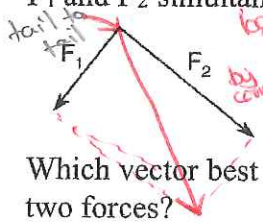
62. Which pair of concurrent forces could produce a resultant force having a magnitude of 10. Newtons?

A) 10. N. 10. N
B) 10. N. 30. N
C) 4.7 N. 4.7 N
D) 4.7 N. 5.0 N

10N in range

A) 10N & 10N max 20N, min 0N
B) 10N & 30N max 40N, min 20N
C) 4.7N & 4.7N max 9.4N min 0N
D) 4.7N & 5.0N max 9.7N min .3N

63. The vector diagram below represents two forces, F_1 and F_2 simultaneously acting on an object.

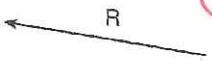


begin F_1 = down & left

by comparison F_2 = more down & more right

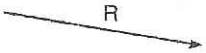
so result is a little right & a lot down

Which vector best represents the resultant of the two forces?

A) 

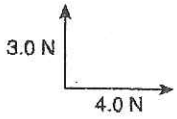
B) 

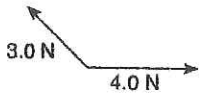
C) 

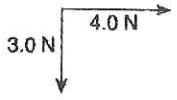
D) 

64. A 3.0-newton force and a 4.0-newton force act concurrently on a point. In which diagram below would the orientation of these forces produce the greatest net force on the point?

A) 

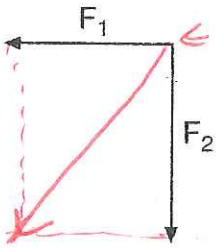
B) 

C) 

D) 

max R is always smallest difference in angle (most similar direction)

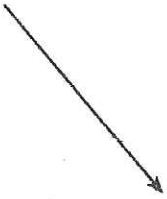
65. A force vector was resolved into two perpendicular components, F_1 and F_2, as shown in the diagram below.



← tail to tail

Which vector best represents the original force?

A) 

B) 

C) 

D) 

66. If two 10.-newton concurrent forces have a resultant of zero, than the angle between the forces must be

A) 0° B) 45° C) 90° D) 180°

min max opposite

67. Two concurrent forces act at right angles to each other. If one of the forces is 40 Newtons and the resultant of the two forces is 50 Newtons, the magnitude of the other force must be

A) 10 N B) 20 N C) 30 N D) 40 N

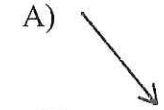
F_1 (x or y) = 40N
F_2 (the other one) = ?
F_{net} = 50N

$F_{net}^2 = F_x^2 + F_y^2$
$(50N)^2 = (40N)^2 + F_y^2$
$F_y = 30N$

68. Forces *A* and *B* have a resultant *R*. Force *A* and resultant *R* are shown in the diagram below.

A + B = R
?

Which vector below best represents force *B*?

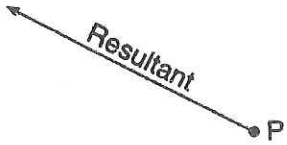
A)


B)

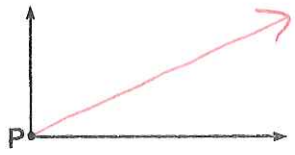

C)

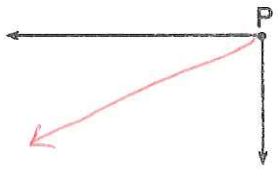

D)

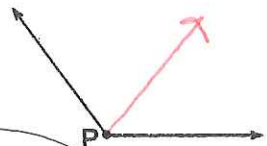
69. The vector below represents the resultant of two velocities acting concurrently on an object at point *P*.

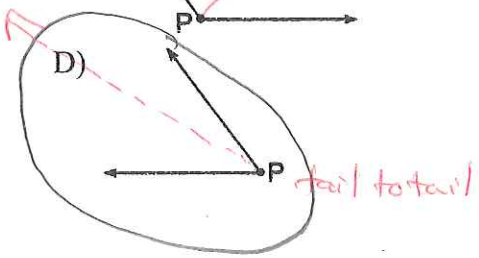


Which pair of vectors best represents two concurrent velocities that combine to produce this resultant vector?

A)


B)


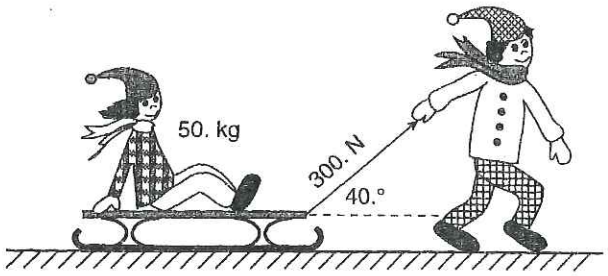
C)


D)


70. A 5.0-newton force could have perpendicular components of

A) 1.0 N and 4.0 N B) 2.0 N and 3.0 N
C) 3.0 N and 4.0 N D) 5.0 N and 5.0 N

71. The diagram below shows a child pulling a 50.-kilogram friend on a sled by applying a 300.-newton force on the sled rope at an angle of 40.° with the horizontal.



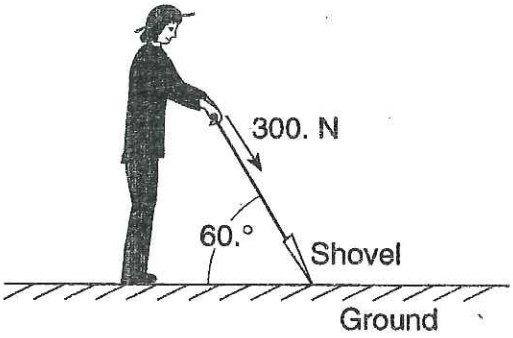
The vertical component of the 300.-newton force is approximately

A) 510 N
B) 230 N
C) 190 N
D) 32 N

$F_{Ay} = F_A \sin\theta$

$F_{Ay} = 300N \sin 40° = 193N$

72. The diagram below shows a person exerting a 300.-newton force on the handle of a shovel that makes an angle of 60.° with the horizontal ground.



The component of the 300.-newton force that acts perpendicular to the ground is approximately (ie F_{Ay})

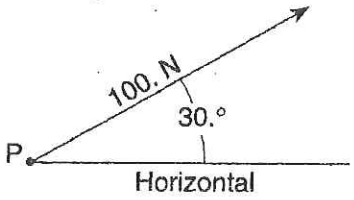
A) 150. N
B) 260. N
C) 300. N
D) 350. N

$F_{Ay} = F_A \sin\theta$

$F_{Ay} = 300N \sin 60°$

$F_{Ay} = 260N$

73. A 100.-newton force acts on point P, as shown in the diagram below.



The magnitude of the vertical component of this force is approximately

A) 30. N
B) 50. N
C) 71 N
D) 87 N

$F_{Ay} = F_A \sin\theta$

$F_{Ay} = 100N \sin 30°$

$= 50N$

74. As the angle between a force and level ground decreases from 60° to 30°, the vertical component of the force

A) decreases
B) increases
C) remains the same

$\sin 60° > \sin 30°$

75. A resultant force of 10. Newtons is made up of two component forces acting at right angles to each other. If the magnitude of one of the components is 6.0 Newtons, the magnitude of the other component must be

A) 16 N
B) 8.0 N
C) 6.0 N
D) 4 N

$F = 10N$

$F_x = 6N$ (pick either x or y)

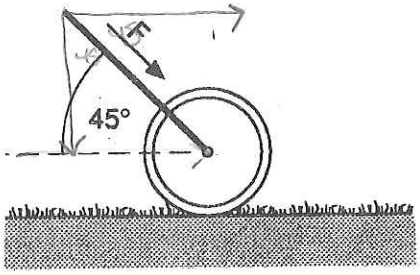
$F_y = ?$

$F^2 = F_x^2 + F_y^2$

$10N^2 = 6N^2 + F_y^2$

$F_y^2 = 64N$ $F_y = 8N$

76. The handle of a lawn roller is held at 45° from the horizontal. A force, F, of 28.0 Newtons is applied to the handle as the roller is pushed across a level lawn, as shown in the diagram below.



What is the magnitude of the force moving the roller forward?

A) 7.00 N B) 14.0 N
C) 19.8 N ~~D) 39.0 N~~

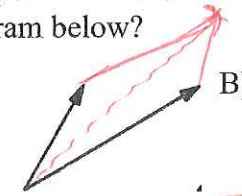
$F = 28N$ $\theta = 45°$ $F_{Ax} = ?$

$F_{Ax} = F_A \cos\theta = 28N \cos 45° = 19.8N$

use protractor

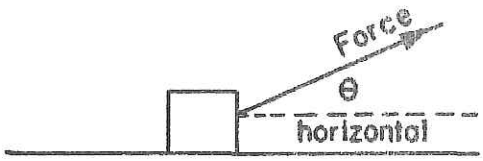
77. If the force vector shown in the diagram above is resolved into two components, these two components could best be represented by which diagram below?

A) B)



C) D)

78. A constant force is exerted on a box as shown in the diagram.



As the angle θ decreases to 0° , the magnitude of the horizontal component of the force

A) decreases
B) increases
C) remains the same

cos θ gets bigger as θ gets smaller

79. Which quantity is scalar?

A) mass B) force vector
C) momentum vector D) acceleration vector

80. Which pair of terms are vector quantities?

A) force and mass (vector, scalar)
B) distance and displacement (scalar, vector)
C) momentum and acceleration (vector, vector)
D) speed and velocity (scalar, vector)