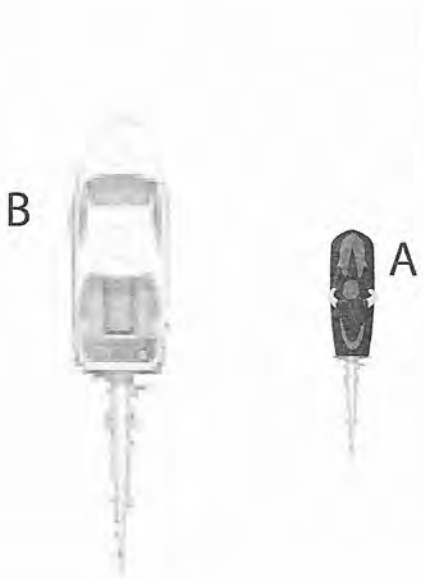
	Total	K+E	I+O
Student	37	19	18
Average	23.9/50	23.2/50	24.7/50
Best	43.0/50	36.5/50	43.0/50

11th Physics (2018 – 19)

(1stQ, #2 Mini Test)

Class	No.	Name Solutions



In calculation problems, describe equations clearly and systematically enough to show how to solve the problems. If not enough, you won't get any points.

Gravitational acceleration rate	$g = 9.80\ m/s^2$
The density of pure water	ρ (water) $= 1000\ kg/m^3$
The density of steel	ρ (steel) $= 8050\ kg/m^3$

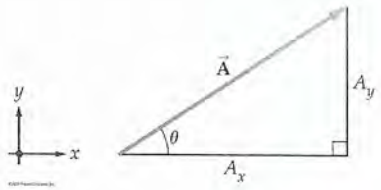
4 pt/question x 13 questions = 52 pt Max 50 pt

/[Total 50 pt]

10/18/2018 By Tohei Moritani

Keio Academy of New York

(1) Find A_x and A_y for the vector $\vec{A}$ with magnitude and direction given by A = 5.7 cm and $\theta = 46°$, respectively.



(Equations)

$A_x = 5.7 \cos 46° = 3.96 \longrightarrow 4.0$

$A_y = 5.7 \sin 46° = 4.10 \longrightarrow 4.1$

(1) Answer

$A_x = 4.0$ cm

$A_y = 4.1$ cm

(92%)

(2) Find B and θ for the vector $\vec{B}$ with components B_x = 25.5 cm and B_y = −16.2 cm.

(Equations)

$B = \sqrt{B_x^2 + B_y^2}$

$= \sqrt{25.5^2 + (-16.2)^2}$

$= 30.21 \longrightarrow 30.2\ (cm)$

$\theta = \tan^{-1}\left(\frac{B_y}{B_x}\right)$

$= \tan^{-1}\left(\frac{-16.2}{25.5}\right)$

$= -32.43$

$360° - 32.43° = 327.57°$

$\longrightarrow 327.6°$

(2) Answer

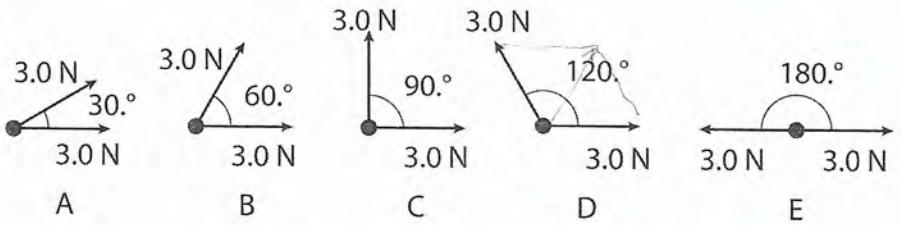
$B = 30.2$ cm

$\theta = 327.6°$

or $\theta = -32.4°$

(55%)

(3) Two 3.0-N forces act on an object. In which diagram would the forces produce a net force with a magnitude of 3.0 N?



(3) D

(43%)

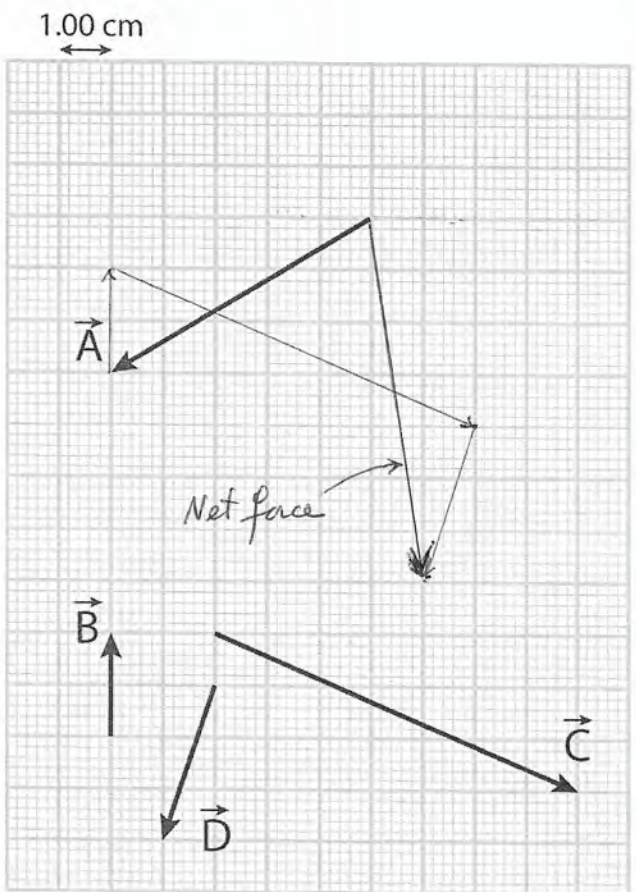
(4) Determine the net of the four forces, $\vec{A}$, $\vec{B}$, $\vec{C}$ and $\vec{D}$ by using the graphical method. Find the magnitude of the net vector.

(Equations)

$F = \sqrt{1^2 + 7^2}$

$= 7.071$

$\rightarrow 7.07$ (cm)

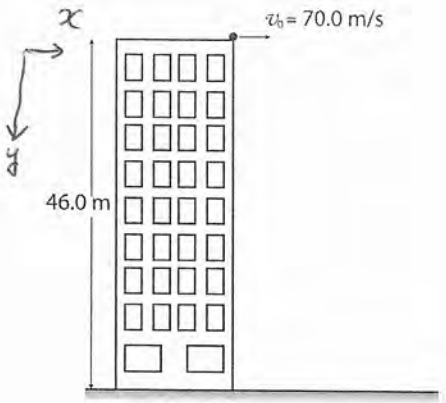


(4) Answer Draw inside above.

Magnitude: 7.07 cm

(50%)

(5,6) A bullet is fired horizontally from a height of 46.0 m at a speed of $v_0 = 70.0$ m/s.
(5) How long does the bullet take to hit the ground? Assume that the ground is flat and the effect of air is negligible.
(6) How far does the bullet travel horizontally? Answer the distance from the bottom of the building to the place the bullet hit the ground.
(Equations)



(5) $y = \frac{1}{2} g t^2$

$\rightarrow t = \sqrt{\frac{2y}{g}} = \sqrt{\frac{2 \times 46.0}{9.80}}$

$= 3.064 \longrightarrow 3.06\ (s)$

(6) $x = v_0 t$

$= 70.0 \times 3.064$

$= 214.47 \rightarrow 214$

(5) Answer: 3.06 s (42%)

(6) Answer: 214 m (29%)

(7) A golfer tees off on level ground, giving the ball an initial speed of $v_0 = 43.0$ m/s and an initial direction of $\theta = 41.0^\circ$ above the horizontal.
(7-a) What are the horizontal and vertical components of the initial speed?
(7-b) How far does it travel before it hit the ground?
(Equations)

(a) $v_{ox} = 43.0 \cos 41.0^\circ$

$= 32.453 \longrightarrow 32.5$ (m/s)

$v_{oy} = 43.0 \sin 41.0^\circ$

$= 28.21 \longrightarrow 28.2$ (m/s)

(b)

$y = v_{oy} t - \frac{1}{2} g t^2, \quad y = 0$

$v_{oy} - \frac{1}{2} g t = 0$

$t = \frac{2 v_{oy}}{g} = \frac{2 \times 28.21}{9.80} = 5.757$

$x = v_{ox} t$

$= 32.453 \times 5.757$

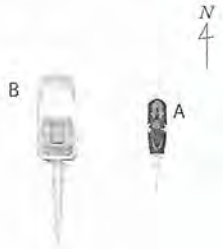
$= 186.8$

$\longrightarrow 187$

(7-a) Answer Horizontal:	32.5 m/s
Vertical:	28.2 m/s
(7-b) Answer	187 m

(55%)

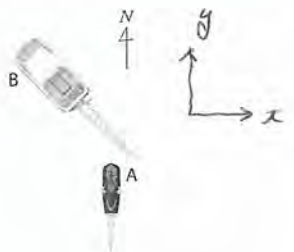
(8-a) On a calm lake a jet ski-A is moving due north at a speed of 15 m/s. A motorboat-B is traveling also due north at a speed of 12 m/s. How does the driver on the jet ski-A experience the velocity (magnitude and direction) of B?



8-a

(8-a) Next, the jet ski-A is moving due north at a speed of 15 m/s while the motorboat-B is traveling to northwest at a speed of 12 m/s. How does the driver on the jet ski-A experience the velocity (magnitude and direction) of B?

(Equations)



8-b

(a) $v_{BA} = v_B - v_A$

$= 12 - 15$

$= -3 \ (m/s)$

(b) $\vec{v}_{BA} = \vec{v}_B - \vec{v}_A$

$v_x = v_{Bx} - v_{Ax}$

$v_y = v_{By} - v_{Ay}$

$v_{Bx} = -12\cos 45^\circ = -\frac{12}{\sqrt{2}} = -\frac{12\sqrt{2}}{2}$ $\quad v_{Ax} = 0$

$v_{By} = 12\sin 45^\circ = \frac{12}{\sqrt{2}} = \frac{12\sqrt{2}}{2}$ $\quad v_{Ay} = 15$

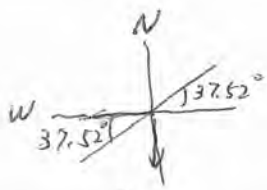
$v_x = -6\sqrt{2} = -8.485$ $\quad v_y = 6\sqrt{2} - 15 = -6.515$

$v = \sqrt{v_x^2 + v_y^2}$

$= \sqrt{8.485^2 + 6.515^2} = 10.7 \rightarrow 11 \ (m/s)$

$\theta = \tan^{-1}\left(\frac{v_y}{v_x}\right) = \tan^{-1}\left(\frac{-6.515}{-8.485}\right)$

$= 37.52^\circ \rightarrow 38^\circ$



(8-a) Answer

3 m/s

to due south

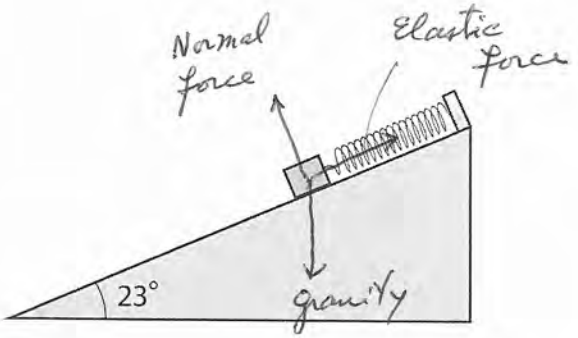
(8-b) Answer

11 m/s

38° South from west

(43%)

(9) A body with a mass of 4.00 kg is at rest on a frictionless slope. Illustrate force vectors acting on this body with their names.



(9) Answer Show your answer in the figure. (58%)

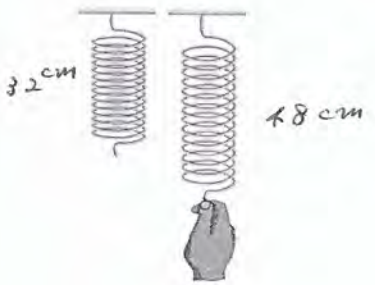
(10) A spring has an original length of 32 cm and force constant of 25 N/m. When you stretch it slowly as shown in the figure, the total length becomes 48 cm. What is the magnitude of the elastic force that exerts on your hand?

(Equations)

$F = kx$

$= 25 \times (48 - 32) \times 10^{-2}$

$= 4.00 \rightarrow 4.0$

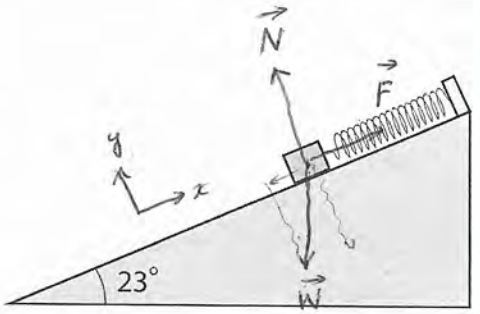


(10) Answer

4.0 N

(71%)

(11) A body with a mass of 4.00 kg is at rest on a frictionless slope. The spring shows an elongation of 15.0 cm from its original length. What is the spring constant of this spring?
(Equations)



$$\vec{N} + \vec{F} + \vec{W} = 0$$

$$\begin{cases} N_x + F_x + W_x = 0 \\ N_y + F_y + W_y = 0 \end{cases}$$

$N_x = 0 \quad N_y = N$

$F_x = F \quad F_y = 0$

$W_x = -W \sin 23^\circ = -4.00 \times 9.80 \sin 23^\circ = -15.32$

$W_y = -W \cos 23^\circ = -4.00 \times 9.80 \cos 23^\circ = -36.08$

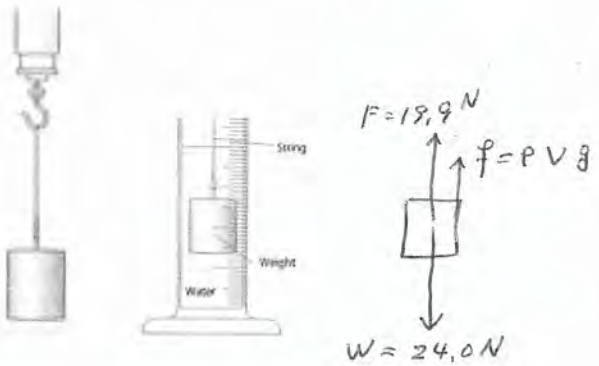
$0 + F - 15.32 = 0 \longrightarrow F = 15.32\ (N)$

$k = \dfrac{F}{x} = \dfrac{15.32}{15.0 \times 10^{-2}} = 102 \longrightarrow 100$

(11) Answer
100 N/m

(16 %)

(12) A weight is attached to a spring scale. When the weight is suspended in air, the scale reads 24.0 N; when it is completely immersed in water, the scale reads 19.9 N.
(12-a) What is the volume of this weight?
(12-b) What is the density of the weight?
(Equations)



(a)

$19.9 + \rho V g = 24.0$

$V = \dfrac{24.0 - 19.9}{1000 \times 9.80}$

$= \dfrac{4.10}{9800} = 4.18 \times 10^{-4}\ m^3$

$\rightarrow 4.2 \times 10^{-4}\ m^3$

$= 420\ cm^3$

(b)

$\rho = \dfrac{m}{V}$ $\quad m = \dfrac{24.0}{9.80} = 2.449\ (kg)$

$\rho = \dfrac{2.449}{4.18 \times 10^{-4}} = 5854 \rightarrow 5900\ (kg/m^3)$

(12-a) Answer	$4.2 \times 10^{-4}\ m^3$
(12-b) Answer	$5900\ kg/m^3$

(20%)

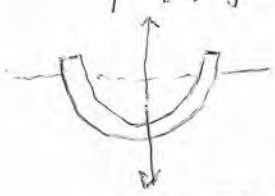
(13) The mass of the largest aircraft carrier has the mass of 97,000 tons. It is mainly made of steel.
[13-a] Why can such a heavy ship float on water? Explain using (a) key word(s) of physics.
(13-b) What kind of structure can such a heavy ship float on water? Explain quantitatively. (= Explain with numerical values.).

[Q5-a] Answer

Because the buoyant force works upward.

(Equations)

$F = \rho V g = 1000 \times V \times 9.80\ N$



$F = mg = 97\times10^6 \times 9.80\ N$

Equilibrium

$1000\,V = 97\times10^6$

$V = 97\times10^3$

$= 9.7\times10^4\ m^3$

(24%)

(13-b) Answer

The 97,000-ton ship can float when at least $9.7\times10^4\ m^3$ vacant space is included inside the ship.