	Total	K+E	I+C
Student	31	15	16
Average	65.7/100	62.6/100	68.6/100
Best	94.5/100	94.5/100	86.0/100

11thG Physics (2019– 20)

1st Q Exam- Honors

(October 29, 2019)

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.

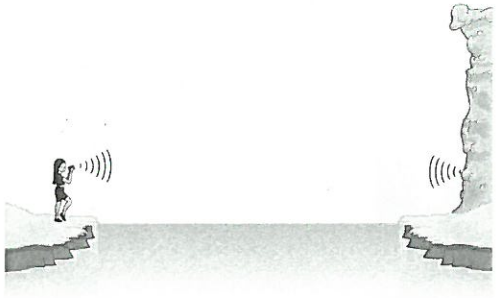
5 points/problem x 21 problems= 105 points(Max 100 points)

Exam ／[Total 100 点]

Number of Lab Reports	/4	Score	Homework	Score

The circular constant	$\pi = 3.14159...$
Mile	1 mile = 1609 m
Gravitational acceleration rate	$g = 9.80\ m/s^2$
The Density of Fresh Water	1,000 kg/m^3
The Density of Sea Water	1,025 kg/m^3
The Density of Ice	917 kg/m^3
The Density of Air	1.29 kg/m^3
The Density of Helium	0.179 kg/m^3
Atmospheric Pressure	1 atm = 1.013 x 10^5 Pa

(1) A woman standing in front of a cliff claps her hands, and 2.50 s later she hears an echo. How far away is the cliff? Assume that the speed of sound is 343 m/s.



(Equations)

$$v = \frac{d}{t}$$

$$\rightarrow d = vt$$

$$= 343 \times 2.50$$

$$= 857.50$$

$$\frac{d}{2} = 428.75 \longrightarrow 429\ (m)$$

858 m
+2

(1) Answer

429 m

(57%)

(1-a) Answer

(2) You drive a straight line at 20.0 m/s for 10.0 min, then at 30.0 m/s for another 20.0 min. Find the average speed for entire drive.

(Equations)

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time}}$$

$$= \frac{20.0\ m/s \times 10.0\ min \times 60\ s/min + 30.0\ m/s \times 20.0\ min \times 60\ s/min}{(10\ min + 20\ min) \times 60\ s/min}$$

$$= \frac{12000\ m + 36000}{1800\ s}$$

$$= \frac{48,000\ m}{1800\ s}$$

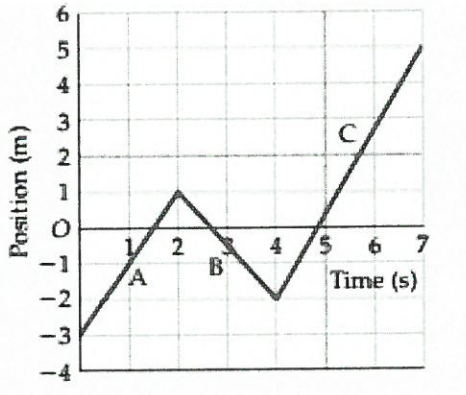
$$= 26.67\ m/s \longrightarrow 26.7\ m/s$$

(2) Answer

26.7 m/s

74%

(3) A small-gage train moves slowly back and forth along a straight segment of track. The position-time graph for the train is shown in the figure at the right.



(3-a) During which portion of its motion – A, B, or C – does the train have the smallest speed?

(3-b) What is the average velocity of the train from t = 0 to t = 7.0 s?

(Equations)

(3-a) A $v_A = \frac{4\ m}{2\ s} = 2\ m/s$

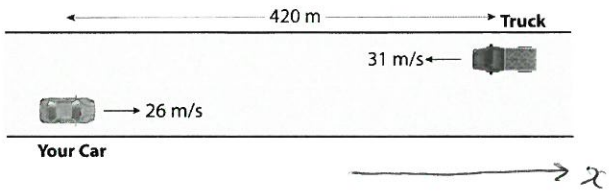
B $v_B = \frac{3\ m}{2\ s} = 1.5\ m/s$ B is the smallest

C $v_C = \frac{7\ m}{3\ s} = 2.3\ m/s$

(3-b) $v = \frac{\Delta x}{t} = \frac{5.0 - (-3.0)}{7.0} = 1.14 \longrightarrow 1.1\ m/s$

(3-a)	B
Answer (3-b)	1.1 m/s

84%



(4, 5) You are riding in a car on a straight stretch of a two-lane highway with a speed of 26 m/s. At a certain time, which we will choose be t = 0, you notice a truck moving toward you in the other lane. The track has a speed of 31 m/s and is 420 m away at t = 0.

(4-a) Write the position time equations of motion for your car and for the truck in the other lane.

(4-b) At what time do you and the truck pass one another, going in opposite direction?

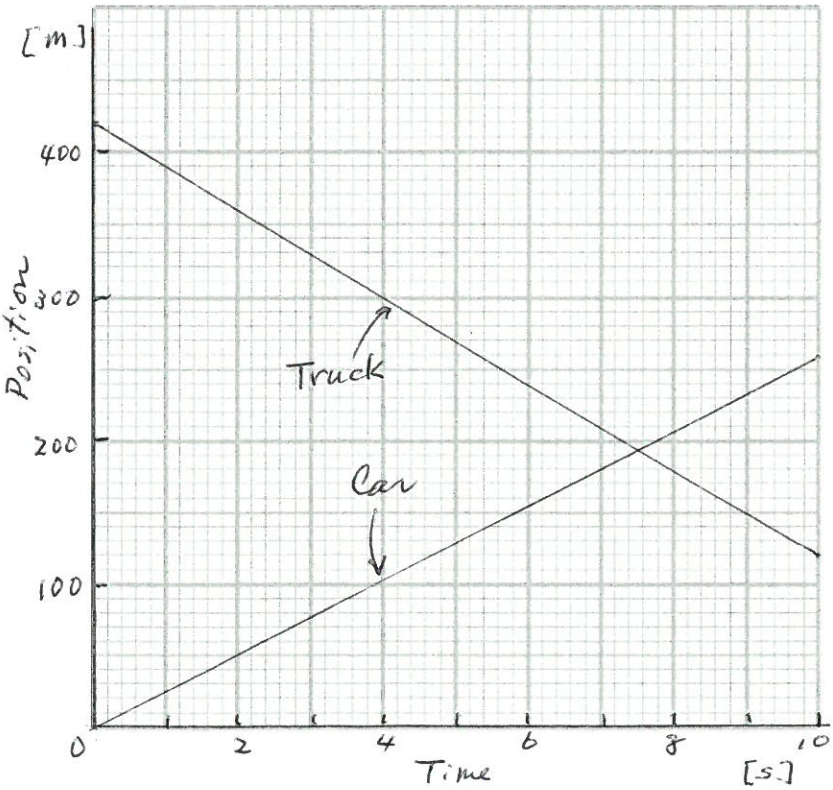
(5) Plot the two equations of motion on a position-time graph.

(Equations)

$26t = 420 - 31t$

$57t = 420$

$t = 7.37 \rightarrow 7.4\ s$



(4-a) Answer

Car $x = (26\ m/s)\,t$

Truck $x = 420\ m - (31\ m/s)\,t$

83%

(4-b) Answer

7.4 s

81%

(5) Answer Draw the graph at the left.

(6) When a jumbo jet takes off, it runs at an acceleration rate of 2.2 m/s^2 and floats up off the runway at a speed of 90,m/s in case of a windless condition.

(6-a) How long does it take to float up off the runway after starting?

(6-b) How far does the jet run on the runway?
(Equations)

(a) $v_f = v_i + at$

$$t = \frac{v_f - v_i}{a}$$

$$= \frac{90.0 - 0}{2.2}$$

$$= 40.9 \longrightarrow 41(s)$$

(b) $v_f^2 - v_i^2 = 2ay$

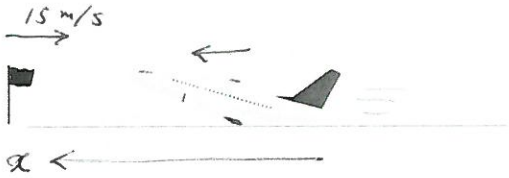
$$y = \frac{v_f^2 - v_i^2}{2a}$$

$$= \frac{90^2 - 0}{2 \times 2.2}$$

$$= 1841\ m \longrightarrow 1.8\ km$$

(6-a) Answer
41 s
(6-b) Answer
1.8 km

84%



(7) In case of a windy condition, a jet runs at an acceleration rate of 2.2 m/s² and floats up when its relative velocity to the air reaches 90 m/s. A jet is running toward windward in wind blowing at 15 m/s.

(7-a) What is the speed of the jet relative to the ground when the jet floats up?

(7-b) How far does the jet run on the runway?
(Equations)

(a) $v_{PG} = v_{PA} + v_{AG}$

$= 90 + (-15)$

$= 75 \ (m/s)$

(b) $v_f^2 - v_i^2 = 2ax$

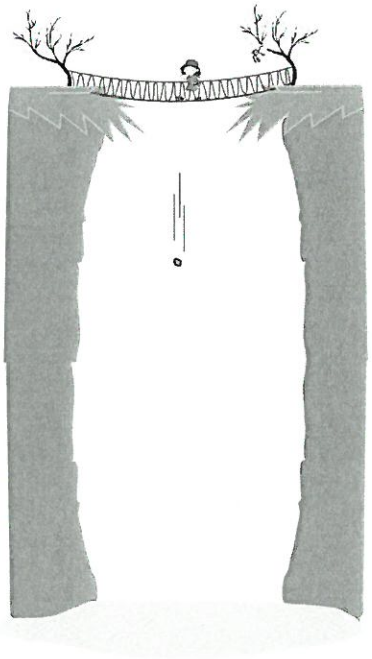
$x = \dfrac{v_f^2 - v_i^2}{2a}$

$= \dfrac{75^2 - 0}{2 \times 2.2}$

$= 1278 \ (m) \longrightarrow 1.3 \ km$

(7-a) Answer
75 m/s
(7-b) Answer
1.3 km

90%



(8) You dropped a stone freely from the suspension bridge. You saw a splash 2.3 seconds after you had dropped the stone.

(8-a) Find the distance between the bridge and the water surface.

(8-b) Find the speed just before hitting the water surface.
(Equations)

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

$= \frac{1}{2} \times 9.80 \times 2.3^2$

$= 25.9 \longrightarrow 26\ m$

(b) $v_f = v_i + gt$

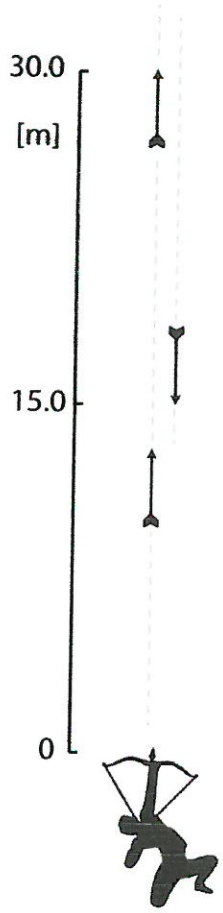
$= 0 + 9.80 \times 2.3$

$= 22.54 \longrightarrow 23\ m/s$

(8) Answer
(8-a) 26 m
(8-b) 23 m/s

81 %

(9, 10) You shoot an arrow into the air. Two seconds later (2.00 s) the arrow has gone straight upward to a height of 30.0 m above its launch point.



(9) What was the arrow's initial speed?

(10) How long did it take for the arrow to reach the highest point?

(Equations)

(9 a) $y = v_i t - \frac{1}{2} g t^2$

$30 = v_i \times 2 - \frac{1}{2} \times 9.80 \times 2^2$

$v_i = \frac{30 + 4.90 \times 4}{2} = 24.80$

$\rightarrow 24.8$ m/s

(9 b) $v_f = v_i - gt$, $v_f = 0$

$t = \frac{v_i}{g}$

$= \frac{24.80}{9.80}$

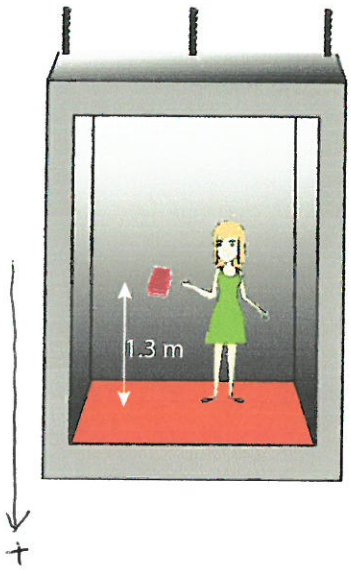
$= 2.531 \rightarrow 2.53$ s

(9) Answer
9-a
24.8 m/s

44%

(~~10~~) Answer
9-b
2.53 s

(10) While riding on an elevator going down with an upward acceleration of 2.0 m/s², you accidentally drop a book from under your arm. How long does it take for the book to reach the elevator floor, 1.3 m below your arm?
(Equations)



Book $y_1 = v_0 t + \frac{1}{2} g t^2$

$= v_0 t + 4.90 t^2$

Floor $y_2 = 1.3 + v_0 t - \frac{1}{2} a t^2$

$= 1.3 + v_0 t - 1.0 t^2$

$y_1 = y_2$

$v_0 t + 4.90 t^2 = 1.3 + v_0 t - t^2$

$5.90 t^2 = 1.3$

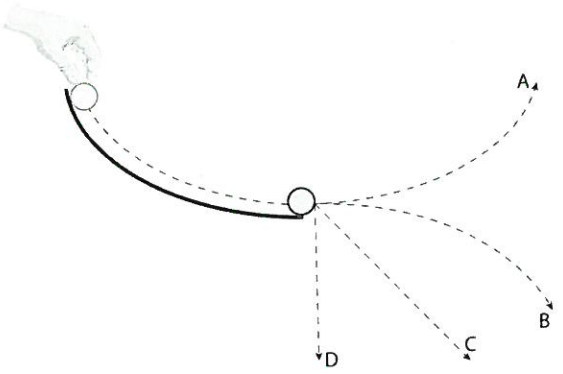
$t = \sqrt{\frac{1.3}{5.90}} = 0.469 \rightarrow 0.47\ s$

(10) Answer

0.47 s

1%

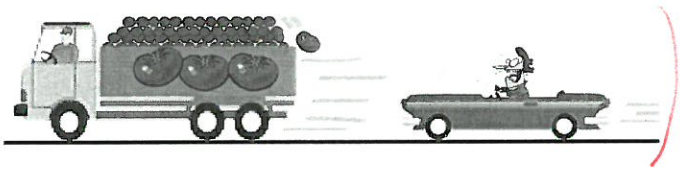
(11-a) A ball is released at the top of a curved ramp and rolls down, as shown in the diagram at the right. Which dotted line best represents the path of the ball after leaving the ramp?



(11-a) Answer

B

(11-b) When you drive on a highway, you catch up with a truck that drives at a constant speed and carries a full of tomatoes. You follow the truck at the same constant speed. Suddenly one of the tomatoes falls from the truck. Does the tomato hit your car or drop to the ground without hitting your car? Explain.



63%

(11-b) Answer

The Tomato drops to the ground without hitting the car. Because the tomato continues to move horizontally with constant speed and keeps up with the truck direct below the back of the truck, at the same time that it accelerates downward.

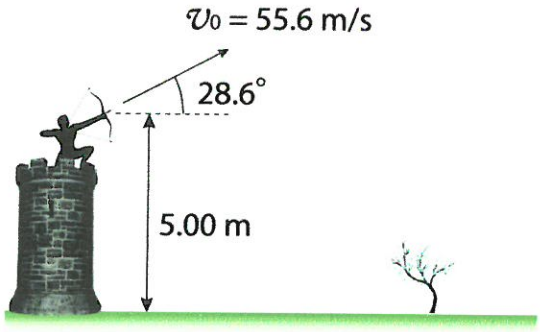
12,13
(~~13,14~~) William Tell shoots an arrow at an initial speed of 55.6 m/s and at an angle of 28.6° above the horizontal from a height of 5.00 m from the flat ground.

12
(~~13~~-a) What are the horizontal and vertical components of the initial speed?

12
(~~13~~-b) How long does the arrow take to reach the highest point?

12
(~~14~~-c) What is the maximum height of the arrow from the ground? The ground is assumed to be flat.

13
(~~14~~-d) What is the speed of the arrow just before it hits the ground?



(Equations)

(a) $v_{ox} = v_0 \cos\theta$

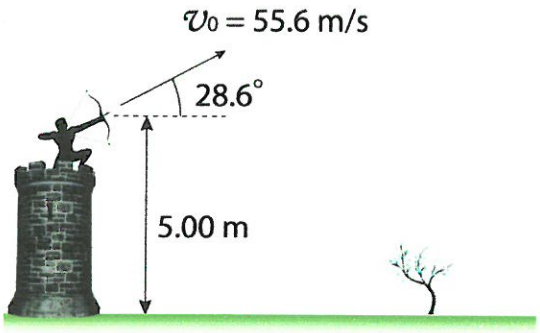
$= 55.6 \cos 28.6^\circ = 48.82 \longrightarrow 48.8$ m/s

$v_{oy} = v_0 \sin\theta$

$= 55.6 \sin 28.6^\circ = 26.62 \longrightarrow 26.6$ m/s

(b) $v_{yf} = v_{oy} - gt$, $v_{yf} = 0$

$t = \frac{v_{oy}}{g} = \frac{26.62}{9.80} = 2.716 \longrightarrow 2.72$ s



(c) $v_{yf}^2 - v_{oy}^2 = -2gy$

$$y = \frac{0 - v_{oy}^2}{-2g}$$

$$= \frac{-26.62^2}{-2 \times 9.80}$$

$$= 36.15$$

$36.15 + 5.00 = 41.15 \longrightarrow 41.2$ (m)

(d) $v_{yf} = \sqrt{v_{oy}^2 - 2gy}$

$$= \sqrt{26.62^2 - 2 \times 9.80 \times (-5.00)}$$

$$= 28.40 \text{ (m/s)}$$

$$v = \sqrt{v_{ox}^2 + v_{yf}^2}$$

$$= \sqrt{48.82^2 + 28.40^2}$$

$$= 56.48 \longrightarrow 56.5 \text{ m/s}$$

28.4 m/s
+1

(~~13~~ 12-a) Answer	
Horizontal:	48.8 m/s
Vertical	26.6 m/s
(~~13~~ 12-b) Answer	2.72 s

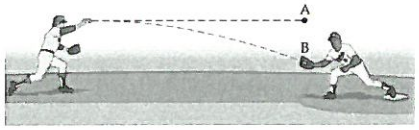
87 %

(~~14~~ 13-c) Answer	41.2 m
(~~14~~ 13-d) Answer	56.5 m/s

51 %

~~14~~ 13

(~~12~~ 14) Playing shortstop, you pick up a ground ball and throw it to the second base. The ball is thrown horizontally, with a speed of 22 m/s, directly toward point A. When the ball reaches the second baseman 0.45 s later, it is caught at point B.



(~~12~~ 14-a) How far were you from the second baseman?

(~~12~~ 14-b) What is the distance of vertical drop, AB? Assume that the effect of air is negligible.

(Equations)

(a) $x = v_0 t$

$= 22 \times 0.45$

$= 9.90 \longrightarrow 9.9\ m$

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

$= \frac{1}{2} \times 9.80 \times 0.45^2$

$= 0.9923 \longrightarrow 0.99\ m$

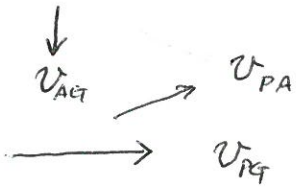
(~~12~~ 14-a) Answer	9.9 m
(~~12~~ 14-b) Answer	0.99 m

75 %

(15) The pilot of an airplane wishes to fly due east, but there is a 65-km/h wind blowing toward due south.

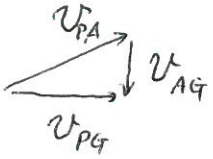
(15- a) In what direction should the pilot head her plane if its ~~speed relative to air is~~ 340 km/h.

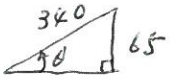
(15-b) If the pilot decreases the air speed of the plane, but still wants to head due east, should the angle found in part (a) be increased or decreased?



(Equations)

(a) $\vec{v}_{PG} = \vec{v}_{PA} + \vec{v}_{AG}$





$\sin\theta = \frac{65}{340}$

$\theta = \sin^{-1}\left(\frac{65}{340}\right) = 11.02^\circ \longrightarrow 11^\circ$

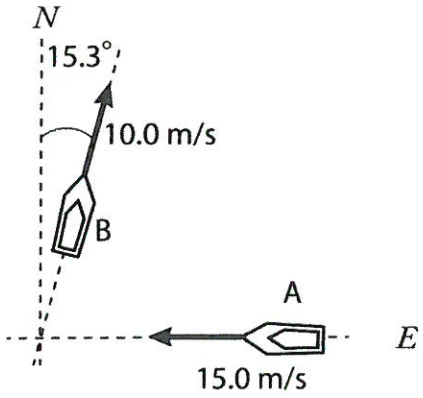
(b)

$\theta < \theta'$

(15-a) Answer
11° north from east
(15-a) Answer
increased

62%

(16) Two boats are moving on a calm lake as shown in the figure. Find the relative velocity (magnitude and direction) of the boat B from the A's viewpoint. (Equations)



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

$$\begin{cases} v_{BAx} = v_{Bx} - v_{Ax} \\ v_{BAy} = v_{By} - v_{Ay} \end{cases}$$

$$\begin{cases} v_{BAx} = 10\sin 15.3^\circ - (-15) \\ \quad = 2.639 + 15 \quad = 17.639\ (m/s) \\ v_{BAy} = 10\cos 15.3^\circ - 0 \\ \quad = 9.646 \end{cases}$$

$$v_{BA} = \sqrt{v_{BAx}^2 + v_{BAy}^2}$$

$$= \sqrt{17.64^2 + 9.646^2}$$

$$= \sqrt{311.2 + 93.05}$$

$$= \sqrt{404.2} \quad = 20.11 \longrightarrow 20.1\ m/s$$

$$\theta = \tan^{-1}\left(\frac{9.646}{17.64}\right)$$

$$= 28.69^\circ \longrightarrow 28.7^\circ$$

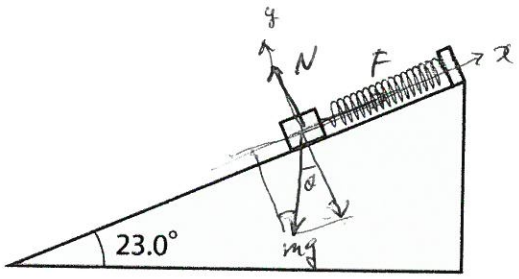
(16) Answer

20.1 m/s

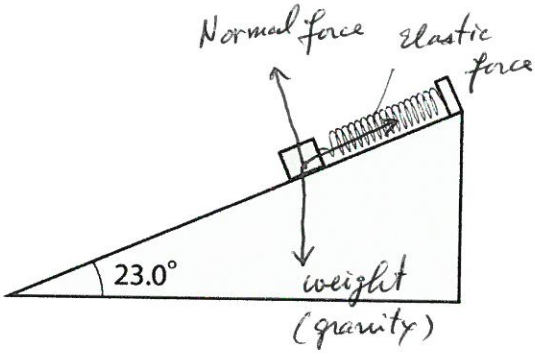
28.7° north from east

27 %

(17) A body with a mass of 6.00 kg attached to a spring is at rest on a frictionless slope.
(17-a) Draw force vectors acting on this body with their names.
(17-b) Find the magnitudes of the forces with their names. (Equations)



(17-a) Answer
Write force vectors and their names inside the figure below.



$$\vec{N} + \vec{F} + (m\vec{g}) = 0$$

$$\begin{cases} N_x + F_x + (mg)_x = 0 \\ N_y + F_y + (mg)_y = 0 \end{cases}$$

$$\begin{cases} 0 + F + (-6.00 \times 9.80 \sin 23.0^\circ) = 0 \\ N + 0 + (-6.00 \times 9.80 \cos 23.0^\circ) = 0 \end{cases}$$

$F = 22.98 \longrightarrow 23.0\,(N)$

$N = 54.13 \longrightarrow 54.1\,(N)$

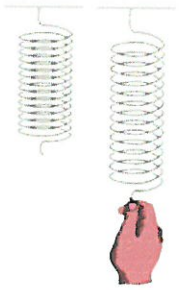
$mg = 6.00 \times 9.80 = 58.80 \longrightarrow 58.8\,(N)$

77%

(17-b) Answer

Elastic force : 23.0 N
Normal force : 54.1 N
weight : 58.8 N

(18) A spring has an original length of 30.0 cm and force constant of 235 N/m. When you stretch it slowly as shown in the figure, the total length becomes 42.5 cm. What is the magnitude of the elastic force that exerts on your hand?
(Equations)



$F = kx$

$= 235\,(N/m) \times (0.425 - 0.300)\,m$

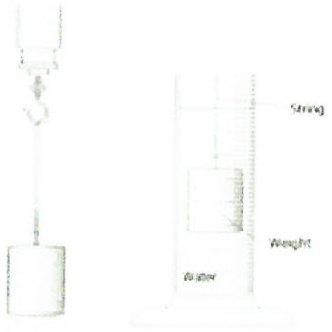
$= 29.38 \longrightarrow 29.4\,(N)$

(18) Answer

29.4 N

58 %

(19) 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.
(19-a) What is the volume of this weight?
(19-b) What is the density of the weight?



(a) $F_b = 24.0 - 19.9$

$= 4.10$

$F_b = \rho_w V g$

$V = \frac{4.10}{1000 \times 9.80}$

$= 0.4184 \times 10^{-3}\ m^3 \rightarrow 4.2 \times 10^{-4}\ m^3$

(b) $m = \frac{24.0}{9.80} = 2.449\ kg$

$\rho = \frac{m}{V}$

$= \frac{2.449}{0.4184 \times 10^{-3}}$

$= 5.853 \times 10^3$

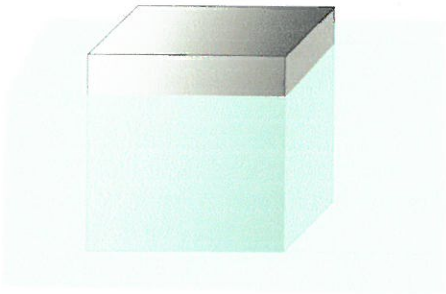
$\rightarrow 5.85 \times 10^3\ (kg/m^3)$

(19-a) Answer
$4.2 \times 10^{-4}\ m^3$
(19-a) Answer
$5.85 \times 10^3\ kg/m^3$

70%

(20) A uniform cube of material 11 cm on each side has a mass of 720 g and floats in water. How much of its volume is under water?

(Equations)



$m = 720\,g = 0.720\,kg$

$V = 0.11^3\,(m^3) = 1.331\times10^{-3}\,m^3$

$\rho_\omega V' g = mg$

$V' = \dfrac{m}{\rho_\omega} = \dfrac{0.720}{1000} = 0.720\times10^{-3}\,m^3$  V'

$\dfrac{V'}{V}\times100 = \dfrac{0.720\times10^{-3}}{1.331\times10^{-3}}\times100 = 54.1 \longrightarrow 54\%$

23%

(20) Answer

54 %

(21) A scuba diver is in a lake at a depth of 8.00 m.

(21-a) What is the total pressure on the diver's back?

(21-b) What is the total force on the diver's back, taking the surface of the back to be a rectangle 60.0 cm by 50.0 cm.

(Equations)

(a) $P = P_{atm} + \rho g h$

$= 1.013 \times 10^5 + 10^3 \times 9.80 \times 8.00$

$= 1.013 \times 10^5 + 0.784 \times 10^5 \ (P_a)$

$= 1.797 \times 10^5 \ (P_a) \longrightarrow 1.8 \times 10^5 \ P_a$

(b) $P = \frac{F}{S}$

$\rightarrow F = P \cdot S$

$1.797 \times 10^5 \times 0.600 \times 0.500$

$= 0.5391 \times 10^5 \ N$

$\longrightarrow 5.39 \times 10^4 \ N$

42%

(21) Answer

-a $1.80 \times 10^5 \ P_a$

(21-b) $5.39 \times 10^4 \ N$