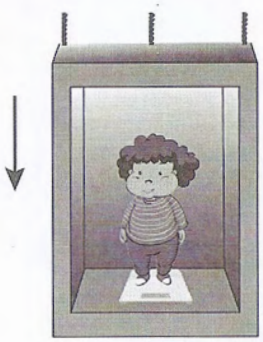
	Total	K+E	I+O
Students	33	15	18
Average	28.3/50	26.4/50	30.0/50
Best	46.0/50	46.0/50	41.5/50

11th Physics (2017 – 18)

(2ndQ, #1Mini Test)

Class	No.	Name Solutions



In calculation problems, describe equations clearly and systematically enough to show how to solve the problems.

The circular constant	$\pi = 3.14159...$
Conversion from atmosphere to pascal	$1.000\ atm = 1.013 \times 10^5\ Pa$
Gravitational acceleration rate	$g = 9.80\ m/s^2$
Universal Gravitational Constant	$G = 6.67 \times 10^{-11}\ N \cdot m^2/kg^2$
Mass of the Earth	$M_E = 5.97 \times 10^{24}\ kg$
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	$0.179\ kg/m^3$

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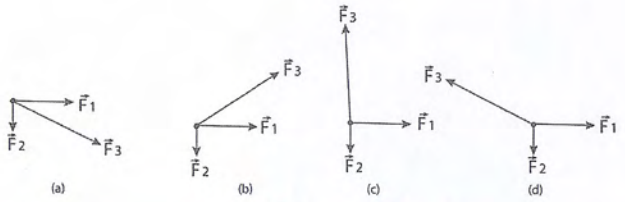
4 pt/question x 13 questions = 52 pt Max 50 pt

/[Total 50 pt]

11/30/2017 *By Tohei Moritani*

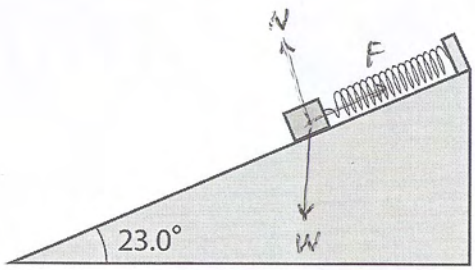
Keio Academy of New York

(1) The figure shows three forces, $\vec{F}_1$, $\vec{F}_2$ and $\vec{F}_3$ where the direction of $\vec{F}_3$ is different in (a), (b), (c) and (d). Which has the largest in magnitude for the resultant force of the three forces?



(1) Answer: a (64%)

(2,3) A body with a mass of 3.50 kg is on a frictionless slope and is supported by a spring as shown in the figure.
(2) Determine the names and magnitude of the forces.
(3) The spring shows an elongation of 17.5 cm from its original length. What is the spring constant of this spring?
Equations



(2)

W $3.50 \times 9.80 = 34.50 \longrightarrow 34.3$

F $34.30 \sin 23^\circ = 13.40 \longrightarrow 13.4$

N $34.30 \cos 23^\circ = 31.57 \longrightarrow 31.6$

(2) Answer

Gravity	34.3 N
Elastic force	13.4 N
Normal force	31.6 N

(67%)

(3)

$F = kx$

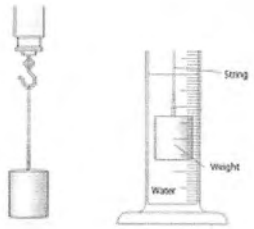
$k = \dfrac{F}{x}$

$= \dfrac{13.40\ (N)}{0.175\ (m)}$

$= 76.57 \longrightarrow 76.6\ (N/m)$

(3) Answer: 76.6 N/m (43%)

(4,5) 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.
(4) What is the volume of this weight?
(5) What is the density of the weight?
Equations



(4) Buoyant force $F_b = 24.0 - 19.9 = 4.1$ (N) — 2 digits

Archimedes principle $F_b = \rho_w V g$

$$V = \frac{F_b}{\rho_w g} = \frac{4.1}{1000 \times 9.80} = 0.418 \times 10^{-3} = 4.18 \times 10^{-4} \rightarrow 4.2 \times 10^{-4}$$ — 2 digits

(4) Answer: $4.2 \times 10^{-4}\ m^3$ (58%)

(5) $W = mg \rightarrow m = \frac{W}{g} = \frac{24.0}{9.80} = 2.449$

Density $\rho = \frac{m}{V} = \frac{2.449}{4.18 \times 10^{-4}}$

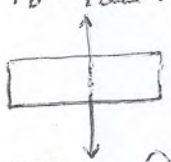
$= 0.5859 \times 10^4 = 5.859 \times 10^3 \rightarrow 5.9 \times 10^3$

(5) Answer: $5.9 \times 10^3\ kg/m^3$ (28%)

(6) "Der Grosse Fuji" is an airship using helium gas. If its volume is 9230 m^3, what is the maximum mass the airship can lift including its mass?
Equations

$F_b = \rho_{air} V g$

Equilibrium of forces



$Mg + \rho_{He} V g$

$\rho_{air} V g = Mg + \rho_{He} V g$

$M = V(\rho_{air} - \rho_{He})$

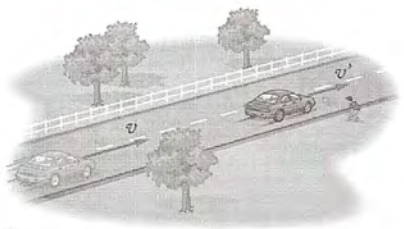
$= 9230(1.29 - 0.179)$

$= 9230 \times 1.111$

$= 10254 \rightarrow 10300$

(6) 10300 kg (33%)

(7,8) Driving home school one day, you spot a ball rolling out into the street.. You brake for 1.25 s, slowing your 955-kg car from 16.7 m/s to 9.3 m/s.
(7) What was the average force exerted on your car during braking?
(8) How much work did the force do while braking?



(7) $v_0 = 16.7$ m/s $\quad v = 9.3$ m/s

$t = 1.25$ s

$$a = \frac{v - v_0}{t} = \frac{9.3 - 16.7}{1.25} = \frac{-7.4}{1.25} = -5.92 \ (m/s^2)$$

$$\Sigma F = ma$$

$$= 955 \times (-5.92) = -5654 \rightarrow -5700 \ (N)$$

(8)

$$W = Fd$$

$$d = \frac{v^2 - v_0^2}{2a} = \frac{9.3^2 - 16.7^2}{2 \times (-5.92)}$$

$$= 16.250 \ (m)$$

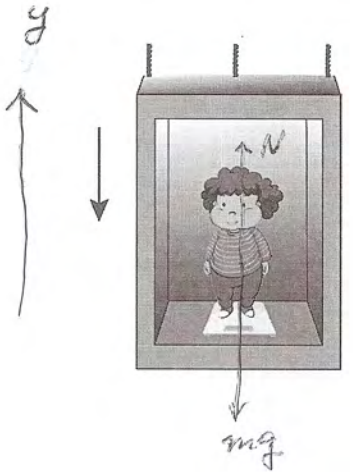
$$W = Fd = -5654 \times 16.250$$

$$= -91871 \rightarrow -92000 = -9.2 \times 10^4$$

(7) Answer
5700 N backward (61%)

(8) Answer
-9.2×10^4 J (35%)

(9) As part of a physics experiment, you stand on a bathroom scale in an elevator. Your mass is 62.0 kg. The elevator is moving downward and the scale reads 74.6 kg. Find the direction and magnitude of the elevator.



Equations

the acceleration of

$\Sigma F = ma$

$N - mg = ma$

$N = 74.6 \times 9.80 = 731.1$

$a = \frac{N}{m} - g$

$= \frac{731.1}{62.0} - 9.80$

$= 11.79 - 9.80$

$= 1.992 \rightarrow 1.99\ (m/s^2)$

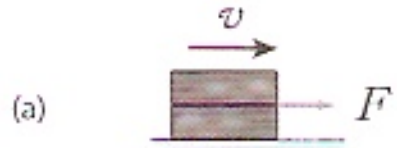
The elevator is moving downward and slowing down. Then its acceleration is directed upward.

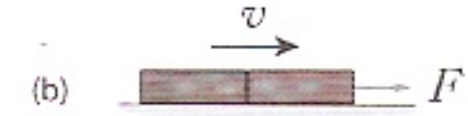
(9) Answer

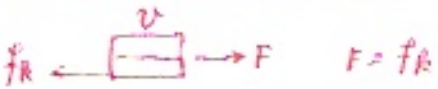
1.99 m/s^2 upward

(61%)

(10-a) As shown in the figure (a), you stack a brick on top of another identical brick and push on the bricks across a tabletop with a force F and the bricks move with constant speed, v. Is the force of kinetic friction exerted on the bricks greater than, less than, or equal to the force F?
(10-b) Next, you place the bricks end to end as shown in the figure (b). Is the force of kinetic friction exerted on the bricks in (b) greater than, less than, or equal to the force of kinetic friction in (a)?





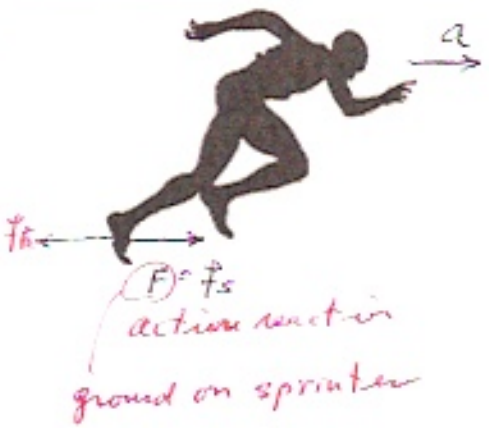


$f_R = \mu_R N$ f_R is independent of area
$= \mu_R m g$

(10-a) Answer
equal to
(10-b) Answer
equal to

(62%)

(11) A 65-kg sprinter wishes to accelerate from rest to a speed of 14 m/s in a distance of 23 m. What coefficient of static friction between the sprinter's shoes and the track?
Equations



Acceleration

$$a = \frac{v^2 - v_0^2}{2x} = \frac{14^2 - 0}{2 \times 23} = 4.261$$

$$\Sigma F = ma$$

$$f_s = ma$$

$$f_s \le \mu_s N = \mu_s mg$$

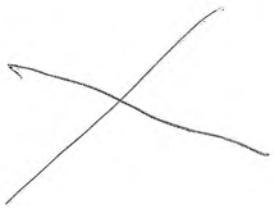
$$ma \le \mu_s mg$$

$$\mu_s \ge \frac{a}{g} = \frac{4.261}{9.80} = 0.4348 \rightarrow 0.43$$

(11)
0.43

(52%)

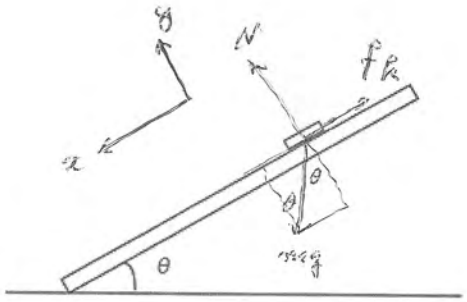
(12) A student attaches a rope to a 20.0 kg box of books. He pulls with a force of 90.0 N at an angle of 30.0° from the horizontal. The coefficient of static friction between the box and the ground is 0.575. Find the force necessary to start the box moving.



(Q12) Answer

(100%)

(13) In the figure, a 2.4 kg-block is released when the angle is set up at 30.0° . The kinetic friction coefficient μ ' is 0.35. What is the acceleration rate generated on the block?



$$\sum \vec{F} = m\vec{a}$$

x	y
$\sum F_x = m a_x$	$\sum F_y = m a_y$
$mg\sin\theta - f_k = m a_x$ —②	$N - mg\cos\theta = m a_y = 0$
$f_k = \mu_k N$ —③	$\rightarrow N = mg\cos\theta$ —①

$$f_k = \mu_k mg\cos\theta \text{ —③}$$

$$ma_x = mg\sin\theta - \mu_k mg\cos\theta$$

$$a_x = g(\sin\theta - \mu_k\cos\theta)$$

$$= 9.80(\sin 30.0^\circ - 0.35\cos 30.0^\circ)$$

$$= 9.80(0.5000 - 0.3031)$$

$$= 9.80 \times 0.1969$$

$$= 1.930 \longrightarrow 1.9$$

(Q13) Answer

1.9 m/s^2 (41%)