Students 8
Average 29.9/50
Best 45/50

12th Physics (2017 – 18)

(1stQ, Review Test)

No.	Name Solution

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

計算問題では、Equationsの欄に解答を得る道筋がわかるように計算式を含めて整然と説明すること。

Gravitational acceleration rate	重力加速度	$g = 9.80\ m/s^2$
Universal Gravitational Constant	万有引力定数	$G = 6.67 \times 10^{-11}\ N \cdot m^2/kg^2$
Elementary Charge	電気素量	$e = 1.60 \times 10^{-19}\ C$
Electron Mass	電子の質量	$m_e = 9.11 \times 10^{-31}\ kg$
Proton Mass	陽子の質量	$m_p = 1.673 \times 10^{-27}\ kg$
Coulomb's Law Constant	クーロンの法則の定数	$k = 8.99 \times 10^9\ N \cdot m^2/C^2$
Avogadro's Number	アボガドロ数	$N_A = 6.022 \times 10^{23}\ mol^{-1}$
Speed of Light in vacuum	真空中での光速度	$c = 3.00 \times 10^8\ m/s$

5 pt/question x 10 questions = 50 pt

／[Total 50 pt]

9/5/2017 *By Tohei Moritani*

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[Q1] You drive a straight line at 25.0 m/s for 15.0 min, then at 37.0 m/s for another 25.0 min. Find the average speed for entire drive.

君は直線道路をドライブしているとき、25.0 m/s で 15.0 min 間走り、ついで 37.0 m/s で 25.0 min 間走った。このドライブの平均の速さを求めよ。

Equations

$x_1 = 25.0\ m/s \times 15\ min \times \frac{60\ s}{1\ min} = 22500\ m$

$x_2 = 37.0\ m/s \times 25\ min \times \frac{60\ s}{1\ min} = 55500\ m$

$\bar{v} = \frac{x_1 + x_2}{t_1 + t_2} = \frac{22500 + 55500}{(15.0 + 25.0) \times 60} = 32.50 \rightarrow 32.5$

[Q1] Answer

32.5 m/s

86%

[Q2] The infamous chicken is dashing toward home plate with a speed of 5.8 m/s when he decides to hit the dirt. The chicken slides for 1.1 s, just reaching the plate as he stops (safe, of course).

(2-a) What are the magnitude and direction of the chicken's acceleration?

(2-b) How far did the chicken slide?

(2-a) あの弱虫野郎が 3 塁から本塁目指して 5.8 m/s で走り込み本塁前で滑り込みを敢行した。滑り込んでいる時間は 1.1 s で、本塁ベースでちょうど止まった（もちろんセーフ）。この滑り込みの加速度の大きさと向きを求めよ。

(2-b) 滑った距離はいくらか。

(a) $v = v_0 + at \rightarrow a = \frac{v - v_0}{t} = \frac{0 - 5.8}{1.1} = -5.27 \rightarrow -5.3$

(b) $v^2 - v_0^2 = 2ax$

$x = \frac{v^2 - v_0^2}{2a} = \frac{0 - 5.8^2}{-2 \times 5.3} = 3.19 \rightarrow 3.2$

[Q2-a] Answer 本塁から3塁に向かって

5.3 m/s²

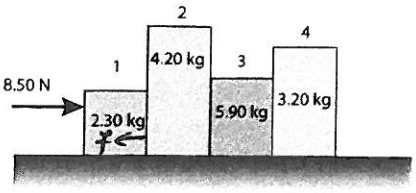
85%

[Q2-b] Answer

3.2 m

[Q3] A force of magnitude 8.50 N pushes four boxes with masses as shown. Find the magnitude of the contact force between boxes 1 and 2.

図に示した質量の4個の箱に 8.50 N の力を加えた。箱1と箱2の間にはたらく力（コンタクトフォース）を求めよ。



Equations

$F = m_{Total}\, a$

$a = \dfrac{F}{m_{Total}} = \dfrac{8.50}{2.3+4.2+5.9+3.2} = 0.5449\ (m/s^2)$

$8.50 - f = 2.30 \times 0.5449$

$f = 8.50 - 2.30 \times 0.5449 = 7.2468 \rightarrow 7.25$

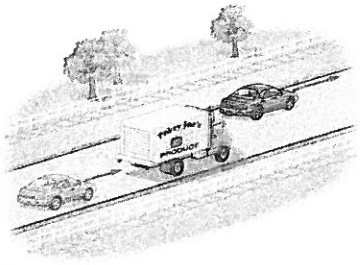
(3) こたえ

7.25 N

45%

[Q4] To pass a slow-moving truck, you want your fancy 1.20 x 10^3-kg car to accelerate from 12.4 m/s to 17.9 m/s in 3.50 s. What is the minimum power required for this pass?

動きの遅いトラックを追い越そうと、1.20 x 10^3-kg の乗用車が 3.50 秒間に 12.4 m/s から 17.9 m/s に加速する。この追い越しに必要な仕事率はいくらか。



Equations

$W = K' - K = \frac{1}{2} m v'^2 - \frac{1}{2} m v^2$

$= \frac{1}{2} m (v'^2 - v^2)$

$= \frac{1}{2} \times 1.20 \times 10^3 (17.9^2 - 12.4^2)$

$= 99990\ (J)$

$P = \dfrac{W}{t} = \dfrac{99990}{3.50} = 28569\ (W)$

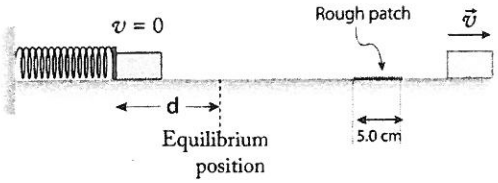
$\rightarrow 28.6\ kW$

(4) こたえ

28.6 kW

80%

[Q5] A 1.2 kg block is held at rest against a spring with a force constant k = 730 N/m. Initially, the spring is compressed a distance d. When the block is released, it slides across a surface that is frictionless except for a rough patch of width 5.0 cm that has a coefficient of kinetic friction μ'=0.44. Find d such that the block's speed after crossing the rough patch is 2.3 cm/s.



1.2 kg の物体がばね定数 k = 730 N/m のばねに接触している。ばねを d だけ圧縮した後、物体をはじき飛ばす。物体はまさつのない水平面を滑る。一カ所 5.0 cm だけ動摩擦係数 μ'=0.44 の部分を滑る。この部分を通過した後の速さは 2.3 cm/s である。d を求めよ。

Equations

Spring $U = \frac{1}{2}kx^2 = \frac{1}{2} \times 730 \cdot d^2 = 365\,d^2$

$U = K$, $K' = \frac{1}{2}mv'^2 = \frac{1}{2} \times 1.2 \times (0.023)^2 = 3.174 \times 10^{-4}$ (J)

$W = K' - K$

$W = Fx = -\mu' N x = -\mu' mgx = -0.44 \times 1.2 \times 9.80 \times 0.05 = -0.2587$

$-0.2587 = 3.174 \times 10^{-4} - 365\,d^2$

$d = \sqrt{\frac{3.174 \times 10^{-4} + 0.2587}{365}} = 0.02664$ (m)

$\rightarrow 2.7$ cm

(5) こたえ

2.7 cm

40%

[Q6] The temperature of 40 kg water in a bathtub is 45℃. You want to make 42℃ bath by adding 10℃ water to the bathtub. How much should you add?

40.0 kgの湯が入っている風呂が 45℃と熱い。 10℃の水を加えて 42℃に下げたいが、何kg加えたらよいか。

Equations

$Q_1 + Q_2 = 0$

$c m_1 \Delta T_1 + c m_2 \Delta T_2 = 0$

$40(42-45) + m_2(42-10) = 0$

$m_2 = \frac{40 \times 3}{32} = 3.75 \rightarrow 3.8$

(6) こたえ

3.8 kg

45%

(Significant figure is 2
because
$40(42-45) = 40 \times 42 - 40 \times 45$)

[Q7] A positive charge of 3.2×10^{-19} C experiences a force due to the electric field $\vec{E}$ and moves through a potential difference of 30 V. Find the work done by the electric field.

3.2×10^{-19} C の正電荷が電場から力を受けて、電位差 30 V の間を移動するとき、電荷が電場からされる仕事の量はいくらか。

Equations

$F = qE \quad , \quad E = V/d$

$\therefore \; F = q \cdot V/d$

$W = Fd = qV = 3.2 \times 10^{-19} \times 30$

$= 96 \times 10^{-19} \longrightarrow 9.6 \times 10^{-18}$

The work is positive because the direction of the force is the same as that of displacement.

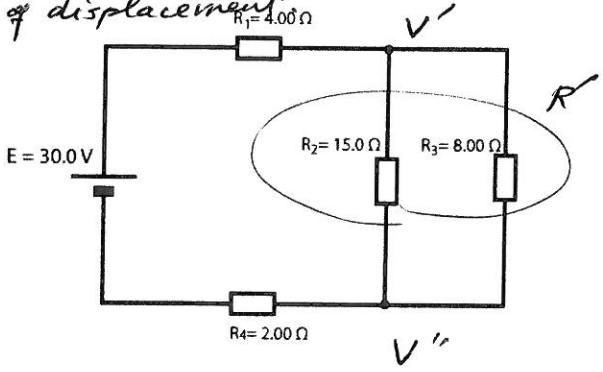
(7) こたえ

9.6×10^{-18} J

5.3%

[Q8] A circuit consists of four resistors and a 30.0 V battery connected as shown in the diagram. Find the current flowing through the 8.00 Ω resistor R3.

4 個の抵抗と 30.0 V の電池を図に示すように接続した。8.00 Ω の抵抗 R3 を流れる電流値を求めよ。



Equations

$\frac{1}{R'} = \frac{1}{15} + \frac{1}{8} \longrightarrow R' = 5.217$

$R_{Total} = 5.217 + 4.00 + 2.00 = 11.217$

$I = \frac{E}{R_{Total}} = \frac{30.0}{11.217} = 2.674 \text{ (A)}$

$V' = 30 - 2.674 \times 4.00 = 19.302 \;, \; V'' = 2.674 \times 2.00 = 5.348$

$V_3 = 19.302 - 5.348 = 13.953$

$I_3 = \frac{V_3}{R_3} = \frac{13.953}{8.00} = 1.744 \longrightarrow 1.74$

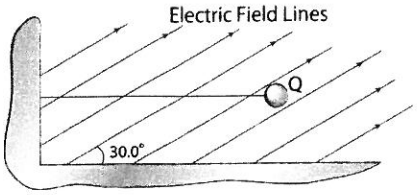
(8) こたえ

1.74 A

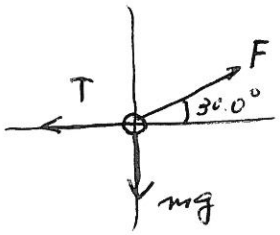
83%

[Q9] An object of mass m = 3.1 g and charge Q = + 48 x 10^{-6} C is attached to a string and placed in a uniform electric field that is inclined at an angle of 30.0° with the horizontal as shown in the figure. The object is in static equilibrium when the string is the horizontal. Find the magnitude of the electric field.

質量 3.1 g、電荷量 Q = + 48 x 10^{-6} C の物体がひもにつながれ均一な電場中にある。電場は水平から 30.0° 傾き、ひもが水平の状態で物体は釣り合いの状態にある。電場の大きさを求めよ



Equations



$mg = F \sin 30^\circ$ —①

$T = F \cos 30^\circ$ —②

$F = QE = 48 \times 10^{-6} E$ —③

① → $3.1 \times 10^{-3} \times 9.80 = 48 \times 10^{-6} \cdot E \cdot \frac{1}{2}$

$E = \frac{2 \times 3.1 \times 10^{-3} \times 9.80}{48 \times 10^{-6}} = 1,266$

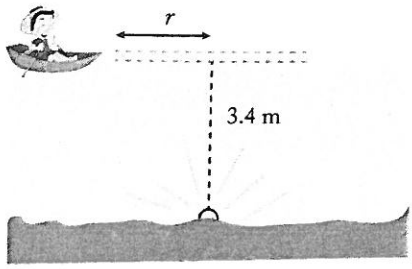
→ 1,300 (N/C)

(9) こたえ

1300 N/C

45%

[Q10] You discovered gold on the bottom of a pond 3.4 m deep. (10a) Viewed from directly above the gold, how far below the surface of the water does the gold appear to be? (10-b) You want to place a circular board on the water surface to hide the gold completely from anywhere in the air. Find the smallest radius of the board assuming the refractive index of water as 1.33.
君は深さ 3.4 m の池の底に金塊を見つけた。(10-a) 金塊の真上から見たとき、水面から金塊までの距離はいくらに見えるか。
(10-b) 金塊の上の水面を円盤でおおって、上方の空気中のどこからも見えないようにしたい。最小の円盤の半径を求めよ。ただし、水の屈折率を 1.33 とする。

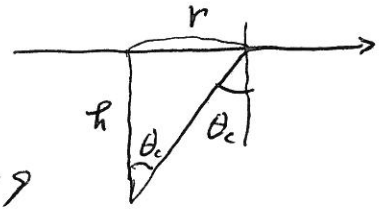


Equations

(a) $h' = \frac{h}{n} = \frac{3.4}{1.33} = 2.56 \longrightarrow 2.6\ (m)$

(b) Snell $n = \frac{\sin 90^\circ}{\sin \theta_c}$

$\sin \theta_c = \frac{1}{n} = \frac{1}{1.33} = 0.7519$



$\theta_c = 48.76^\circ$

$\tan \theta_c = \frac{r}{h}$

$\rightarrow r = h \tan \theta_c = 3.4 \tan 48.76^\circ$

$= 3.88 \longrightarrow 3.9\ (m)$

(10-a) Answer
2.6 m
(10-b) Answer
3.9 m

38%