| | Total | K+E | I+O |
|---|---|---|---|
| Student | 33 | 15 | 18 |
| Average | 34.8/50 | 36.4/50 | 33.5/50 |
| Best | 42.5/50 | 42.5/50 | 40.0/50 |

# 11th Physics (2018 – 19)

(4thQ, #2 Mini Test)

| Class | No. | Name Solutions |
|---|---|---|

**In a calculation problem, describe equations clearly and systematically enough to show how to solve the problem. <u>If not enough, you won't get any point.</u>**

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| | |
|---|---|
| Gravitational acceleration rate | $g = 9.80\ m/s^2$ |
| The speed of sound in air | ~~$V = 331.5 + 0.61$ [m/s] · t °C~~ |

In this test, use 343 m/s as the speed of sound in air.

| | |
|---|---|
| The speed of light in vacuum | $c = 3.00 \times 10^8$ m/s |
| Elementary Charge | $e = 1.60 \times 10^{-19}$ C |
| Electron Mass | $m_e = 9.11 \times 10^{-31}$ kg |
| Proton Mass | $m_p = 1.673 \times 10^{-27}$ kg |
| Coulomb's Law Constant | $k = 8.99 \times 10^9\ N \cdot m^2/C^2$ |
| Universal Gravitational Constant | $G = 6.67 \times 10^{-11}\ N \cdot m^2/kg^2$ |
| Avogadro's Number | $N_A = 6.022 \times 10^{23}\ mol^{-1}$ |
| Refractive Index of Water | $n = 1.33$ |
| Refractive Index of Ice | $n = 1.31$ |
| Refractive Index of Diamond | $n = 2.42$ |
| Refractive Index of Glass | $n = 1.66$ |

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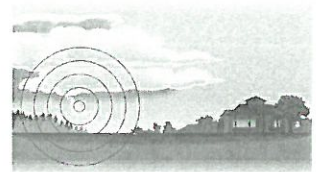
4 pt/question x 13 questions = 52 pt  Max 50 pt

／[Total 50 pt]

In this test, use 343 m/s as the speed of sound in air.



(1-a) It was dark and windless night. Suddenly you saw a flash of lightening and 3.5 seconds later you heard the thunder. How far away was the lightening bolt.

(1-b) Later you saw a flash of lightening again and 4.0 seconds later you heard the thunder. How far away was the lightening bolt if the wind of 20 m/s was blowing from the direction of lightening to you?

(Equations)

(a) $d = vt = 343 \times 3.5 = 1200.5 \rightarrow 1200$ [m]

(b) $v = v_1 + v_2 = 343 + 20 = 363$ [m/s]

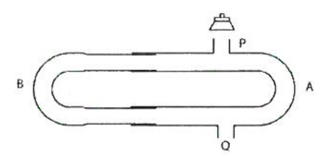
$d = vt = 363 \times 4.0 = 1452 \rightarrow 1500$ [m]

(1-a) Answer
1200 m

(1-b) Answer
1500 m

64%

2) Using the Quincke tube shown in the figure, a sound continuously emits at the opening P as the part B is slowly sliding and pulling out of the part A. At another opening Q, destructive sounds are heard every 6.5 cm sliding. Find the frequency of the sound.




(Equations)

$|l_1 - l_2| = \frac{\lambda}{2} \times (2m+1)$

$m = 0 \quad 0.5\lambda$

$m = 1 \quad 1.5\lambda$ ] $\lambda$

$m = 2 \quad 2.5\lambda$ ] $\lambda$

$\lambda = 6.5\,\text{cm} \times 2 = 13.0\,\text{cm}$

$f = \frac{V}{\lambda} = \frac{343}{0.130} = 2638 \rightarrow 2640$

(2) Answer
2640 Hz

32%



5/9/2018 By Tohei Moritani

(3) A violin produces a sound intensity level of 62.5 dB.
(3-a) If ten identical violins play at the same time, what is the intensity level?

(3-b) By what factor the loudness increases for playing ten violins in comparison with playing one violin?
(Equations)

(a) 62.5 dB + 10 dB = 72.5 dB

(b) 10 times intensity = 2 times loudness

| (3-a) Answer |
|---|
| 72.5 dB |
| **(3-b) Answer** |
| 2 |

15%

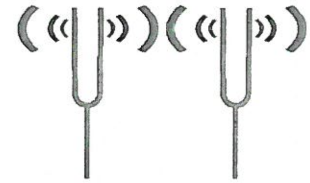
(4) You can hear sounds at the backside of a wall, the sound of lower frequencies like 100 Hz. Explain why in terms of properties of waves quantitatively.
(Equations)

(4) Answer

The sound of 100 Hz has a wavelength of 3.4 m. This is comparable with the height of a usual wall, and then the sound diffracts and spread outward. This is why we can hear sound produced at the backward of the wall.

11 %

(5) Two tuning forks have frequencies of 278 Hz and 292 Hz. What is the beat frequency if both tuning forks are sounded simultaneously?



(Equations)

$f' = |f_1 - f_2|$

$= |278 - 292| = \pm 14$

(5) Answer

14 Hz

83%

(6) The frequency of the standing wave shown in the figure is 202 Hz.

(6-a) What is the fundamental frequency of this pipe?

(6-b) What is the length of this pipe?

(Equations)

(a) $f_2 = 2 f_1 \rightarrow f_1 = \frac{f_2}{2} = \frac{202}{2} = 101$

(b) $\frac{\lambda_2}{4} \times 4 = L \rightarrow L = \lambda_2 = \frac{V}{f_2} = \frac{343}{202} = 1.698 \rightarrow 1.70$

(6-a) Answer

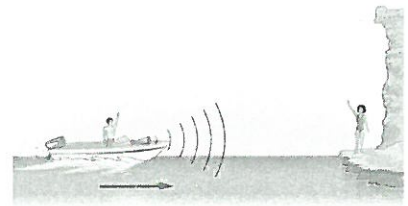
101 Hz

(6-b) Answer

1.70 m

53%

(7) Taro is speeding toward an island with a speed of 24 m/s when he sees Hanako standing on shore at the base of a cliff. Taro sounds his 333 Hz horn.
(7-a) What frequency does Hanako hear?
(7-b) Tarao hears the echo of his horn reflected back to him by the cliff. Find the frequency Taro hears in the echo from the cliff.
(Equations)



(a) $f' = \frac{V}{V - v_s} f$

$= \frac{343}{343 - 24} \times 333$

$= 1.07\overline{5} \times 333$

$= 358.1 \longrightarrow 358$

(b) $f' = \frac{V + v_0}{V - v_s} f$

$= \frac{343 + 24}{343 - 24} \times 333$

$= 1.1\overline{50} \times 333$

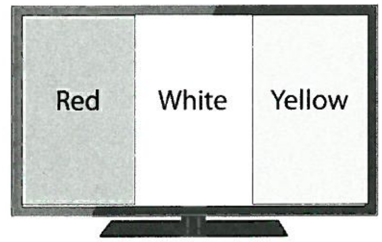
$= 382.95 \longrightarrow 383$

| | |
|---|---|
| (7-a) Answer | 358 Hz |
| (7-b) Answer | 383 Hz |

66%

(8)

(8-a) A TV screen has 3,000,000 pixels. When the screen shows the image in the figure at the right, how many green color dots are lit?




(8-b) Find the frequency of green light with a wavelength of 551 nm. (Equations)

(a)

| Red | white | yellow |
|---|---|---|
| R | RG B | RG |

(b) $f = \frac{c}{\lambda} = \frac{3.00\times10^{8}}{5.51\times10^{-9}} = 0.00544446\times10^{17}$

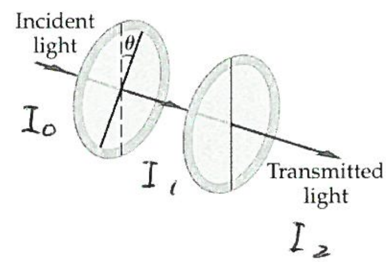
$\longrightarrow 5.44\times10^{14}$ [Hz]

(8-a) Answer
2,000,000 dots

(8-b) Answer
$5.44\times10^{14}$ Hz

61%

(9) Unpolarized incident light passes through two polarizers whose transmission axes are at an angle of $\theta = 30.0^\circ$ with respect each other. What fraction of the intensity is transmitted through the polarizers? (Equations)




$I_1 = \frac{1}{2} I_0$

$I_2 = I_1 \cos^2 30.0^\circ$

$= \frac{1}{2} I_0 \cos^2 30.0^\circ$

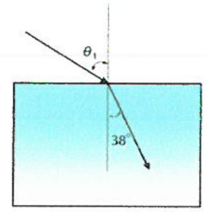
$= I_0 \times \frac{1}{2} \times 0.750$

$= 0.3750\, I$

$\longrightarrow 0.375\, I$

(9) Answer
0.375

31%

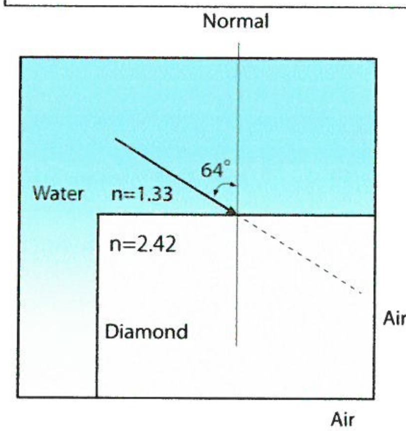



(10) The angle of refraction of a ray traveling into ice cube (n = 1.31) from air is 38° . Find the angle of incidence.
(Equations)

$1 \sin\theta_1 = 1.31 \sin 38^\circ$
$= 0.8065$
$\theta_1 = 53.76^\circ \rightarrow 54^\circ$

(10) Answer
$54^\circ$

86%




(11, 12) A beam of light in water (n=1.33) enters diamond (n = 2.42) at an angle of $\theta$ =64° relative to the normal.
(11) Find the angle of refraction.

(12) How does the light propagate at the interface between the diamond and air? Draw lines showing angle(s) in the figure and explain.
(Equations)

(11) $1.33 \sin 64^\circ = 2.42 \sin\theta_2$
$\sin\theta_2 = \frac{1.33 \sin 64^\circ}{2.42} = 0.4940$
$\theta_2 = 29.60 \longrightarrow 30^\circ$

(12) $2.42 \sin 29.6^\circ = 1 \sin\theta_2$
$\sin\theta_2 = 1.185 > 1$
$2.42 \sin\theta_c = 1 \sin 90^\circ \rightarrow \sin\theta_c = \frac{1}{2.42}$
$= 0.4132$
$\theta_c = 24.4^\circ$

(11) Answer
$30^\circ$

58%

(12) Answer

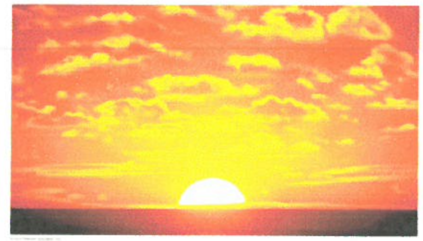
Draw lines in the figure.

Explain here.

The critical angle at the interface between diamond and air is 24° 。 The incident angle 30° is larger than this, then the light shows total refraction.

20%

(13) Sunsets are always beautiful! The next time you see the Sun just about to set, explain the physics of sunset to your friends or family members.



(13-a) Explain why sunsets are red in terms of the properties of light.

(13-b) Even though the Sun is visible at sunsets, actually it's already below the horizon. Explain how can we still see it in terms of the properties of light

(13-a) Answer

Most of the Sun's blue light has been scattered of in other direction because the scattering due to air molecule is larger for the light with smaller wavelength typically blue. This leaves us with red light.

13 3/0

(13-b) Answer

It is due to refraction. This refraction is related to the density of atmosphere. The atmosphere is thicker at the bottom than at the top. The speed of light is faster a the top and slower at the bottom. Then the sunlight is bent. At sunsets, we see virtual image of the Sun that is actually below the horizon.