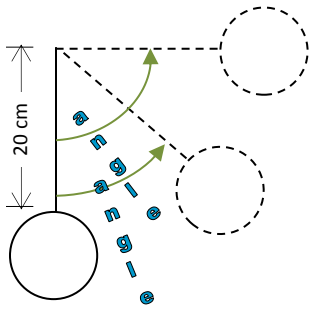
Physics Problems with solutions

12b

1 – A closed container of hydrogen gas is warmed from 20°C to 25°C. If the volume remains the same, what will happen to the pressure in the container?

a) It will remain the same.
b) It will decrease.
c) It will fluctuate.
d) It will increase

The next to questions are based on an experiment planned to find out what factors affect the time it takes a pendulum to swing back and forth (its period). The length of a pendulum, the weight of the bob, and the angle from which the bob is released vary in each experiment as specified in the chart below. The average time over three full swings was recorded.



Experiment	Bob weight	Length	Angle
A	50 g.	40 cm.	45°
B	50 g.	20 cm.	45°
C	200 g.	40 cm.	45°
D	50 g.	20 cm.	90°
E	200 g.	40 cm.	90°

2 – In order to find the effect of the pendulum's length on its period, one should compare the results of experiments

a) A and B
b) B and C
c) C and D
d) D and E

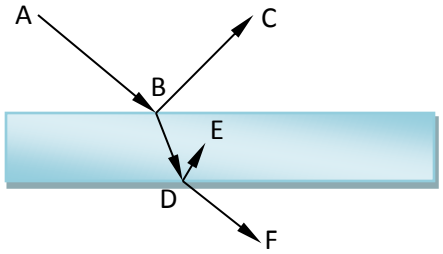
3 – In order to find the effect of the bob weight on the pendulum's, one should compare experiments

a) A and B
b) B and C
c) C and D
d) D and E

4 – Ohm's law is used in the study of

a) electricity
b) mechanics
c) thermodynamics
d) optics

The next three questions are based on this diagram.



Light ray AB strikes a glass block at B. Part of the beam goes toward C, part toward D. At D, part of the light stays in the glass (DE), going toward E, part leaves the glass (DF), going toward F.

5 – Which ray is an example of a reflected ray?

a) Ray DF
b) Ray BC
c) Ray BD
d) Ray AB

6 – Which ray is an example of a refracted ray?

a) Ray AB
b) Ray BC
c) Ray BD
d) Ray DE

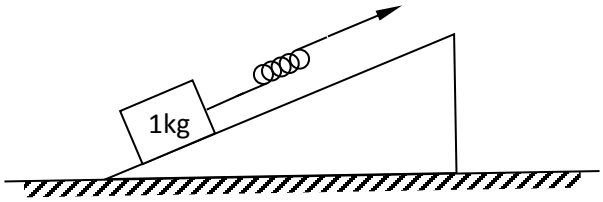
7 – Since the ray AB is bent toward the normal upon entering the glass block, one can infer that

a) the velocity of the light ray increases in the glass.
b) the surface of the glass is probably not smooth.
c) white light was being used in this experiment.
d) the medium surrounding the glass is optically less dense than glass.

– The next question is based on the following situation.

In the attempt to estimate the coefficient of sliding friction, the following experiment is performed:

A 1-kg block was pulled along the surface as indicated. The scale registered a force of ½ kg. The coefficient of sliding friction was determined by dividing the force applied (½ kg.) by the mass of the block(1 kg).



8 – Which of these statements is the best evaluation of this experiment design?

a) the procedure is correct
b) there should be a pulley at the left end of the surface, with the string attached to the block and the scale pulled down.
c) the surface should be horizontal.
d) There should be rollers under the block.

9 – A 36-watt lamp is operated by 9-volt battery. How many amperes are flowing through the lamp?

a) ¼
b) 4
c) 27
d) 45

10 – Which of the following statements best describes how pressure and volume will be affected as a sample of ideal gas is heated in a rigid, sealed container?

a) Neither pressure nor volume will increase.
b) Pressure will remain constant while volume increases.
c) Both pressure and volume will decrease.
d) Pressure will increase while volume remains constant

11 – An object is traveling at a constant velocity of 100 meters per seconds. How far will it travel in 20 seconds?

a) 5 meters
b) 120 meters
c) 200 meters
d) 2000 meters

12 – Quantities having both magnitude and direction are called

a) line segments
b) scalars
c) vectors
d) directrixes

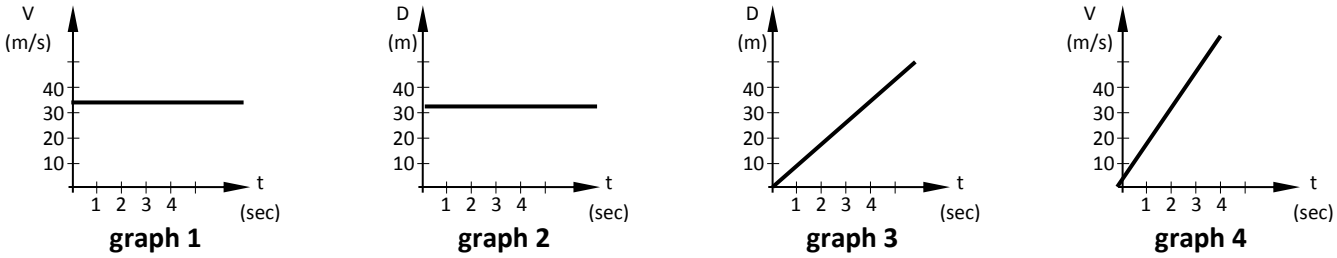
13 – Which of the following statements best describes the functioning of a battery?

a) It changes chemical energy into electrical energy.
b) It stores electricity.
c) It creates electrons.
d) It changes current into voltage.

14 – A 4-newton and 18-newton force are acting in opposite directions upon the same point object. The magnitude of their resultant is

a) 0 newtons.
b) 14 newtons.
c) 18 newtons.
d) 22 newtons.

15 – Which one of the graphs shown below represents an object at rest?



V = velocity D= Displacement t = time

a) graph 1.
b) graph 2.
c) graph 3.
d) graph 4.

16 – Which of the following terms is the metric unit for work ?

a) joules.
b) watts.
c) amperes.
d) meters.

17 – The pitch of a vibrating string depends on all of the following **except**

a) the length of the string.
b) the amplitude of the string.
c) the thickness of the string.
d) the frequency of the vibration.

18 – As the angle of incidence of a ray of light passing from air to water increase from 0° to 90°, the angle of refraction will

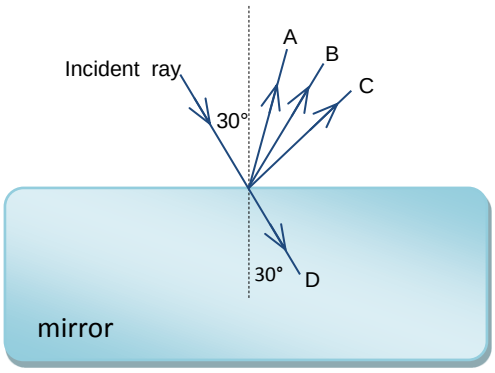
a) increase.
b) decrease.
c) remain the same .
d) first increase, then remain constant.

19 – Machines may be used for all of the following purposes **except** to

a) multiply the force
b) increase energy.
c) transform energy.
d) multiply speed.

– The next question refers to the following diagram showing a ray of light as strikes a mirror an angle of 30°.

Ray A is 15 degrees from the normal
Ray B is 30 degrees from the normal
Ray C is 45 degrees from the normal
Ray D is 30 degrees from the normal



20 – Which of the rays best represents the reflected ray?

a) A
b) B
c) C
d) D

21 – Car A weighs 2,000 lb and is traveling 50 miles per hour. Car B weighs 3,000 lb and is raveling 20 miles per hour. They collide head on a stick together. In which directions will the wreckage of the two cars move?

a) The wreckage will move in the direction car A was going.
b) The wreckage will move in the direction car B was going.
c) The wreckage will remain at he point of impact.
d) It is impossible to tell from the information given.

22– The brakes decelerate a certain car at the rate of 6 miles per hour per second. How many seconds does it take to stop the car if the car is going 54 miles per hour?

a) 48
b) 32.4
c) 11.1
d) 9

23 – The work output of a machine is always less than the work input. Work is lost due to

a) inertia
b) friction
c) momentum
d) gravity

Questions 24 and 25 are based on the information in the table below

Sample	Mass	Pressure	Temperature
Gas A	3 moles	760 mm	0°C
Gas B	1 mole	300 mm	0°C
Gas C	1 mole	760 mm	0°C
Gas D	2 moles	760 mm	300°C

24 – Which gas contains molecules with the highest average kinetic energy?

a) A
b) B
c) C
d) D

25 – Which gas occupies the smallest volume?

a) A
b) B
c) C
d) D

ANSWERS

1.	D	2.	A	3.	B	4.	A	5.	B
6.	C	7.	D	8.	C	9.	B	10.	D
11.	D	12.	C	13.	A	14.	B	15.	B
16.	A	17.	B	18.	A	19.	B	20.	B
21.	A	22.	D	23.	B	24.	D	25.	C

SOLUTIONS

1– Using the ideal gas law,

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

Where the subscripts 1 and 2 simply refer to the initial and final condition of the gas, respectively

Since volume remains the same (given), $V_1 = V_2$, or we could just call them both "volume."

$$\frac{P_1V}{T_1} = \frac{P_2V}{T_2}$$

Divide both sides by V, and they cancelled out

Now we have:

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \qquad \Rightarrow \qquad \frac{P_1}{20°\text{C}} = \frac{P_2}{25°\text{C}}$$

Cross multiply: $P_2 20 = P_1 25$

$P_2 = (25/20)\ P_1$ (divided both sides by 20)

$P_2 = (5/4)\ P_1 = 1¼$ times P_1 (simplified)

If the final pressure equals 1¼ times the initial pressure, then there must have been an *increase* in pressure. The answer is D.

2– This question involves understanding the scientific method. In the experiment (question 2), we want to check the effect of length – *only* – has on the period. To do this, we must conduct the experiment so all parameters except length are the same. The only experiment that fulfills this criteria is a). The mass of the pendulum is 50 g, the angles is 45°, but the lengths are 40 cm and 20 cm. The answer is A.

3 – Question 3 is similar, but only mass (the bob weight) should vary. The length and the angle must be held constant. The answer is B.

4 – Ohm's law is

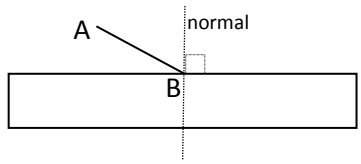
Voltage (emf) = current times resistance.

The answer is A

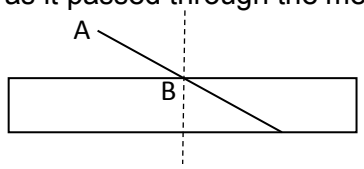
5 – "Reflect" means "bounce off", so the answer is B.

6 – "Refract" means "enter and bend", so the answer is C

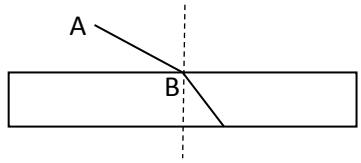
7 – The normal is the line perpendicular to the surface 0



If AB weren't bent at all as it passed through the medium, we would have:

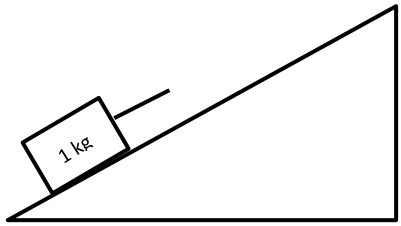


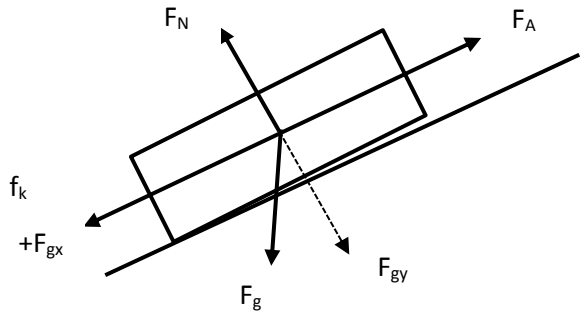
But since the glass's medium is denser than the surrounding medium, the ray was bent toward the normal:



So, the answer is D.

8 – The goal of this experiment is to determine the coefficient of sliding friction on the block, and our goal is to determine if this experiment was carried out satisfactorily. If you pull the block up the incline you have the following force diagram.





Where F_N is the normal force, F_A is the applied force, f_k is the frictional force, and F_g is the gravitational force. The way this experiment was carried out, friction is not the only force opposing the motion, the weight of the block down the incline is as well! Therefore in order to improve the experiment, we should perform it on a level surface. The answer is C.

9 – Power = $I^2 \cdot R$

Rewrite: $P = I \cdot I \cdot R$

But we know that V is $I \cdot R$, so $P = I \cdot \underbrace{I \cdot R}_{V}$ become $P = I \cdot V$

Replacing in this formula 36watts = I.(9 volts)

Solving for I $\Rightarrow$ I=4 amps (answer B)

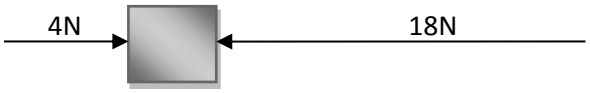
10 – The container is rigid and sealed. Thus, the volume can never change. If an enclosed gas is heated in a container whose shape cannot change, the only result will be an increase in pressure within the container. (D)

11 – When "velocity is constant " there is no acceleration (or deceleration, for that matters, which is really just a negative acceleration). So, we are allowed to use our simply D=R.T formula, where rate is really velocity. (D).

12 – By definition, (C).

13 – "Electricity" is not a value which can be stored of stored itself, but " potential " or "voltage", which have to do it with electricity, are storable. (Not B).
"Electrons" are never "created", only transferred (not C). Answer (A) best states what a battery does: convert chemical energy to electrical energy.

14 – Draw a free body diagram:



Imagine your left hand pushing with a force of 4N and your right hand pushing with a force of 18N in the opposite direction. Your right hand would "win" by a force of 14N. Mathematically, let the "right" direction be represented by a positive sign, then sum the forces :

4+(-18)= -14 or 14N in the negative (left) direction.

15 –

Graph 1 is a velocity graph, showing a velocity that remains at 30 meters per second no matter how much time passes . Having a velocity means you are moving. Not A.

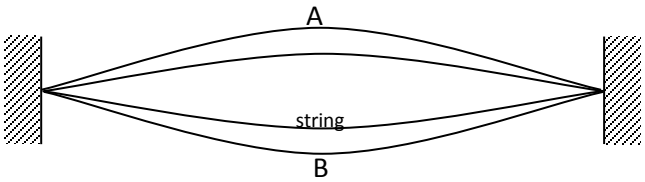
Graph 2 shows a displacement that remains at 30 meters no matter how much time passes. Displacement represents being at certain distance from a starting point. If you are remaining at the 30 meter point all the time you are not moving. B is the answer.

Graph 3 shows a person who is at 10 meters at the first second of time, 20 meters at he next second, and so on. He is therefore moving away from his starting point. Not C

Graph 4 shows a velocity that is growing with every passing second. Not D.

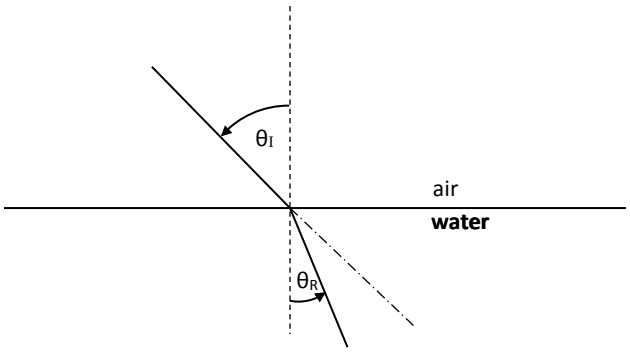
16 – If you don't have it memorized, eliminate the other possible answers. "Watts" is power, (not work !), "amperes" is current, and "meters is length.

17 – "Pitch" is governed by frequency , and frequency is the number of times a peak of a wave form passes by us with every second. (Peaks per second)

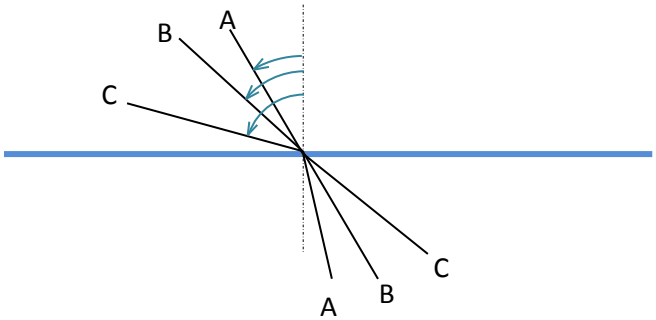


In our case, the frequency represents how many times per second the string will move back and forth between A and B. What sort of things would affect this movement, or frequency, and therefore pitch? The thickness of the string would definitely affect how well it vibrated, and so would the length of the string. The only other selection offered us in the answers is B , amplitude . Amplitude is a measure of how wide the string will vibrate out from the center, NOT how many times per second it will fluctuate. So, it's the only thing on the page not related to the pitch. Instead, amplitude affects loudness. The answer is B.

18 – Recall that the angle of incidence is measured from the normal as shown below (as is the angle of refraction!).



Notice that the incident ray has been bent toward the normal because water is a denser medium than air. The dotted line shows the path the light would have ordinarily taken if it hadn't been refracted. Now look at what happens as we increase the incident angle θ_1.



The angle of refraction increases.

19 – Machines can change the size, direction, and speed of a force. Therefore, A and D are things machines do. We know that energy is never that energy is never increased within any system (conservation of energy), just transferred, so B is our answer.

20 – The answer is B, because the angle of reflection on a flat surface is equal to the angle of incidence.

21 – This is a momentum problem:

Car A: momentum = m▪v=2000.50=100,000 **Car B:** momentum = m▪v=3000.20=60,000

Car A has the grater momentum, so it will cause the wreckage to move in its direction. It is easy to think of momentum as the thing which makes it hard to stop yourself when running. Your momentum relies on two things: your weight and your speed. Answer A.

22 – It takes the same amount of time to star a car from rest and bring it up to a velocity of 54 miles per hour, as it would to slow it to stop an initial speed of d4 miles /hr. (This is true if we assume deceleration and acceleration are constant and equal in both cases). Thus we are allowed to use the acceleration formula in a backwards application:

$a = \frac{v}{t} \Longrightarrow \frac{6\ mi}{h \cdot s} = \frac{54\frac{mi}{h}}{t}$ with $a = \frac{6\ mi}{h \cdot s}$ and $v = 54\frac{mi}{h}$

Then multiply both sides by *t* $6\frac{mi}{h \cdot s} \cdot t = 54\frac{mi}{h}$

Now divide both sides by $6\frac{mi}{h \cdot s}$ $\Longrightarrow t = \frac{54\frac{mi}{h}}{6\frac{mi}{h \cdot s}} = 9\frac{\frac{mi}{h}}{\frac{mi}{h \cdot s}}$

Using property of division with fractions $t = 9\frac{\cancel{mi}}{\cancel{h}} \cdot \frac{\cancel{h \cdot s}}{\cancel{mi}} \Longrightarrow t = 9\ seconds$ (Answer D)

23 – A perfect machine would put out exactly as much output as it received from its input. Real machines have friction in their parts, so we lose some output there (B).

24 – Kinetic energy is dependent on heat, so D is the answer.

25 – The problem did not specify a rigid container, so we must assume the volume of the gas is shrinking and growing like a balloon. From the gas laws, we know the cooler the gas, the more it contracts: the hotter, the more it expands. This narrows the answers to A, B, or C. But, applying pressure to a gas compresses it (as in a piston), so we look for the higher pressure: A or C. The gas with less mass to compress will become a smaller volume under pressure, since the smaller number of molecules can pack more tightly into a small space, so the answer is C.

The questions and letter answers in this worksheet were supplied by th National League of Nursing, and are correct. The solutions, however, were written by Lisa Bisol, CPI instructor (Fall 1994) and revised(typing and drawing) by Liliana Leegstra, Academic Support Specialist of the ASC at IRSC, (Spring 2009.)