ACT Activities

Examples that directly align to Advanced Manufacturing, Information Technology and STEM standards.

Career Cluster: Advanced Manufacturing

Mathematics in <u>Principles of Manufacturing</u>- Addresses Standard 23

The lead of the screw is the distance that the screw advances in a straight line when the screw is turned 1 complete turn. If a screw is $2\frac{1}{2}$ inches long and has a lead of $\frac{1}{8}$ inch, how many complete turns would get it all the way into the piece of wood?[1]

A. 5
B. 10
C. 15
D. 20
E. 28

D is the correct answer

With every complete turn 1/8 inch of the screw goes into the wood. So after 8 complete turns, 1 inch of the screw would be in the wood. Let x be the number of turns needed. Then we have the equation x(1/8) = 2 1/2. Multiplying by 8 gives x = 8(2 1/2) = 8(5/2) = 20.

[1] ACT Student Online. (n.d.). Retrieved from http://www.actstudent.org/sampletest/math/math_02.html (visited February 16, 2016)

Science in <u>Introduction to Electromechanical</u>- Addresses Standards 9, 10, 11

An electrical circuit contained a 12-volt (V) battery, a *resistor* (a device that resists the flow of electricity), a *capacitor* (a device that stores electrical charge and electrical energy), a *voltmeter* (an instrument for measuring voltage), and a switch, as shown in Figure 1.[2]

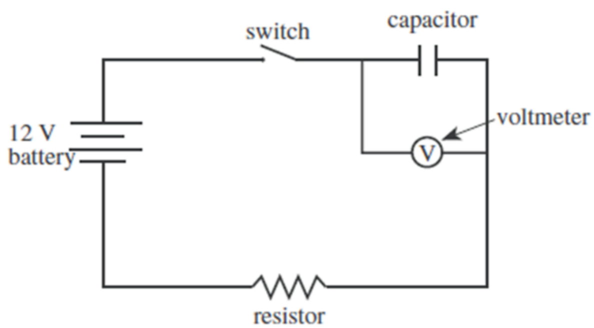


Figure 1

Experiment 1

The students used a 1 × 107 ohm (Ω) resistor and a capacitor with a capacitance of 1 × 10–6 farad (F). (Capacitance is a measure of the maximum amount of electrical charge and electrical energy a capacitor can store.) The capacitor was initially uncharged. At time zero, the students simultaneously closed the switch and started a stopwatch. At time zero and at 12 sec intervals thereafter, they recorded the voltage across the capacitor. Their results are shown in Table 1.

Table 1

Time (sec)	Voltage across capacitor (V)
0	0.0
12	8.4
24	10.9
36	11.7
48	11.9
60	12.0

[2] 2007-2008 ACT Practice Test. (n.d.). Retrieved from http://files.eric.ed.gov/fulltext/ED499163.pdf (visited on February 16, 2016)

Experiment 2

Using the 1×10^7 Ω resistor and several different capacitors, the students determined the length of time from when the switch was closed until the voltage across the capacitor reached 6 V. Their results are shown in Table 2.

Table 2	
Capacitance ($\times 10^{-6}$ F)	Time to reach 6 V across capacitor (sec)
1.2	8.3
0.6	4.2
0.3	2.1
0.1	0.7

Experiment 3

The students conducted the same procedure described in Experiment 2, except that they used a constant capacitance of 1×10^{-6} F and several different resistors. Their results are shown in Table 3.

Table 3	
Resistance ($\times 10^7$ Ω)	Time to reach 6 V across capacitor (sec)
0.75	5.2
0.50	3.5
0.25	1.7

1. In Experiment 1, the *time constant* of the circuit was the time required for the voltage across the capacitor to reach approximately 7.6 V. The time constant of the circuit used in Experiment 1 was:

F. less than 12 sec.
G. between 12 sec and 24 sec.
H. between 24 sec and 36 sec.
J. greater than 36 sec.

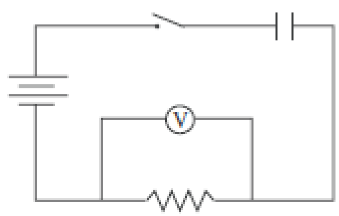
2. If, in Experiment 2, a 1.5×10^{-6} F capacitor had been used, the time required for the voltage across the capacitor to reach 6 V would have been closest to:

A. 4.2 sec.
B. 7.0 sec.
C. 10.5 sec.
D. 15.0 sec.

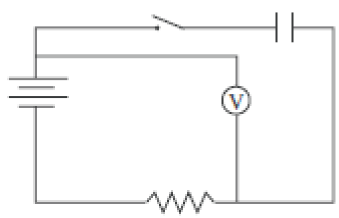
3. The main purpose of Experiment 3 was to determine how varying the:
F. battery's voltage affected the resistor's resistance at a given time.
G. capacitor's capacitance affected the time required for the voltage across the capacitor to reach a set value.
H. capacitor's capacitance affected the voltage across the battery at a given time.
J. resistor's resistance affected the time required for the voltage across the capacitor to reach a set value.

4. Based on Figure 1, to measure the voltage across the resistor only, which of the following circuits should one use? **Answer A**

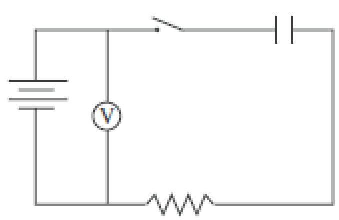
A.



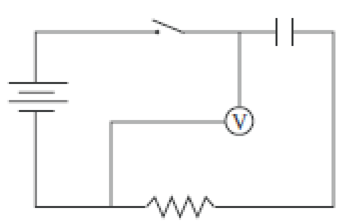
B.



C.



D.



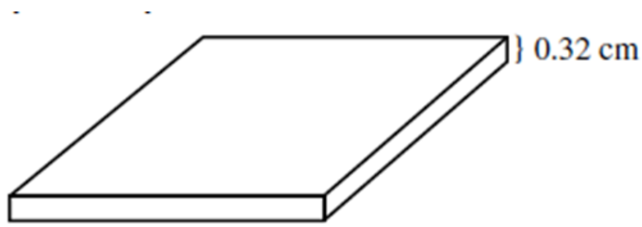
5. Consider the following hypothesis: In a circuit arranged as in Figure 1 containing a battery, a capacitor, and a constant resistance, as capacitance increases, the time required to reach a given voltage across the capacitor increases. Do the experiments support this hypothesis?

A. Yes; in Experiment 1, as capacitance increased, the time required to reach a given voltage increased.
B. Yes; in Experiment 2, as capacitance increased, the time required to reach a given voltage increased.
C. No; in Experiment 1, as capacitance increased, the time required to reach a given voltage decreased.
D. No; in Experiment 2, as capacitance increased, the time required to reach a given voltage decreased.

Career Cluster: Information Technology

Mathematics in <u>Information Technology Foundations</u>- Addresses Standard 12

A computer chip 0.32 cm thick is made up al layers of silicon. If the top and bottom layers are each 0.03 cm thick and the inner layers are each 0.02 cm thick, how many inner layers are there?[3]



A. 13
B. 15
C. 16
D. 52
E. 64

A is the correct answer

Top and bottom layer are 0.03 + 0.03 = 0.06

0.32 – 0.06 = 0.26

0.26 ÷ 0.02 = 13 layers

[3] Preparing for the ACT 2015-2016. (n.d.). Retrieved from http://cty.jhu.edu/talent/docs/2014actpreparing.pdf (visited on February 16, 2016)

Reading Comprehension in Programming & Logic I- Addresses Standard 1

This passage is adapted from the article "Information Stupor-highway" by Cal Jergenson (© 2005 by Cal Jergenson).[4]

Think about a remote control. Something so simple in function is seemingly capable of invisible magic to most of us. Only those with an engineering and electronics background probably have any real idea of *why* a remote control works. The rest of us just assume it *should*. And the longer a given technology exists, the more we take it for granted.

Consider for a moment a split screen showing modern remote control users versus the first remote control users: the original users would be cautiously aiming the remote directly at the television, reading the names of the buttons to find the right one, and deliberately pressing the button with a force that adds nothing to the effectiveness of the device. The modern users would be reclined on a sofa, pointing the remote any which way, and instinctively feeling for the button they desired, intuiting its size, shape, and position on the remote.

Humans are known for being handy with tools, so it is no surprise that we get so comfortable with our technology. However, as we become increasingly comfortable with how to *use* new technologies, we become less aware of how they *work*. Most people who use modern technology know nothing of its underlying science. They have spent neither mental nor financial resources on its development. And yet, rather than be humbled by its ingenuity, we consumers often become unfairly demanding of what our technology should do for us.

Many of the landmark inventions of the twentieth century followed predictable trajectories: initial versions of each technology (television, video games, computers, portable phones, etc.) succeeded in wowing the general public. Then, these wondrous novelties quickly became commonplace. Soon, the focus of consumer attitudes toward these inventions changed from awed gratitude to discriminating preference.

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[4] Martz, G., & Hendrix, M. (2012). Cracking the ACT: 2012 Edition. New York: Random House.

1. The passage states that original users of remote controls likely did all of the following EXCEPT:

A. use more strength pressing the button than is necessary.

B. aim the remote directly at the television.

C. feel instinctively for the desired button.

D. read the names of the buttons carefully.

2. In the passage, the author answers all of the following questions EXCEPT:

F. How do most people think the global climate crisis should be solved?

G. What was the most significant invention of the twentieth century?

H. What idea underlies humanity's tool-making instinct?

J. How do consumer attitudes about new technology change?

3. The descriptions offered by the author in the second paragraph (lines 7-15) are used to illustrate the concept that:

A. consumer behavior toward new forms of technology changes over time.

B. modern humans do not pay enough attention to instructions.

C. the first consumers of new technology used new devices with ease and comfort.

D. remote controls have become far more effective over the years.

4. The principal tone of the passage can best be described as:

F. nostalgic.

G. critical.

H. sympathetic.

J. frightened.

5. As it is used in line 79, the word alien most nearly means:

A. extraterrestrial.

B. repetitive.

C. unusual.

D. hilarious.

6. The author uses the statement "these technological marvels seem like elements of the periodic table" (lines 38-39) most nearly to mean that:

F. children learn technology while they learn chemistry.

G. consumers regard many technological inventions as unremarkable.

H. space exploration gives us most of our technology.

J. consumers complain when modern conveniences break down.

7. The phrase the status quo (line 85) most likely refers to:

A. reexamining the scope and complexity of technology.

B. making sacrifices to combat the global climate crisis.

C. blaming technology for the problems we encounter.

D. our current pattern of lifestyles and consumer habits.

8. One form of consumer behavior the author describes is a discriminating preference for:

F. less realistic video games.

G. needing to understand technology.

H. more powerful computers.

J. wanting to make sacrifices.

9. Among the following quotations from the passage, the one that best summarizes what the author sees as a potential danger is:

A. the shortcomings of any current version of technology (line 54).

B. devising alternative forms of energy (line 64).

C. the complexity of global weather patterns (lines 71-72).

D. our outlook on solving global climate problems (line 59).

10. The last paragraph differs from the first paragraph in that in the last paragraph the author:

F. makes a prediction rather than making an observation.

G. refutes a scientific theory.

H. quotes experts to support his opinions.

J. uses the word "we" instead of "I."

Career Cluster: STEM

Mathematics in Principles of Engineering and Technology- Addresses Standards 6, 7, 8

Abandoned mines frequently fill with water. Before an abandoned mine can be reopened, the water must be pumped out. The size of the pump required depends on the depth of the mine. If pumping out a mine that is "D" feet deep requires a pump that pumps a minimum of

$\frac{D^2}{25}$ +4D-250 gallons per minute, pumping out a mine that is 150 feet deep would require a pump that pumps a minimum of how many gallons per minute?[5]

A. 362 gallons/minute
B. 500 gallons/minute
C. 800 gallons/minute
D. 1250 gallons/minute
E. 1750 gallons/minute

D is the correct answer

D = 150 so substitute 150 into the equation

$\frac{D^2}{25}$ +4D-250 = Rate gallons/minute

$\frac{150^2}{25}$ +4(150)-250 = Rate gallons/minute

900 + 600 – 250 = Rate gallons/minute

1250 gallons/minute

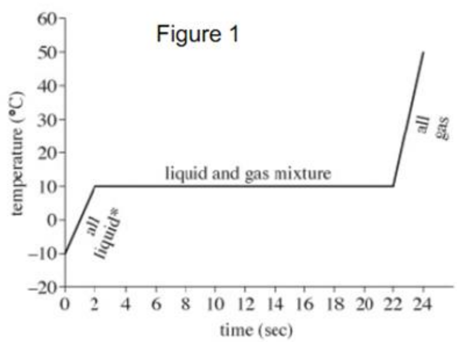
[5] ACT Student Online. (n.d.). Retrieved from http://www.actstudent.org/sampletest/math/math_01.html (visited February 16, 2016)

Science in Engineering Design I- Addresses Standards 5, 17

Suppose that 1 gram (g) of material A, initially a liquid, is kept in a cylinder fitted with a piston at a constant pressure of 1 atmosphere (atm). Table 1 and figure 1, respectively, show how material A's volume and temperature vary over time as material A absorbs heat at a rate of 10 calories per second (cal/sec). Table 2 gives the boiling points of liquid materials B-D at 1 atm.[6]

Table 1

Time (sec)	Volume of Material A (cm^3)
0	1
2	1
4	136
6	271
8	406
10	541
12	676
14	811
16	946
18	1,081
20	1,216
22	1,351
24	1,541



*Between 0 and 2 sec, some gaseous Material A is present, but the amount is negligible.

Table 2

Material	Boiling point (°C)	Heat absorbed (cal)
B	13	500
C	19	610
D	28	270

Table 1 and figure 1 best support which of the following hypotheses about the temperature and volume of Material A? (Note: Pressure is assumed to stay constant).

A. If liquid Material A is in contact with gaseous Material A and the volume of the gas increases, the gas's temperature will increase.
B. If liquid Material A is in contact with gaseous Material A and the volume of the gas increases, the gas's temperature will decrease.
C. When the temperature of gaseous Material A increases, its volume will increase.
D. When the temperature of liquid Material A increases, its volume will increase.

C is the best answer

According to figure 1, Material A was entirely in the gas phase from Time 22 sec to Time 24 sec. During this time, the temperature of Material A increased. According to Table 1, during this time, the volume of Material A also increased.

[6] 2007-2008 ACT Practice Test. (n.d.). Retrieved from http://files.eric.ed.gov/fulltext/ED499163.pdf (visited on February 16, 2016)