

Given the following equations:

$$3a = 24$$
$$a + b = 16$$

What is the value of b?

Enter a number, or enter (0) for Impossible to determine.

**solve**

*credit: Wiliam, D. (2007). Keeping learning on track: Classroom assessment and the regulation of learning. In F. K. Lester (Ed.), Second Handbook of Mathematics Teaching and Learning. (pp. 1051-98). Greenwich, CT: Information Age Publishing.*

1

A volleyball (circumference=66cm) is inflated to a pressure of 4.5psi. The number of moles of gas inside the volleyball is CLOSEST to:

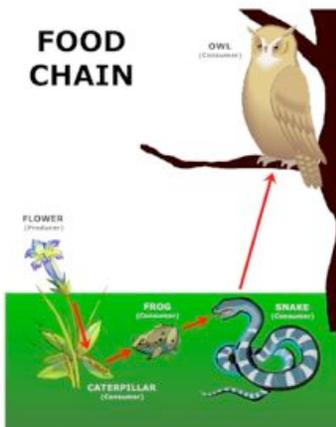
- |         |         |
|---------|---------|
| 1. 0.02 | 5. 0.18 |
| 2. 0.06 | 6. 0.22 |
| 3. 0.10 | 7. 0.26 |
| 4. 0.14 | 8. 0.30 |

**solve**

*credit: Bill Leonard, UMass Amherst*

2

In this food chain, would you expect to have more owls or more frogs? Why?



**evaluate**

1. More owls because they are good hunters and can catch more food than frogs can.
2. More frogs because they are lower on the food chain.
3. More owls because they are higher on the food chain.
4. More frogs because they have more food to eat.
5. More frogs because they are smaller and need less food.
6. More owls because no predators eat them.

*credit: Cathy Wanat, Northampton High School*

3

The sky appears to be blue during the day because:

1. Air absorbs blue light less than other frequencies (i.e., acts like a blue filter).
2. Air molecules emit blue light after being struck by sunlight.
3. The sky reflects blue light from the oceans.
4. The temperature high in the Earth's upper atmosphere is 1000 K.
5. None of the above.

**evaluate**

*credit: Bill Gerace, UMass Amherst*

4

A block m sits on a rough surface, with a spring attached and extended. As the block moves up the incline a small distance, how many forces are exerted on the block?

- |                 |                            |
|-----------------|----------------------------|
| 1. one force    | 6. six forces              |
| 2. two forces   | 7. seven forces            |
| 3. three forces | 8. more than seven forces  |
| 4. four forces  | 9. impossible to determine |
| 5. five forces  | 0. none of the above       |

enumerate

credit: Bill Gerace, UMass Amherst

5

You are hiking, and have run out of water. You are overheated and thirsty. How many of your body's systems (digestive, excretory, endocrine, nervous, muscle, circulatory, etc.) are involved in restoring homeostasis?

Enter a number from 0 to 8, or "9" to mean "more than 8".

enumerate

credit: adapted from a question by Kate Dollard, Northampton High School

6

Which component(s) of the digestive system are most like the pictures below?

Enter all that apply.



1. Mouth
2. Pharynx
3. Esophagus
4. Stomach
5. Small Intestine
6. Large Intestine
7. Rectum
8. Liver
9. Gall bladder
10. Pancreas

Skin:Wall as Mucus: \_\_\_\_\_

- |                |                      |
|----------------|----------------------|
| 1. Welcome mat | 6. vaseline          |
| 2. Storm door  | 7. no pest strip     |
| 3. Moat        | 8. none of the above |
| 4. Room        | 9. other             |
| 5. mailbox     |                      |

judge similarity

credit: Cathy Wanat, Northampton High School

7

judge similarity

credit: Kate Dollard, Northampton High School

8

In which of the following situations is the object accelerating? Choose ALL that apply; enter "0" for "none".

1. a car slowing down at a stop sign
2. a ball being swung in a circle at constant speed
3. a vibrating string
4. the Moon orbiting the Earth
5. a skydiver falling at terminal speed
6. an astronaut in an orbiting space station
7. a ball rolling down a hill
8. a person driving down a straight section of highway at constant speed with her foot on the accelerator
9. a molecule in the floor of this room

sort/classify

credit: Bill Leonard, UMass Amherst

9

Which of the following are alive? Choose ALL that apply. (Enter "0" for "none".)

1. a seed
2. a leaf on a tree
3. a leaf immediately after it has fallen
4. a tree in spring (no leaves; just buds)
5. a tree in summer (lots of leaves)
6. a tree in fall (leaves are not green)
7. a tree in winter (no leaves)

sort/classify

credit: Bill Leonard, UMass Amherst

10

Which of the following are ambiguous? Choose ALL that apply.

- |                |                   |
|----------------|-------------------|
| 1. origin      | 6. m              |
| 2. function    | 7. $\sin^{-1}(x)$ |
| 3. equilibrium | 8. relationship   |
| 4. $f(x)$      | 9. power          |
| 5. x           | 0. none of these  |

**Pick the 2 groups that would have the biggest effect on water quality in a watershed.**

**Enter up to two.**

1. Homeowners
2. Factory owners
3. Pet owners
4. Vehicle owners
5. Boat owners
6. Farmers
7. Loggers
8. City wastewater treatment plant operators

sort/classify

credit: Bill Leonard, UMass Amherst

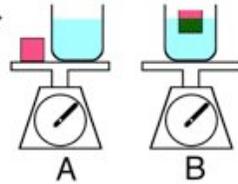
11

rank/compare

credit: Cathy Wanat, Northampton High School

12

A block and a beaker of water are placed side-by-side on a scale (case A). The block is then placed into the beaker of water, where it floats (case B). How do the two scale readings compare?



1. Scale A reads more than scale B.
2. Scale A reads the same as scale B.
3. Scale A reads less than scale B.
4. Not enough information.

rank/compare

credit: Bill Gerace, UMass Amherst

13

Which kind of reproduction is best for species survival?

1. Asexual
2. Sexual
3. Neither

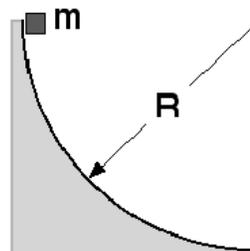
compare ways

credit: Kate Dollard, Northampton High School

14

b) A mass  $m$  slides down a frictionless circular track of radius  $R$ . Which of the following would let you most efficiently find its angular velocity relative to the center of curvature when it reaches the bottom?

- 1) Kinematics only
- 2)  $F = ma$  or Newton's laws
- 3) Work-energy theorem
- 4) Impulse-momentum theorem
- 5) Angular impulse-angular momentum theorem
- 6) More than one of the above
- 7) None of the above



If you could only have one system left, which would it be?

- |                |                    |
|----------------|--------------------|
| 1. Circulatory | 5. Digestive       |
| 2. Nervous     | 6. Respiratory     |
| 3. Endocrine   | 7. Excretory       |
| 4. Immune      | 8. Muscle/Skeletal |

compare ways

credit: Bill Gerace, UMass Amherst

15

prefer

credit: Kate Dollard, Northampton HS (based on a question by Chevy Seney of Frontier Regional School)

16

If you were walking along a road and passed a piece of trash, would you pick it up?

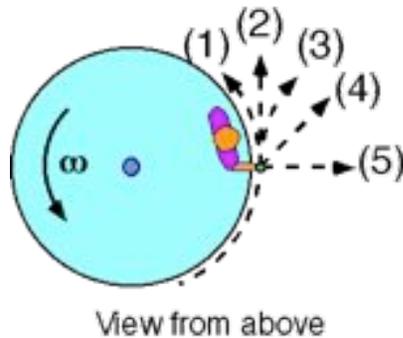
1. yes
2. no
3. it depends

prefer

credit: vaguely recollected from a question described by Kate Dollard, Northampton HS

17

A child is standing at the rim of a disk holding a rock. The disk rotates freely without friction. At the instant shown, the child throws the rock radially outward. Which of the indicated paths most nearly represents the trajectory of the rock as seen from above?



6. none of the above
7. cannot be determined

relate representations

credit: Bill Gerace, UMass Amherst

19

The diagrams below show two uniformly charged spheres. The charge on the right sphere is 3 times as large as the charge on the left sphere. Which force diagram best represents the magnitudes and directions of the electric forces on the two spheres?

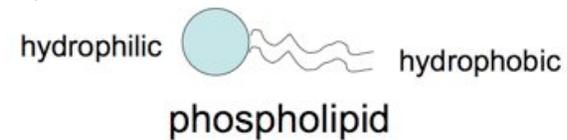
- 1.
- 2.
- 3.
- 4.
- 5.

relate representations

credit: Bill Gerace, UMass Amherst

18

the set-up...



**Hundreds of phospholipids are dropped in water and, under the water, form a sphere with water trapped inside. Draw a possible arrangement of the phospholipids to form this sphere**

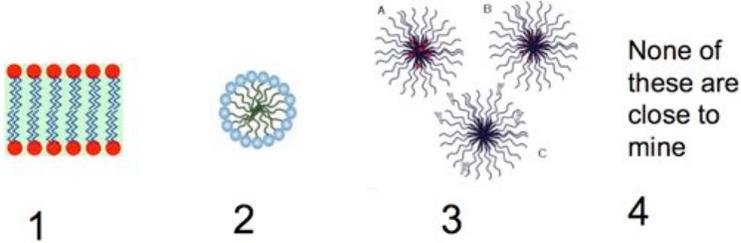
depict (step 1)

credit: Kate Dollard, Northampton High School

20

...and the question.

Which drawing is closest to your idea of how the phospholipids could be arranged into a sphere in water with water trapped inside?

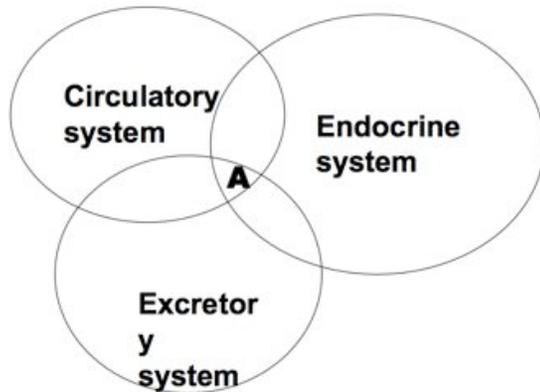


depict (step 2)

credit: Kate Dollard, Northampton High School

21

What could A represent? [Students discussed Q in groups, responses were collected on board, class discussed, and then used the CRS to vote on their top 2 picks from the list.]



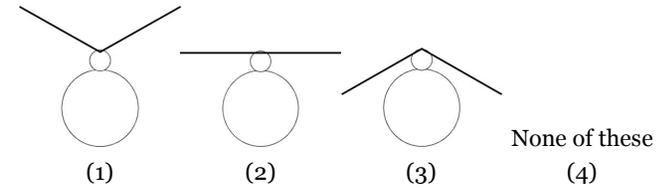
gestalt

credit: Kate Dollard, Northampton High School

23

[Context: Students have been shown how to connect two forks to a quarter, and balance the assembly counter-intuitively on the edge of a cup. After experimenting with this for a bit:] Make a drawing of the top view of the arrangement of 2 forks, 1 quarter, and 1 cup.

[after drawing:] Which drawing below most closely resembles yours?



depict (both steps)

credit: Bill Leonard, UMass Amherst

22

What physiological problem might this electrocardiogram indicate?



[imagine an appropriate list of possible health conditions]

gestalt

credit: Idea by Ian Beatty, UMass Amherst, who doesn't have the content knowledge to invent a good set of choices.

24

If you want to have strong, athletic children, you should work out at the gym a lot.

Enter one response.

1. Agree
2. Disagree
3. It depends.

If you want to do as little work as possible while carrying a heavy box, should you be careful not to let it move up and down at all as you walk?

1. yes
2. no
3. it depends

### determine implication

*credit: Cathy Wanat, Northampton High School*

25

A coin has just been flipped 1000 times, and it landed heads 600 times and tails 400 times. What is the probability that the next flip of the coin will land heads?

- |        |                            |
|--------|----------------------------|
| 1. 10% | 6. 60%                     |
| 2. 20% | 7. 70%                     |
| 3. 30% | 8. 80%                     |
| 4. 40% | 9. impossible to determine |
| 5. 50% | 0. none of the above       |

### predict & verify

*credit: Bill Leonard, UMass Amherst*

27

### determine implication

*credit: Ian Beatty, UMass Amherst*

26

Two identical steel balls are released from rest from the same height and travel along tracks as shown and labeled below.



Which ball reaches the end of its track first?

1. The ball on track A.
2. The ball on track B.
3. Neither; it's a tie.
4. Not enough information.

### predict & verify

*credit: Bill Gerace, UMass Amherst*

28

You are a doctor, and a patient comes to you complaining that she's unusually short of breath after exercising. What health problems might be responsible? Choose all that apply.

1. leaky heart valve(s)
2. damaged heart muscle
3. hardened arteries
4. high blood pressure
5. low red blood cell count
6. obstructed veins in heart muscle
7. poor diet
8. high cholesterol levels
9. heartbeat arrhythmia
0. none of the above

## diagnose

*credit: Ian Beatty, UMass Amherst*

29

To minimize the work you do getting a heavy bag of groceries from the first floor to the second floor of a building, should you:

1. carry the bag up the stairs?
2. carry the bag up in an elevator?
3. put the bag on the floor of an elevator, ride up with it, and then pick up the bag again?
4. carry the bag up a ramp?
5. put the bag in a cart and push it up a ramp?

## recommend

*credit: Bill Gerace, UMass Amherst*

31

You are a dietician helping a teenager with his diet. Here is a typical day's meal:

Breakfast: bagel and orange juice

Lunch: Pita with lettuce, tomato, peppers & olives and banana

Supper: pasta with tomato sauce, salad with low-fat dressing, Coke

What advice would you give this person?

Choose ALL that apply.

1. Keep up the good choices!
2. Add more fat to your diet.
3. Remove fat from your diet.
4. Add more carbohydrates to your diet.
5. Remove carbohydrates from your diet.
6. Add more calcium to your diet.
7. Reduce the calcium in your diet
8. Add more protein to your diet.
9. Remove protein from your diet.

## recommend

*credit: Cathy Wanat, Northampton High School*

30

How would a giraffe's heart be different from a human's? Choose all that apply.

1. it would be larger
2. it would be proportionally larger
3. it would have thicker walls
4. it would have proportionally thicker walls
5. it would beat faster
6. it would beat more slowly
7. it would have more chambers
8. it would have different valve mechanisms
9. it would be located somewhere else in the body

## hypothesize change

*credit: Ian Beatty, UMass Amherst*

32

In a beaker, a saturated salt solution is in equilibrium with undissolved salt lying on the bottom of the container. If some alcohol is now poured into the beaker, what will happen?

1. More salt will dissolve, leaving less on the bottom.
2. Some salt will crystallize out of solution, leaving more on the bottom.
3. All the salt will crystallize out of solution.
4. Something else will happen.
5. Nothing will change.

Methotrexate is an antimetabolite drug that interferes with the formation of nucleotides. At what stage would it be most effective?

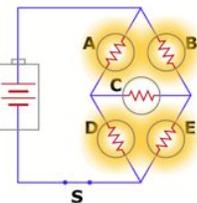
1. G<sub>1</sub>
2. G<sub>0</sub>
3. S
4. G<sub>2</sub>
5. Prophase
6. Metaphase
7. Anaphase
8. Telophase
9. Cytokinesis

### hypothesize change

credit: Ian Beatty, UMass Amherst

33

A battery and 5 bulbs are arranged as shown, and when the switch is closed 4 of the bulbs are lit. Which bulbs **change** when bulb B is unscrewed from its socket?



1. Bulb E goes out. (Bulbs A and D stay on; bulb C stays off.)
2. Bulb E goes out; bulb C goes on. (Bulbs A and D stay on.)
3. Bulb A goes out; bulb C goes on. (Bulbs D and E stay on.)
4. Bulb C goes on. (Bulbs A, D, and E stay on.)
5. Bulb C goes on; bulb D goes out. (Bulbs A and E stay on.)
6. I have no idea!

### infer from a model

credit: Bill Leonard, UMass Amherst

35

### infer from a model

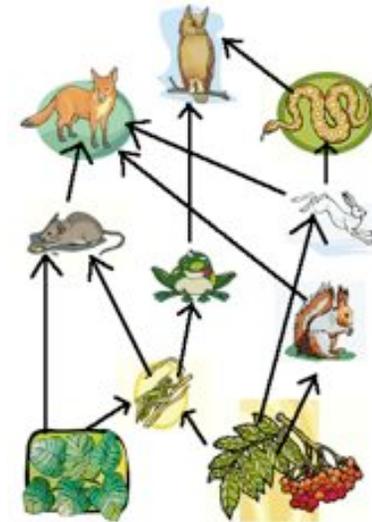
credit: Sue Lincoln, Northampton High School

34

the set-up...

Observations of a particular ecosystem lead you to propose this food web. If a disease causes the population of frogs to decrease, what would you expect to happen to the population of rabbits?

1. increase
2. decrease
3. stay the same



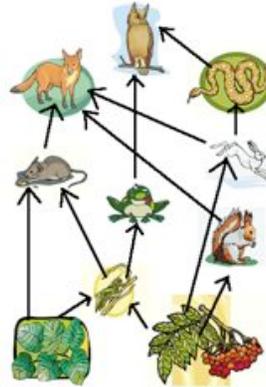
### extend a model, set-up

credit: Ian Beatty, UMass Amherst

36

...and the primary question.

Now, if you observe that the population of rabbits increases but the population of squirrels does not, which of these changes to the food web is most likely to explain this?



1. decide frogs eat rabbits
2. decide owls don't eat frogs
3. decide squirrels eat crickets
4. decide owls eat rabbits
5. decide foxes eat frogs

6. decide snakes eat frogs
7. decide we're missing an important plant or animal (that fits where?)

### extend a model, completion

credit: Ian Beatty, UMass Amherst

37

Which of the following are you least comfortable using to solve problems?

1. Kinematics
2. Newton's Laws
3. Work-Energy Theorem
4. Momentum-Impulse Theorem
5. Angular Momentum-Angular Impulse Theorem

### reflection

credit: Ian Beatty, UMass Amherst

39

A simple pendulum is released from rest with the string at an angle  $A$ . It swings back and forth with frequency  $f$ . The angle  $\theta$  that the string makes with the vertical as a function of time can be described by the equation  $\theta(t) = A \cos(2\pi f t)$ . Which of the following equations might describe a real pendulum whose oscillations gradually die out as time passes? ("B" is some constant.)

1.  $\theta(t) = A \cos(2\pi f t)$
2.  $\theta(t) = A \cos(2\pi f \sqrt{t})$
3.  $\theta(t) = A \cos^2(2\pi f t)$
4.  $\theta(t) = A e^{-Bt} \cos(2\pi f t)$
5.  $\theta(t) = A \cos(2\pi f e^{-Bt} t)$
6.  $\theta(t) = A \cos(2\pi f t) - Bt$
7. none of the above

### extend a model

credit: Ian Beatty, UMass Amherst

38

Which of the following skills are you confident about right now? Mark ALL that apply. Enter "9" for "None of these".

1. operating the PRS hardware and software
2. creating PRS questions
3. managing small-group work
4. managing whole-class discussions
5. anticipating students' answers and explanations
6. interpreting students' answers and explanations
7. adjusting instruction based on students' answers & explanations
8. integrating PRS with classroom and curricular constraints

### reflection

credit: Bill Leonard, UMass Amherst

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