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QUESTION 1

Just as the ingestion of nutrients is mandatory for human life, so is the excretion of metabolic waste products. One of these nutrients, protein, is used for building muscle, nucleic acids, and countless compounds integral to homeostasis. However, the catabolism of the amino acids generated from protein digestion produces ammonia, which, if not further degraded, can become toxic. Similarly, if the same salts that provide energy and chemical balance to cells are in excess, fluid retention will occur, damaging the circulatory, cardiac, and pulmonary systems.

One of the most important homeostatic organs is the kidney, which closely regulates the excretion and reabsorption of many essential ions and molecules. One mechanism of renal function involves the secretion of antidiuretic hormone (ADH).

Diabetes insipidus (DI), is the condition that occurs when ADH is ineffective. As a result, the kidneys are unable to concentrate urine, leading to excessive water loss. There are two types of DI -- central and nephrogenic. Central DI occurs when there is a deficiency in the quantity or quality of ADH produced. Nephrogenic DI occurs when the kidney tubules are unresponsive to ADH. To differentiate between these two conditions, a patient\\'s urine osmolarity is measured both prior to therapy and after a 24-hour restriction on fluid intake. Exogenous ADH is then administered and urine osmolarity is measured again. The table below gives the results of testing on four patients. Assume that a urine osmolarity of 285 mOsm/L of H2O is normal.

Table 1 Urine Osmolarity (mOsm/L of H_2O)

Patient	Before Therapy	After fluid restriction	After ADH
A	285	765	765
B	180	765	765
C	180	180	400
D	180	180	180

Based on the data in Table 1, which of the four patients most likely has nephrogenic diabetes insipidus?

A. Patient A

B. Patient B

C. Patient C

D. Patient D

Correct Answer: C

You\\'re told that a normal value for urine osmolarity is 285 milli-osmoles per liter of H2O. Since ADH increases water reabsorption in the kidneys, patients with diabetes insipidus are expected to have a decreased urine osmolarity. And if normal is 285 milli-osmoles per liter of water, then based on the information in Table 1, you should have concluded that Patient A does not have diabetes insipidus. Patients B, C, and D, have a very low urine osmolarity prior to therapy, indicating that there is something wrong. To answer this question, you must have a good understanding of the

mechanisms behind both central and nephrogenic diabetes insipidus. According to the passage, central diabetes insipidus is when ADH itself is either deficient in quantity or quality. Therefore, exogenous supplementation of ADH SHOULD alleviate the symptoms; that is, the kidneys should be able to concentrate urine, and therefore, urine osmolarity should greatly increase only AFTER ADH is administered. It should NOT increase after the 24- hour restriction of fluid intake because water is not being reabsorbed.

QUESTION 2

A continuous spectrum of light, sometimes called blackbody radiation, is emitted from a region of the Sun called the photosphere. Although the continuous spectrum contains light of all wavelengths, the intensity of the emitted light is much

greater at some wavelengths than at others. The relationship between the most intense wavelength of blackbody radiation and the temperature of the emitting body is given by Wien\\'s law, ? = 2.9 x 106 /T, where ? is the wavelength in

nanometers and T is the temperature in kelvins.

As the blackbody radiation from the Sun passes through the cooler gases in the Sun\\'s atmosphere, some of the photons are absorbed by the atoms in these gases. A photon will be absorbed if it has just enough energy to excite an electron

from a lower energy state to a higher one. The absorbed photon will have an energy equal to the energy difference between these two states. The energy of a photon is given by E = hf = hc/? where h = 6.63 × 10-34 J•s, Planck\\'s constant,

and c = 3 × 108 m/s, the speed of light in a vacuum.

The Sun is composed primarily of hydrogen. Electron transitions in the hydrogen atom from energy state n = 2 to higher energy states are listed below along with the energy of the absorbed photon:

Final Energy State

Energy (x 10-19 J)

n = 3

3.02

n = 4

4.08

n = 5

4.57 n = 6

4.84

n = ?

5.44

At the center of the visible spectrum is light with a wavelength of 550 nm. What is the frequency of this light?

A. 9.0 x 108 Hz

B. 1.8 x 1012 Hz

C. 5.4 x 1014 Hz

D. 1.8 x 1016 Hz

Correct Answer: C

This question asks for the frequency f of light given its wavelength . If you didn\\'t remember the relationship between the two, you could have figured it out from the formula hf = hc/ given in the passage. Dividing both sides by h, we obtain f =

$$f = \frac{3 \times 10^{8}\ m/s}{550 \times 10^{-9} m} = 5 \times 10^{14}\ \text{Hz}$$

c/, where c is the speed of light in a vacuum. Plugging in = 550 nm, we obtain which most closely corresponds to choice C.

QUESTION 3

Musical instruments generate vibrations in the air that are perceived as musical tones. In many kinds of drums, these vibrations are created by a standing waves in a vibrating membrane. In a timpani drum, membrane vibration is coupled to the vibration of an enclosed volume of air. There may also be a second membrane whose vibration is coupled to that of the first by the enclosed air space, as in a snare drum. An idealized circular membrane will vibrate at normal mode frequencies given by Equation 1 where T is the membrane tension, r is the membrane radius, is the mass per unit area of the membrane, and frel is the relative frequency shown under each mode in Figure 1. The pitch of drums can be tuned by adjusting the membrane tension.

$$f_{mn} = \frac{2.40 \times f_{rel}}{2\pi r}\sqrt{\frac{T}{\sigma}}$$

Equation 1

The modes are designated by two numbers, m and n. m indicates the number of diameter nodes, and n indicates the number of circular nodes. Several modes of vibration are shown in Figure 1.

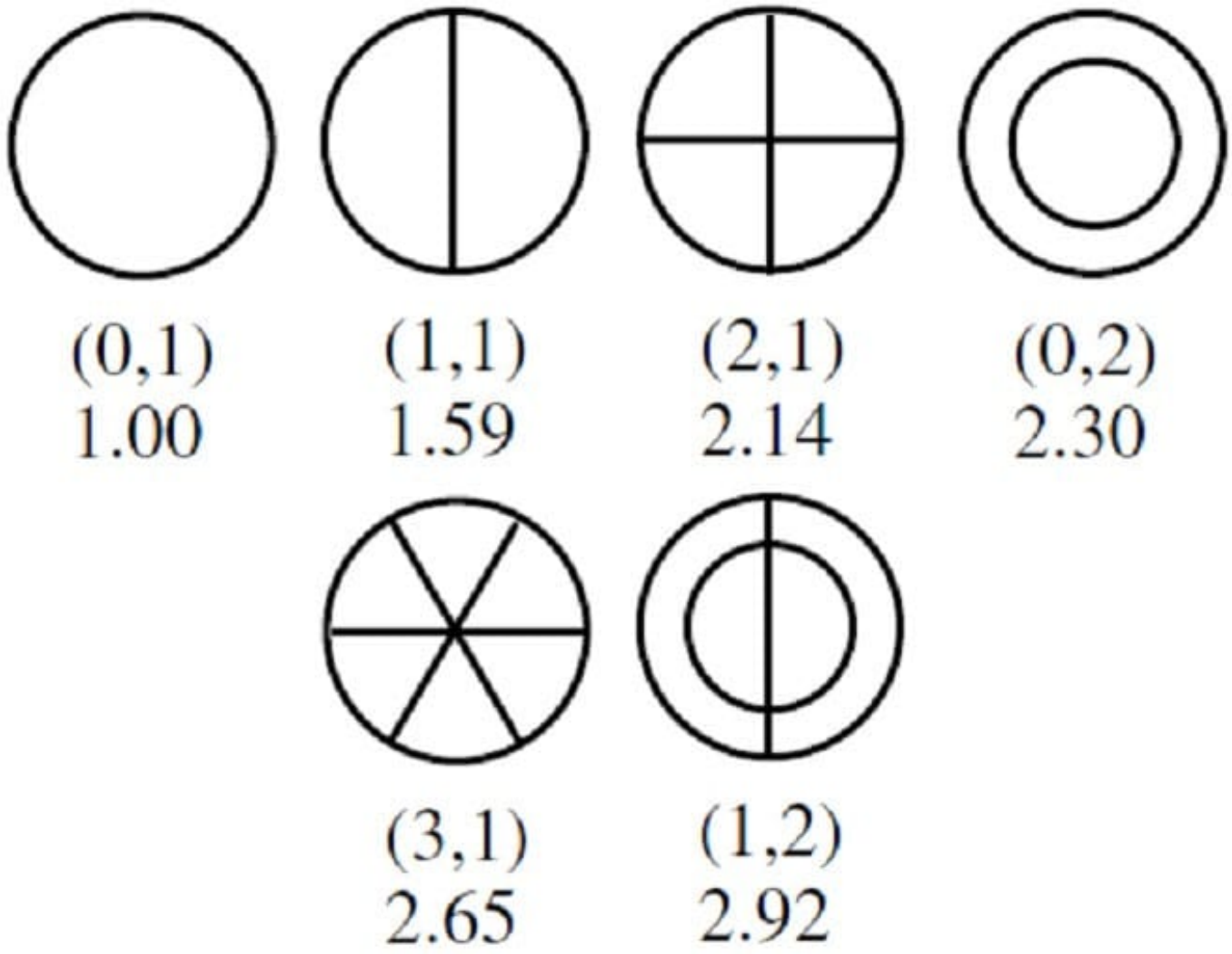


Figure 1

Which of the following combinations of modal frequencies would generate the highest beat frequency?

A. (0,1) and (2,1)

B. (0,1) and (0,2)

C. (1,1) and (3,1)

D. (2,1) and (1,2)

Correct Answer: B

Sounds that differ in their frequency produce "beats" of high amplitude by interference at a frequency equal to the difference between their frequencies. The greater the difference in frequencies between the two sounds, the greater will be the frequency of the beats produced. Musicians may use beats to help tune intruments. When an instrument is tuned to a known frequency, the beats will slow down, then disappear when the frequencies are equal.

$$\text{Freq}_{\text{beats}} = \text{Freq}_1 - \text{Freq}_2$$

The relative frequencies given in Figure 1 are directly proportional to the actual frequency of vibration, so we can

compare them directly. Among the choices, the greatest difference is between the (0,1) and (0,2) modes.

QUESTION 4

When softball players take batting practice, they often use a machine called an "automatic pitcher," which is essentially a cannon that uses air pressure to launch a projectile. In a prototype automatic pitcher, a softball is loaded into the barrel of the cannon and rests against a flat disk. That disk is locked into place, and a high air pressure is built up behind it. When the disk is released, the softball is pushed along the barrel of the cannon and ejected at a speed of V0. Figure 1 shows the batter and automatic pitcher. The angle of the barrel to the horizontal is . The unit vectors I and j point in the horizontal and vertical directions respectively.

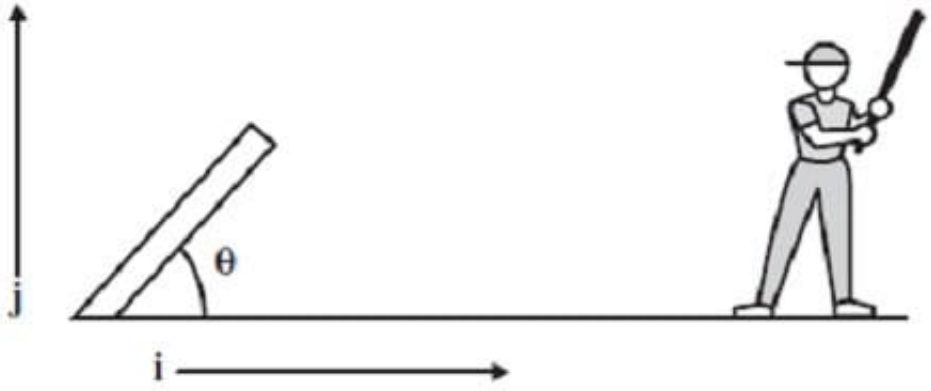


Figure 1

The height above the ground y of the softball as a function of time t is shown in Figure 2, where t = 0 at Point A, t = tB at Point B, and t = tC at Point C. The softball is ejected from the barrel of the cannon at Point A; it reaches its maximum height at Point B; and the batter hits the softball at Point C. (Note: Assume that the effects of air resistance are negligible unless otherwise stated.)

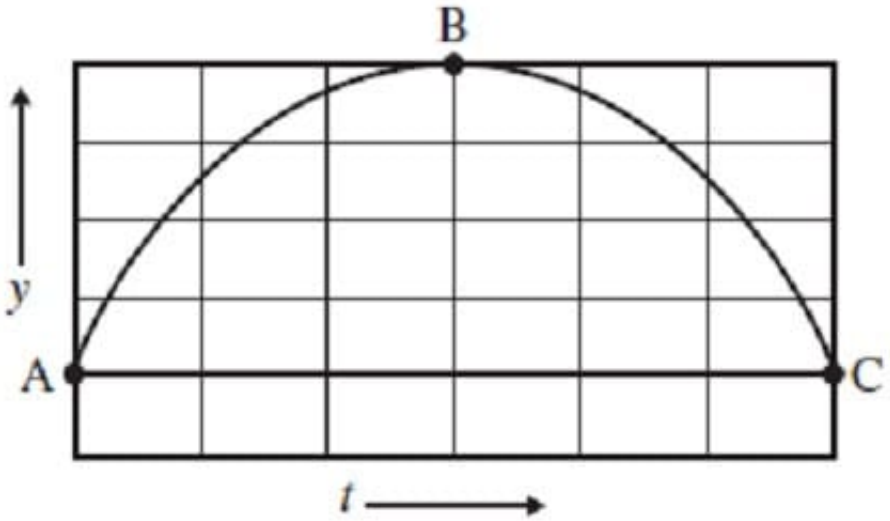


Figure 2

What physical quantity is NOT the same at Point C as at Point A?

A. The velocity of the softball

B. The speed of the softball

C. The gravitational potential energy of the softball

D. The horizontal component of the velocity of the softball

Correct Answer: A

The velocity of the softball is a vector, which means that it has both a magnitude and direction. At Point A, the velocity vector points up and to the right, because the softball is traveling in his direction. At Point C, however, the velocity vector points down and to the right. Since the velocity\\'s direction has changed, it is not the same at Points A and C, and choice A is correct.

You should know that the gravitational potential energy of the softball is given by U = mgy, where m is the mass, g is the acceleration due to gravity, and y is the height above the Earth. Since Points A and C are at the same height y, the gravitational potential is the same and choice C is incorrect.

The passage says to ignore air resistance, so the total mechanical energy, which is the kinetic plus potential energy, is conserved in this system. Since the gravitational potential is the same at Points A and C, the kinetic energy (1/2)mv2 must be the same as well. Because the mass m does not change, the speed v must be the same at both points also, and choice B is wrong.

Since air resistance is negligible, the only force present is that of gravity, which acts in the vertical direction. Consequently, there is no horizontal force on the softball, which means there can be no horizontal acceleration. Therefore, the horizontal component of the velocity must remain the same throughout the softball\\'s flight, and choice D is wrong.

QUESTION 5

In an acetyl molecule, two atoms of carbon are bonded by:

A. two sigma bonds and two pi () bond.

B. one sigma bond and one pi () bond.

C. two sigma bonds and one pi () bond.

D. one sigma bonds and two pi () bond.

Correct Answer: D

QUESTION 6

When Gwendolyn Brooks published her first collection of poetry A Street In Bronzeville in 1945 most reviewers recognized Brooks\\' versatility and craft as a poet. Yet, while noting her stylistic successes few of her contemporaries discussed the critical question of Brooks\\' relationship to the Harlem Renaissance. How had she addressed herself, as a poet, to the literary movement\\'s assertion of the folk and African culture, and its promotion of the arts as the agent to define racial integrity? The New Negro poets of the Harlem Renaissance expressed a deep pride in being Black; they found reasons for this pride in ethnic identity and heritage; and they shared a common faith in the fine arts as a means of defining and reinforcing racial pride. But in the literal expression of this impulse, the poets were either romantics, or realists and, quite often within the same poem, both. The realistic impulse, as defined best in the poems of McKay\\'s

Harlem Shadows (1922), was a sober reflection upon Blacks as second class citizens, segregated from the mainstream of American socio-economic life, and largely unable to realize the wealth and opportunity that America promised. The romantic impulse, on the other hand, as defined in the poems of Sterling Brown\\'s Southern Road (1932), often found these unrealized dreams in the collective strength and will of the folk masses. In comparing the poems in A Street in Bronzeville with various poems from the Renaissance, it becomes apparent that Brooks brings many unique contributions to bear on this tradition. The first clue that A Street In Bronzeville was, at its time of publication, unlike any other book of poems by a Black American is its insistent emphasis on demystifying romantic love between Black men and women. During the Renaissance, ethnic or racial pride was often focused with romantic idealization upon the Black woman. A casual streetwalker in Hughes\\' poem, "When Sue Wears Red," for example, is magically transformed into an Egyptian Queen. In A Street In Bronzeville, this romantic impulse runs headlong into the biting ironies of racial discrimination. There are poems in which Hughes, McKay and Brown recognize the realistic underside of urban life for Black women. But for Brooks, unlike the Renaissance poets, the victimization of poor Black women becomes not simply a minor chord but a predominant theme. ...Brooks\\' relationship with the Harlem Renaissance poets, as A Street in Bronzeville ably demonstrates, was hardly imitative. As one of the important links with the Black poetic tradition of the 1920s and 1930s, she enlarged the element of realism that was an important part of the Renaissance world-view. Although her poetry is often conditioned by the optimism that was also a legacy of the period, Brooks rejects outright their romantic prescriptions for the lives of Black women. And in this regard, she serves as a vital link with the Black Arts Movement of the 1960s that, while it witnessed the flowering of Black women as poets and social activists as well as the rise of Black feminist aesthetics in the 1970s, brought about a curious revival of romanticism in the Renaissance mode.

Suppose that a recently-discovered collection of Gwendolyn Brooks\\' poems contained female protagonists that embodied the ideal woman. This information would:

A. support the author\\'s contention that women poets were self-serving.

B. negate the author\\'s view that black poets presented women and men with inequality.

C. contradict the author\\'s opinion that Gwendolyn Brooks allowed readers to experience a more accurate description of the modern Black woman.

D. neither support nor contradict the author\\'s claim that Brooks served as an integral link between Harlem Renaissance poets and the Black Arts Movement poets.

Correct Answer: C

One of the major points of this passage is that Gwendolyn Brooks was one of the first poets to take her readers away from the overidealized Black woman represented as an "Egyptian Queen." Choices A and B are incorrect because the author never indicates women poets to be selfserving, or how men and women were presented differently in the context of poetry. Choice D is a distracter choice because it touches on the theme of Brooks having served as a link between the Renaissance and the Black Arts Movement. However, upon close examination, we see that this would contradict with the author\\'s view that Brooks did indeed serve as a vital link between the two periods of poetry, seen in her visionary portrayal of women.

QUESTION 7

A helium-neon gas discharge laser as shown in Figure 1 below generates a coherent beam of monochromatic light at a wavelength of 632.8 nm.

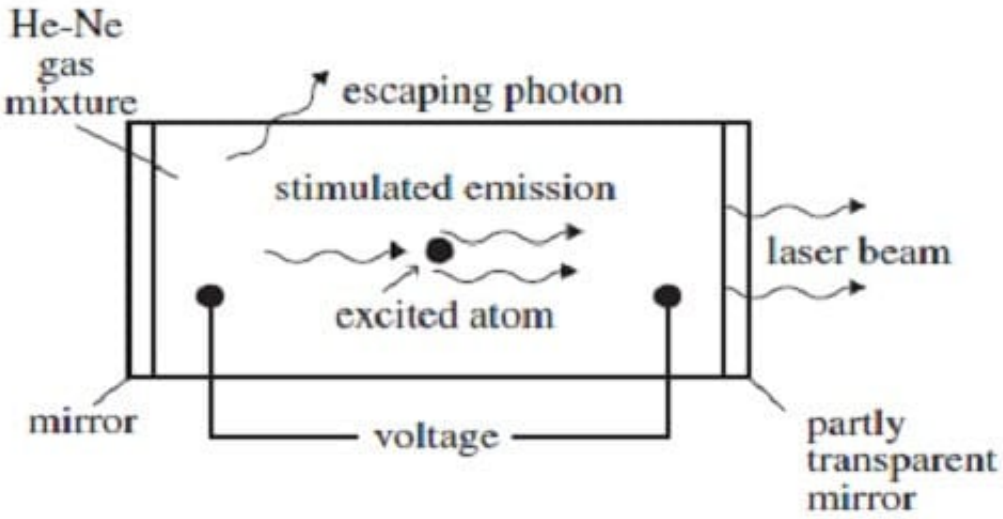


Figure 1

A discharge current of electrons is created in the tube by an applied voltage. When these electrons collide with the helium atoms, they can excite ground-state helium electrons to an energy level of 20.61 eV. The excited electrons cannot decay back to the ground state by emitting a photon because such a transition does not conserve angular momentum. Instead, if the excited helium atom collides with a neon atom, a ground-state electron in the neon atom can be excited to an energy level of 20.66 eV, and the helium electron can return to its ground state. The above process occurs quite often in the tube until the percentage of neon atoms with electrons in the 20.66-eV energy level is greater than the percentage of neon atoms with electrons in lower levels. This condition is called a population inversion. An excited electron in one of the neon atoms can then spontaneously decay by emitting a photon of wavelength 632.8 nm in a random direction. The photon will stimulate the same transition in another excited electron in a neon atom. The photon radiated by this stimulated emission process travels in the same direction as the original photon. The resulting light is then reflected back and forth inside the tube until it escapes through the partially transparent mirror. (Note: A photon\\'s energy in eV is given by E = 1240/, where is the photon\\'s wavelength in nm. The helium and neon ground-state energies are both 0 eV.)

Why is stimulated emission of photons necessary in order to produce a coherent beam of light instead of spontaneous emission alone?

A. Stimulated emission produces photons of higher energy than those produced by spontaneous emission.

B. Stimulated emission produces photons that travel in the same direction as the photon that induces their emission.

C. Stimulated emission produces photons with longer wavelengths than those produced by spontaneous emission.

D. Either spontaneous or stimulated emission alone would be sufficient to produce laser light.

Correct Answer: B

To answer this question, you have to figure out the difference between stimulated and spontaneous emission. The passage states that a photon is emitted in a random direction when an atom spontaneously decays. This process is called spontaneous emission. It also states that a photon can stimulate an electron transition in an atom. The photon that is emitted in this process, called stimulated emission, travels in the same direction as the stimulating photon. Therefore, spontaneous emission produces photons that travel in random directions, whereas stimulated emission produces photons that travel in the same direction as the stimulating photon. A coherent beam of light consists of photons travelling in the same direction. So choice B is correct. Choices A and C are wrong because, as stated in the

third paragraph, the photon produced by spontaneous emission causes stimulated emission by inducing the same electron transition in another excited atom. Since the electron transition is the same, the photon energy released by the transition is the same, and the photon wavelengths must be the same because energy and wavelength are related by the formula E = 1240/. Choice D is incorrect because stimulated emission is necessary to obtain a large number of photons traveling in the same direction.

QUESTION 8

Every atomic orbital contains plus and minus regions, defined by the value of the quantum mechanical function for electron density. When orbitals from different atoms overlap to form bonds, an equal number of new molecular orbitals results. These are of two types: or bonding orbitals, formed by overlap between orbital regions with the same sign, and antibonding * or * orbitals, formed by overlap between regions with opposite signs. Bonding orbitals have lower energy than their component atomic orbitals, and antibonding orbitals have higher energy. The electron pairs reside in the lower-energy bonding orbitals; the higher-energy, less stable orbitals remain empty when the molecule is in its ground state. A benzene ring has six unhybridized pz orbitals (one from each carbon atom), which together from six molecular orbitals, each one delocalized over the entire ring. Of the possible orbital structures for benzene, the one with the lowest energy has the plus region of all six p orbital functions on one side of the ring. The six electrons occupying the orbitals fill the three most stable molecular orbitals, leaving the other three empty. Molecular orbitals are filled from the lowest to the highest energy level. The number of bonds between atoms is determined by the number of filled bonding orbitals minus the number of filled antibonding orbitals; each antibonding orbital cancels out a filled bonding orbital. For a diatomic molecule, orbitals in the n = 2 energy level are filled as follows:

σ_{2s}, σ^*_{2s}, $\sigma 2p_z$, $\pi 2_{px}$ and $\pi 2_{py}$

$^*_{2px}$

p_z

(equal in energy), and * (equal in energy), *2 . (The designation of the three p orbitals as , , and are interchangeable.) Absorption of a photon can raise an electron to a higher-energy molecular orbital. The excited electron does not immediately change its spin, which is opposite to that of the electron with which it was previously paired. This singlet state is relatively unstable: the molecule may interact with another molecule, or fluoresce and return to its ground state. Alternatively, there may be a change in spin direction somewhere in the system; the molecule then enters the so-called triplet state, which generally has lower energy. The molecule now cannot return quickly to its ground state, since the excited electron no longer has a partner of opposite spin with which to pair. It also cannot return to the singlet state, because the singlet has greater energy. Consequently, the triplet state, which has two unpaired electrons in separate orbitals, is long-lived by atomic standards, with a lifetime that may be ten seconds or more. During this period, the molecule is highly reactive.

Among conjugated polyenes (molecules with alternating carbon-carbon double and single bonds) why are those that are longer able to absorb longer wavelengths of light?

A. Larger molecular orbitals have a lower ground state.

B. A longer wavelength is better able to interact with a longer molecular orbital.

C. The larger number of molecular orbitals allows for smaller energy transitions.

D. Larger molecular orbitals can absorb more energy.

Correct Answer: C

The key to this question is found in the discussion in Chapter 1 of your Physical Sciences Review Notes where you are told that a photon of light can be absorbed only if its energy level is equal to the change in energy between two orbitals in the atom or molecule. Longer wavelengths of light have a lower frequency and thus lower energy level, so you can eliminate choice D immediately. The wavelength of light does not have to fit the length of the molecule, so choice B is wrong. This leaves you with choices A and C. To decide between these choices, think about what determines the energy of a quantum of light absorbed by an atom or molecule. The energy of the photon must be equal to the difference in energy between the ground state and the excited state. What is important is not the absolute energy level of the ground state, but the difference in energy level between the lower and higher orbital. Longer conjugated polyenes have a greater number of p electrons forming pi orbitals, and therefore a greater number of possible molecular orbitals. This produces smaller energy transitions, allowing for absorption of photons at a lower energy and longer wavelength. Thus, choice C is correct.

QUESTION 9

There are two opposing theories of light: the particle theory and the wave theory. According to the particle theory, light is composed of a stream of tiny particles that are subject to the same physical laws as other types of elementary particles.

One consequence of this is that light particles should travel in a straight line unless an external force acts on them. According to the wave theory, light is a wave that shares the characteristics of other waves. Among other things, this means

that light waves should interfere with each other under certain conditions.

In support of the wave theory of light, Thomas Young\\'s double slit experiment proves that light does indeed exhibit interference. Figure 1 shows the essential features of the experiment. Parallel rays of monochromatic light pass through two

narrow slits and are projected onto a screen. Constructive interference occurs at certain points on the screen, producing bright areas of maximum light intensity. Between these maxima, destructive interference produces light intensity minima.

The positions of the maxima are given by the equation dsin = n, where d is the distance between the slits, is the angle shown in Figure 1, the integer n specifies the particular maxima, and is the wavelength of the incident light. (Note: sin tan

for small angles.)

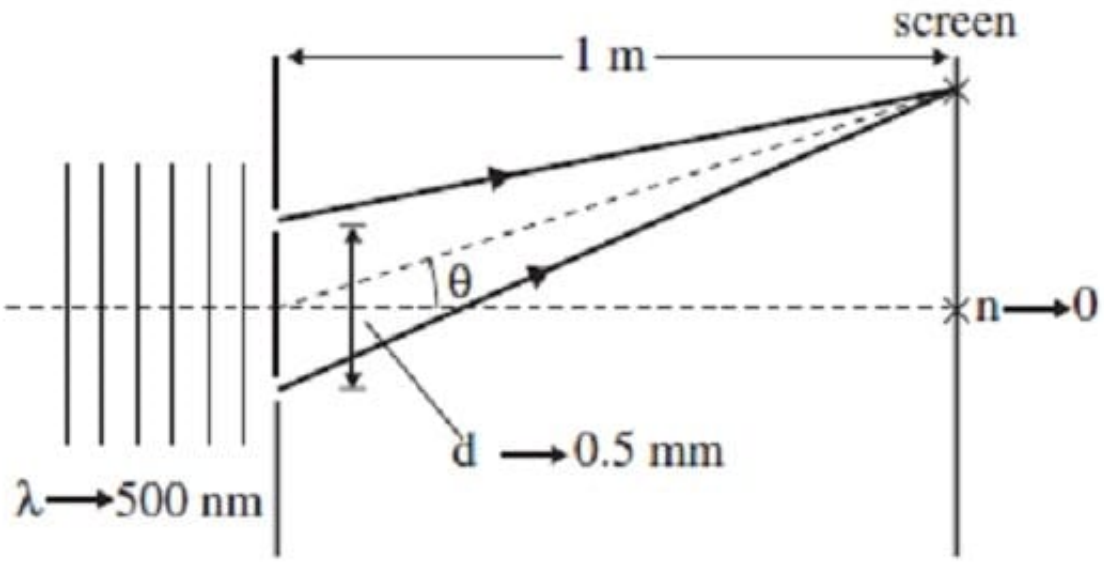


Figure 1

Which of the following is sufficient information to determine the approximate speed of a ray of light in water?

A. The angle of incidence and the angle of refraction of the light ray as it enters water from air

B. The wavelength in water and the wavelength in air of the light ray as it enters water from air

C. The speed of light in a vacuum and the density of water

D. The speed of light in a vacuum and the index of refraction of water

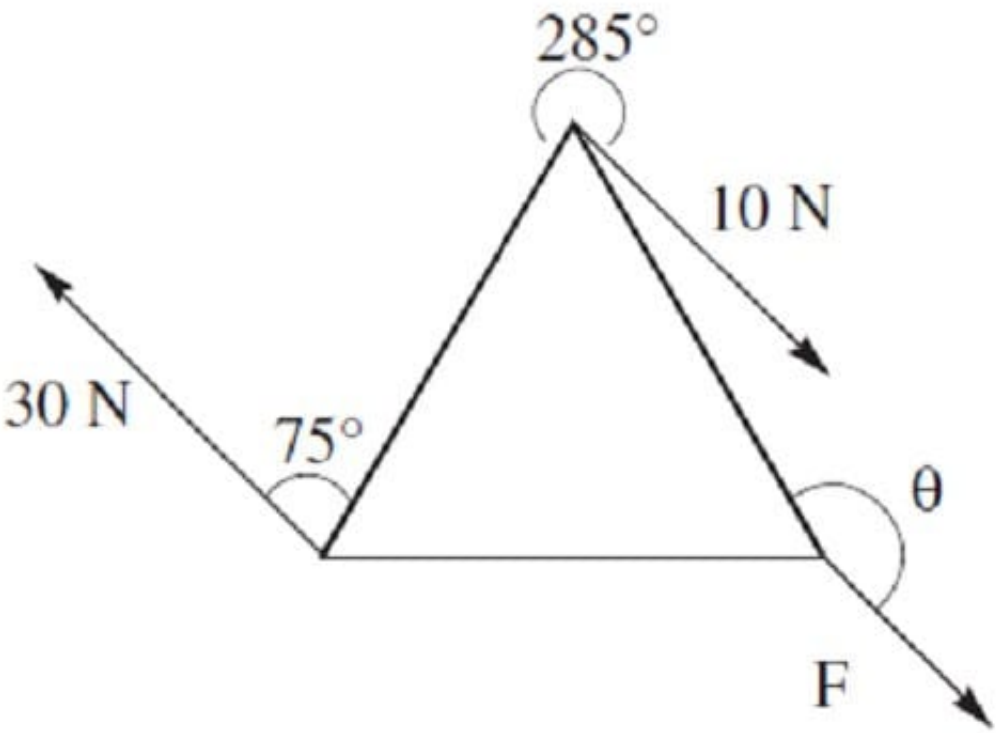
Correct Answer: D

You should know that the speed of light is different in different media. The formula associated with this concept is n = c/v, where n is the index of refraction of a given medium, c is the speed of light in a vacuum, and v is the speed of light in the given medium. Hence, if the index of refraction and the speed of light in a vacuum are known, we can solve for the speed of light in the medium. Thus, choice D is correct.

We would need the air\\'s index of refraction, along with the variables in choice A, to calculate the water\\'s index of refraction using Snell\\'s law. Even if we could calculate the water\\'s index of refraction, we would need the speed of light in a vacuum to calculate the speed of light in water, so choice A is wrong. Similarly, the variables in choice B allow the calculation of the index of refraction, but the speed of light is still required so choice B is wrong. Choice C is incorrect because while density might play an indirect role in the index of refraction, the density is not sufficient information to determine the index of refraction.

QUESTION 10

An object at rest with the shape of an equilateral triangle is subject to three external forces as shown in the diagram. If the object does not exhibit translational motion, what must F and be, respectively?



A. 20 N, 120°

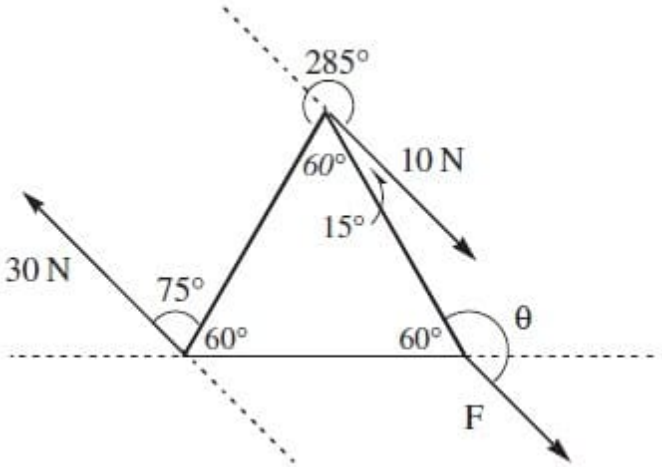
B. 20 N, 165°

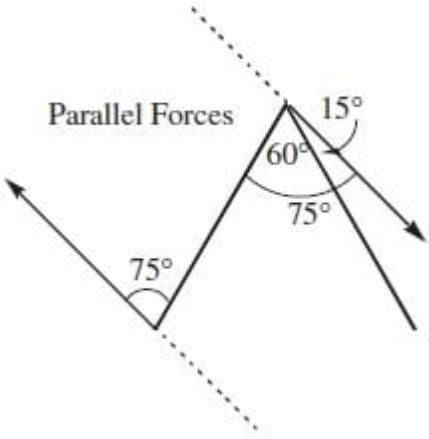
C. 10 N, 120°

D. 10 N, 165°

Correct Answer: B

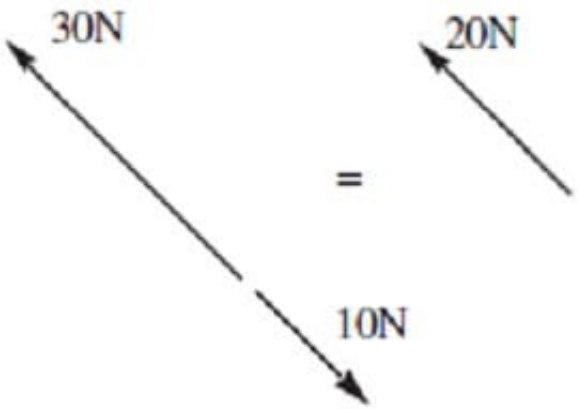
This problem can be solved by examining the angles and noting that the two given forces are antiparallel. First, each of the angles in an equilateral triangle is 60°, adding up to the 180° characteristic of all triangles. We know that the forces are antiparallel because they make the same angle, 75°, with a line that intersects both of them. That line is the left edge of the equilateral triangle.



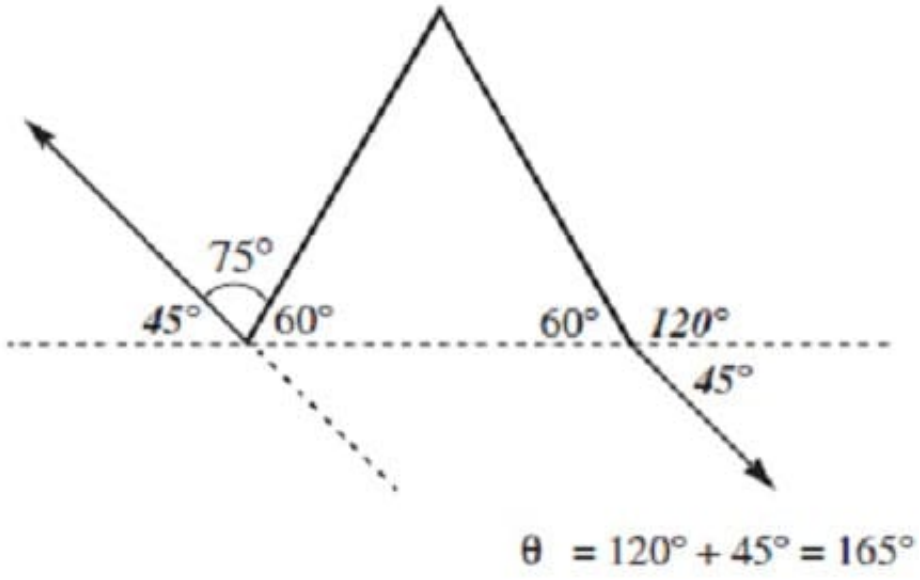


Once we determine that the two given forces are antiparallel, we know that the third force must be applied along the

same angle (in order to cancel out with the other two.) Summing the two given forces, we get a net force of 20N to the upper left.



So we know that the answer must be 20N towards the bottom right. This narrows the choices to A and B. Now we must determine the angle. The supplementary angle is 120? as shown below. Knowing that the two forces are parallel, we can calculate the 45? as shown below. This allows us to calculate .



QUESTION 11

Today\\'s new urban Asia is just as sophisticated and in many ways more exciting than Western cities. Urban Asian consumers are knowledgeable, modern, and keen to embrace the global lifestyle. Young, urban Asians have grown up accustomed to many things that originated in the West. They have, for example, completely embraced pizza, some even claiming that it is a part of their heritage. The story is told about a young Singaporean boy who was taken by his father to Rome. "Hey, look, Dad," the little boy exclaimed, "they have pizza here too!" On sampling the product, the boy decided that it was not as good as the original back home. Nury Vitachi, who writes for the South China Post and the Far Eastern Economic Review, describes the Asian middle-class phenomenon: "Executives in Asia have become rich at warp speed by taking full control of their own lives. They invest a great deal of time in their work, they use strategy to scramble up the corporate ladder, and they demand payment in cash -- so they can make their money work as hard as they do." Signs of affluence are everywhere, but don\\'t get carried away. Traveling around Asia, no matter how rich the Asians become, signs of their frugal nature are still apparent. And they are very cost-conscious. Shopkeepers in many Asian cities, most notably in Hong Kong, demand payments for discounted merchandise in cash instead of plastic, and

many Asians are accustomed to that. Most people save the increases in their income, and many prefer to put it into fixed or other income-generating assets. Stock, land, and property are their favorites. Many affluent Asians still regard financial security as the most important form of security, and they are confident that Asia is the place to be to achieve that. While many have begun to savor the good life, they are not letting go of their top priority of education for their children. Education is looked upon as the most important contributing factor to success in life. And in many of Asia\\'s competitive urban centers, there is a rush to acquire a second degree and other forms of professional qualification to ensure personal competitiveness in the workplace. There are extraordinary opportunities in Asia for education and training programs from language to software programming. Despite the rise in their assertiveness, Asians still look to the United States and not so much to Europe for ideas and trends. In general, except for those in Hong Kong and Japan, they are not particularly concerned with being fashionable. For today\\'s Asia, Japan and Hong Kong are the sources of Asian fashion ideas, but as Asia becomes more affluent, there is a great opportunity to develop an indigenous fashion industry. For example, a huge market potential exists in introducing new materials and simplified but fashionable designs for countries in tropical Asia with a hot humid climate throughout the year. The population density and lack of space in urban areas has prohibited Asians from exercising frequently and few indulge in outdoor activities. This is changing. Most Asians consider themselves in good health. Compared with Americans, few are overweight -- largely as a result of their Asian diet. But now health clubs are becoming popular among younger Asians. Potential for indoor exercise equipment holds great promise. It is also important to dress for the gym, and younger Asians are serious about looking good, complete with makeup, sunglasses, designer exercise shoes and outfits, and a gym bag. In trying to hit Asia\\'s moving targets, regardless of what you are selling, it is a good idea to stick with market density -- not country by country, but, mostly, city by city. Asian markets can be a marketer\\'s dream in that their densities are among the highest in the world. Java, Indonesia\\'s main island, has 115 million people. On Nanjing Road, Shanghai\\'s busiest street, businesses are open twelve hours a day almost every day of the year. More than 1.5 million people visit the shops there and spend more than $50 million every day. Someone said that you can only become rich if you sell to the rich. I would add that you can become rich faster if you sell to the new rich. For investors in the West, watch for Western companies that are preparing a big push in Asia. The world has not yet seen anything like it before, and you can reap handsome dividends if you back those stocks that are going eastward.

In the passage, the author does all of the following EXCEPT:

A. resolve a seeming economic paradox.

B. offer an interpretation of an observed trend.

C. project consequences of current developments.

D. make the information presented relevant to the reader.

Correct Answer: A

The author does not resolve, or attempt to resolve, any economic paradox: for example, he does not try to present Asia\\'s prosperity as an anomaly and explain this "Asia phenomenon." He does, however, interpret observed trends based on characteristics he attributes to Asians: cost consciousness, low level of preoccupation with health, etc. Choice B is therefore incorrect. He describes business opportunities based on projection on current observations: popularity of further education, fashion trends, etc. In the last paragraph, he offers quite specific advice to his readers about investing in companies that are making a push in Asia. Choices C and D are hence also incorrect.

QUESTION 12

The time has come to acknowledge the ascendancy of the humanistic psychology movement. The so- called "Third Stream" emerged at mid-century, asserting itself against the opposition of a pair of mighty, long-established currents, psychoanalysis and behaviorism. The hostility between these two older schools, as well as divisiveness within each of them, probably helped enable humanistic psychology to survive its early years. But the movement flourished because of its wealth of insights into the nature of this most inexact science.

Of the three major movements in the course of 20th century psychology, psychoanalysis is the oldest and most

introspective. Conceived by Sigmund Freud as a means of treating mental and emotional disorders, psychoanalysis is based on the theory that people experience unresolved emotional conflicts in infancy and early childhood. Years later, although these experiences have largely disappeared from conscious awareness, they may continue to impair a person\\'s ability to function in daily life. The patient experiences improvement when the psychoanalyst eventually unlocks these long-repressed memories of conflict and brings them to the patient\\'s conscious awareness.

In the heyday of behaviorism, which occurred between the two world wars, the psychoanalytic movement was heavily criticized for being too concerned with inner subjective experience. Behavioral psychologists, dismissing ideas and feelings as unscientific, tried to deal only with observable and quantifiable facts. They perceived the human being merely as an organism which generated responses to stimuli produced by its body and the environment around it. Patients\\' neuroses no longer needed analysis; they could instead by modified by behavioral conditioning. Not even babies were safe: B.F. Skinner devised a container in which infants could be raised under "ideal" conditions -- if a sound-proof box can be considered the ideal environment for child-rearing.

By mid-century, a number of psychologists had grown dissatisfied with both the deterministic Freudian perspective and the mechanistic approach of behaviorism. They questioned the idea that human personality becomes permanently fixed in the first few years of life. They wondered if the purpose of psychology was really to reduce people to laboratory specimens. Was it not instead possible that human beings are greater than the sum of their parts? That psychology should speak to their search for fulfillment and meaning in life?

It is questions like these that members of the Third Stream have sought to address. While the movement cannot be simplified down to a single theoretical position, it does spring from certain fundamental propositions. Humanistic psychologists believe that conscious experience, rather than outward behavior, is the proper subject of psychology. We recognize that each human being is unique, capable of change and personal growth. We see maturity as a process dependent on the establishment of a set of values and the development of self. And we believe that the more aspects of self which are satisfactorily developed, the more positive the individual\\'s self-image. Abraham Maslow, a pioneer of the Third Stream, articulated a hierarchy of basic human needs, starting with food, water and air, progressing upward through shelter and security, social acceptance and belonging, to love, esteem and self-expression. Progress toward the higher stages cannot occur until all of the more basic needs have been satisfied. Individuals atop the pyramid, having developed their potential to the highest possible extent, are said to be "self-actualized".

If this humanist theoretical perspective is aimed at empowering the individual, so too are the movement\\'s efforts in the practical realm of clinical psychology. Believing that traditional psychotherapists tend to lead patients toward predetermined resolutions of their problems, Carl Rogers pressed for objective evaluations of both the process and outcome of psychotherapeutic treatment. Not content to function simply as a reformer, Rogers also pioneered the development of "client-centered" or nondirective therapy, which emphasizes the autonomy of the client (i.e., patient). In client-centered therapy, clients choose the subjects for discussion, and are encouraged to create their own solutions to their problems.

The author most probably believes that, in its early days, the humanistic psychology movement:

I. benefited from dissension among psychologists.

II. acknowledged Maslow and Rogers as its only leaders.

III.

was an offshoot of behaviorism.

A.

I only

B.

II only

C.

I and II only

D.

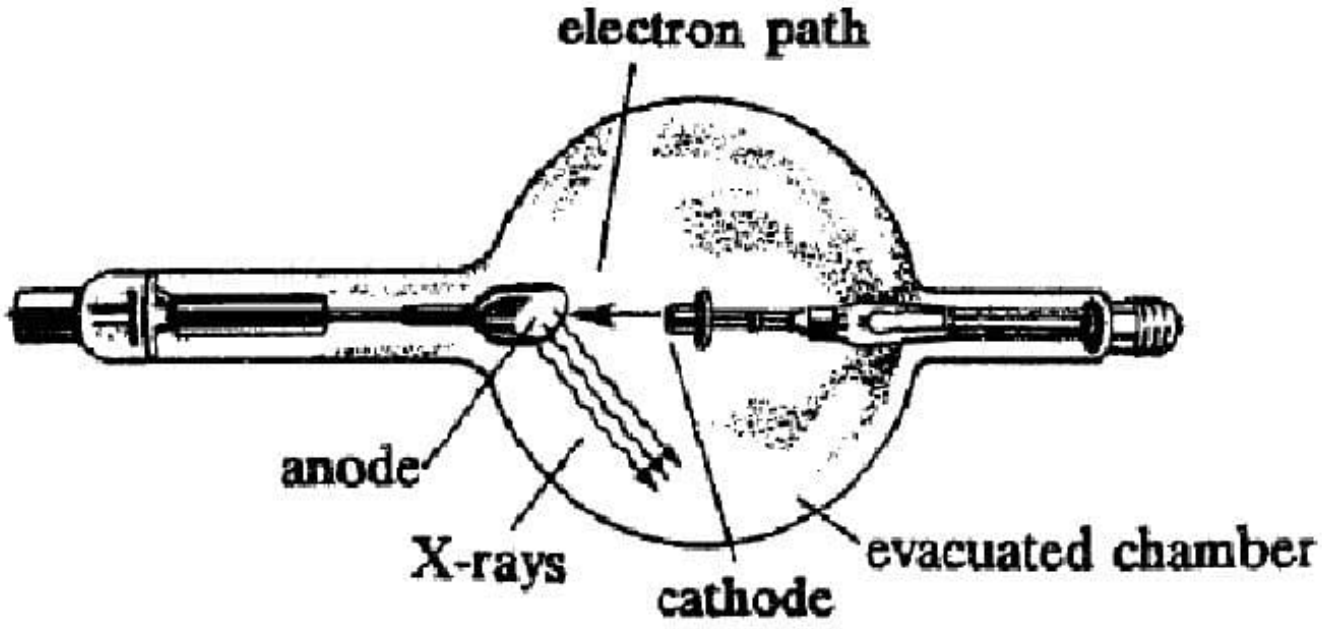
II and III only

Correct Answer: A

This is in Roman Numeral format. It asks you to infer what the author believes about the early days of humanistic psychology. The movement\\'s early days are referred to in the opening paragraph of the passage. In sentence 2 of paragraph 1, the author says that, at first, humanistic psychology had to struggle against the two older movements, psychoanalysis and behaviorism. In the next sentence, the author says that hostility between psychoanalysts and behaviorists, and divisiveness within their respective movements, probably helped humanistic psychology to survive those early years. This last point, concerning divisiveness between and within each of the two older schools, means that Roman numeral statement I is true, and will be part of the correct answer. So choices (B) and (D), which don\\'t contain Roman Numeral I, are already eliminated. More importantly, there is no choice that says Roman numerals I and III, we know we don\\'t even have to look at Roman numeral statement III. So what about Roman numeral statement II? In its early days, did the humanistic psychology movement recognize Maslow and Rogers as its only leaders? No, the author never hints that this is so. Maslow and Rogers are named as early pioneers of the movement, not as its first, or unchallenged and exclusive rulers. So Roman numeral statement II is false, and the correct answer must be choice (A), statement I only. Statement III says that early humanistic psychology was an offshoot of behaviorism. This is not true; from what the author says, it seems clear that humanism was a revolt against both of the older schools, psychoanalysis and behaviorism. If anything, humanism seems to have more in common with psychoanalysis than with behaviorism, since humanism and psychoanalysis are both concerned with conscious experience. Regardless, statement III is incorrect, and choice (A), statement I only, is correct.

QUESTION 13

X-rays are produced by a device which beams electrons with an energy between 103 and 106 eV at a metal plate. The electrons interact with the metal plate and are stopped by it. Much of the energy of the incoming electrons is released in the form of X-rays, which are high-energy photons of electromagnetic radiation. An example of such a device is shown below. Electrons are accelerated from the cathode towards the anode by an electric field.



There are two mechanisms by which the X-rays are produced within the metal. The first mechanism is called bremsstrahlung, which is German for "breaking radiation." X-rays are emitted by the electrons as they are brought to rest by interactions with the positive nuclei of the anode.

The second mechanism occurs when an incoming electron knocks an inner electron out of one of the metal atoms of the anode. This electron is replaced by an electron from a higher energy level of the atom, and a photon making up the

energy difference is emitted.

X-rays are absorbed by a material when they pass through it. The amount of X-rays absorbed increases with the density of the material. In addition, lower energy X-rays are more likely to be absorbed than higher energy X-rays. (Note: 1 eV =

1.6 x 1019 J; Planck\\'s constant h = 4.1 x 10–15 eV•s; speed of light c = 3 x 108 m/s.)

In an X-ray tube, electrons of charge e are accelerated through a potential difference of V. The anode is cooled by water of mass m with specific heat c. If n electrons per second strike the anode, what is the maximum possible rise in the temperature of the water after 100 s?

A. nVe/100mc

B. 100Ve/mc

C. 100n(Ve + mc)

D. 100nVe/mc

Correct Answer: D

We must first calculate the maximum energy that the electrons could transfer to the water. Now, the equation that relates the energy of the electrons E to the total charge q and the potential difference V is E = qV. There are n electrons hitting the anode target per second, therefore 100n electrons strike the target in 100 seconds, which is equal to a charge 1 of 100ne. Therefore, the amount of energy transferred in 100 s = 100ne V. Assuming that all of this energy is converted to heat energy, we can use the equation for specific heat to calculate the change in temperature of the anode.

This equation is E = mcT, where E is the energy, m is the mass, c is the specific heat, and T is the change in temperature. This is equal to the energy transferred to the anode target. Setting the two expressions equal to one another, we get that 100nVe = mcT. The question asks us to determine the change in temperature, so if we rearrange this equation to solve for T, we get that the change in temperature T = 100neV/mc, choice D.

QUESTION 14

Saul Hoffman\\'s scientific journal paper published in 2015 in Societies explores the relationship between two topics that at the surface are very distant from each other. As he goes on to state, "It is relatively easy, at least for an economist, to see why economists would be attracted to issues like teen pregnancy and teen childbearing, despite their apparent distance from the core topics of economics. First, economics ?especially microeconomics ?is fundamentally the study of choices that individuals make, traditionally and most often in formal markets with monetary prices, but now more and more frequently outside that sphere. Viewed from that perspective, choices involving sexual and fertility behavior among teens are an incredibly challenging, but inviting, target. Is it possible to identify the role of economic incentives, including government policy, on these behaviors? Is it sensible to apply traditional models of rational choice decision-making to teens?

Second, the traditional concern about teen fertility was predicated on the notion that it was an economically catastrophic act. In a famous and oft-quoted 1968 article, Arthur Campbell wrote that \\'The girl who has an illegitimate child at the age of 16 suddenly has 90 percent of her life\\'s script written for her,\\' including reduced opportunities for schooling, the labor market, and marriage. But it doesn\\'t take too much reflection to appreciate that more may be going on in leading to these poor outcomes than just a teen birth. Disentangling the causal effect of teen childbearing on subsequent socio-economic outcomes from its correlational effect is another deliciously inviting and challenging target, this time well-suited for the applied economist or econometrician.

Just to make all this yet more inviting, the two research strands are closely related. Suppose it could be demonstrated that for some teens the socio-economic impact of a teen birth was negligible. For example, maybe future prospects for some teens were equally poor with or without a birth or perhaps government programs provided substantial benefits, so that the net impact on socio-economic well-being was consequently small or even positive. Then, it might well be \\'rational\\' in an economic sense to have a teen birth in the first place, thereby linking the research on the causal impact of a teen birth with the research on the choice determinants of a teen birth. So what came to be known as the teen birth `causes\\' literature and the teen birth `consequences\\' literature were clearly interrelated.

And then, to add yet another layer of challenge, the teen fertility rate in the U.S. has fallen at a rate that is totally unprecedented. Teen fertility was once widespread, with most of it occurring within early and sometimes not entirely voluntary marriage. In 1960, the teen fertility rate was approximately 90 births per 1000, which implied that more than 40% of women ever had a teen birth. When I published my first article on teen births 25 years ago, the teen fertility rate was 60 births per 1000, down one-third from 1960, but it had increased six years in a row in what turned out to be a deviation from the downward trend. Since then the rate has declined every single year, except for a short but puzzling uptick between 2005 and 2007. In 2014, the teen fertility rate was 24.2 births per 1000, the lowest teen fertility rate ever recorded in the U.S., though still shockingly high by European standards. Thus, the rate fell by more than 50% during my professional association with the topic and by 70% since 1960. Of course, at the same time teen marital births largely disappeared, falling from 85% of teen births to 12%.

This adds yet another focus for economic research. Why did the rate fall? Did it have anything to do with changes in the costs of teen childbearing or changes in policy? Is it a good thing or not?

In this article I try to make sense out of these various research strands by providing a personal narrative through the economics literature on teen childbearing, with a special emphasis on the three issues discussed above. My goal is to make the literature, including some reasonably technical content, accessible and valuable to a non-economist."

Hoffman, S. (2015). Teen Childbearing and Economics: A Short History of a 25-Year Research Love Affair. Societies, 5(3), 646-663. doi:10.3390/soc5030646

The author\\'s main point could be most strongly undermined by a sociological or economic study showing that:

A. statistics on teen birth make little apparent sense because even when there is an overall downward trend, the teen birth rate can unpredictably swing upward, and vice versa.

B. many teens who give birth do so not out of desire to be parents, but because they lack access to birth control and effective sex education.

C. in recent years, the economic and career results of teen pregnancy have been getting worse.

D. potential teenage mothers are minimally influenced by economic considerations like career and financial prospects, but make choices based on irrational factors like community beliefs about morality.

Correct Answer: D

This Reasoning-Beyond-the-Text question asks you to consider the effects of possible outside information on the passage. The author cites reasons to apply economic theory to teen pregnancy, writing "Viewed from that perspective, choices involving sexual and fertility behavior among teens are an incredibly challenging, but inviting, target. Is it possible to identify the role of economic incentives, including government policy, on these behaviors?" If such incentives had little or no effect on the behavior being studied, it would not make sense to apply the framework of economics to it. A ?incorrect. This would not undermine the author\\'s claim since he describes the data as in need of explanation and cites times when the birth rate rose during periods of overall decline. B. ?incorrect. The author does not suggest that desire to be a parent is a key motive in teen childbirth. C ?incorrect. The passage states teen birth has been declining. If the potential consequences have been getting worse, this would reinforce the author\\'s assumption that economic considerations influence behavior.

QUESTION 15

Agonistic behavior, or aggression, is exhibited by most of the more than three million species of animals on this planet. Animal behaviorists still disagree on a comprehensive definition of the term, but aggressive behavior can be loosely described as any action that harms an adversary or compels it to retreat. Aggression may serve many purposes, such as food gathering, establishing territory, and enforcing social hierarchy. In a general Darwinian sense, however, the purpose of aggressive behavior is to increase the individual animal\\'s -- and thus, the species\\' -- chance of survival. Aggressive behavior may be directed at animals of other species, or it may be conspecific -- that is, directed at members of an animal\\'s own species. One of the most common examples of conspecific aggression occurs in the establishment and maintenance of social hierarchies. In a hierarchy, social dominance is usually established according to physical superiority; the classic example is that of a pecking order among domestic fowl. The dominance hierarchy may be viewed as a means of social control that reduces the incidence of attack within a group. Once established, the hierarchy is rarely threatened by disputes because the inferior animal immediately submits when confronted by a superior. Two basic types of aggressive behavior are common to most species: attack and defensive threat. Each type involves a particular pattern of physiological and behavioral responses, which tends not to vary regardless of the stimulus that provokes it. For example, the pattern of attack behavior in cats involves a series of movements, such as stalking, biting, seizing with the forepaws and scratching with the hind legs, that changes very little regardless of the stimulus -- that is, regardless of who or what the cat is attacking. The cat\\'s defensive threat response offers another set of closely linked physiological and behavioral patterns. The cardiovascular system begins to pump blood at a faster rate, in preparation for sudden physical activity. The eyes narrow and the ears flatten against the side of the cat\\'s head for protection, and other vulnerable areas of the body such as the stomach and throat are similarly contracted. Growling or hissing noises and erect fur also signal defensive threat. As with the attack response, this pattern of responses is generated with little variation regardless of the nature of the stimulus. Are these aggressive patterns of attack and defensive threat innate, genetically programmed, or are they learned? The answer seems to be a combination of both. A mouse is helpless at birth, but by its 12th day of life can assume a defensive threat position by backing up on its hind legs. By the time it is one month old, the mouse begins to exhibit the attack response. Nonetheless, copious evidence suggests that animals learn and practice aggressive behavior; one need look no further than the sight of a kitten playing with a ball of string. All the elements of attack -- stalking, pouncing, biting and shaking -- are part of the game which prepares the kitten for more serious situations later in life.

The author suggests that the question of whether agonistic behavior is genetically programmed or learned:

A. still generates considerable controversy among animal behaviorists.

B. was first investigated through experiments on mice.

C. is outdated since most scientists now believe the genetic element to be most important.

D. has been the subject of extensive clinical study.

Correct Answer: D