DIRECTIONS: Read each Section carefully. The questions following each Section are based on the information given. In other words, the answers to the questions are dependent in some way on the materials of the Section to which they belong. Four possible answers are given for each question. Put an X in the answer box corresponding to the answer which you think is **most nearly correct.**

SECTION A: Special study of the heart rate of small birds and mammals has been made by means of the cardio-vibrometer. Because the heart rate is variable and such a sensitive "physiology-of-the-whole" indicator, it is necessary (1) to determine a basal rate or some sort of standard rate to serve as a basis for comparisons, and (2) to obtain quantitative data, that is, a large number of readings over sufficient time period to obtain a true measure of heart activity. To obtain a basal rate, muscular activity, food intake, temperature and cerebral activity (fear, excitement, etc.) must be controlled since, generally speaking, these have the most marked effects on the heart rate. Removal of the unpredictable effects of the conscious centers has been one of the chief difficulties in dealing with the heart rate in the past, but with the cardio-vibrometer this factor can be satisfactorily controlled even in wild species since the heart beat together with breathing and other movements is picked up indirectly, amplified, and recorded by a piezo-electric system. No electrodes are attached to the bird; it perches normally of its own volition, and need not be disturbed in any way during the experimental period. The use of a crystal-driven pen recorder facilitates obtaining a large number of accurate readings over long periods.

Disregarding age, sex, and seasonal variations, the average basal heart rates in round numbers of several species of birds are listed in the table, together with the maximum rates which were recorded immediately after flying, vigorous exercise, or excitement. The basal rates represent the average rates of the birds when at rest, in a post-absorptive but not starved condition (3-7 hours after last feeding for passerines, longer for larger birds or those with crops), in darkness, away from human presence, and at an air temperature at or slightly below thermal neutrality (about 30-32°C. for small birds)

AVERAGE BASAL HEART RATE (TIMES PER MINUTE) IN ROUND NUMBERS AND MAXIMUM HEART RATE

	Number of Individuals	Approx. wt. (gms.)	Basal rate	Maximum rate
Mourning Dove (Zenaidura macroura)	5	130	135	570
Towhee (Pipilo erythrophthalmus)	4	40	445	810
Cardinal (Richmondena cardinalis)	3	40	375	800
English Sparrow (Passer domesticus)	7	28	350	902
Song Sparrow (Melospiza melodia)	5	20	450	1,020
Canary (Serinus canarius)	10	16	514	1,000+?
Black capped Chickadee (Penthestes atricapillus)	14	12	480	1,000
Chipping Sparrow (Spizella passerina)	2	12	440	1,060
House Wren (Troglodytes aedon)	4	11	450	950
Ruby-Throated Hummingbird (Archilochus colubris)	2	4	615	?

QUESTIONS FOR SECTION A

51 Although the relationship is far from perfect, which is the most nearly correct statement regarding heart rate in small birds?
- ( ) 1. the size of species and heart rate are independent
- ( ) 2. the smaller the species, the less rapid the rate
- ( ) 3. the smaller the species, the more rapid the rate
- ( ) 4 the smallest species has the fastest maximum rate

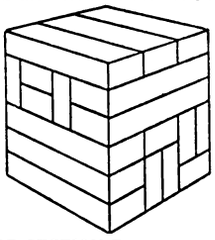
52 The word "passerines" refers to birds
- ( ) 1. at rest
- ( ) 2. like the sparrow
- ( ) 3. that migrate
- ( ) 4. without crops

PART B

53. A piezo-electric system has been used to
- ( ) 1. eliminate recordings of breathing
- ( ) 2. piece electrical discharges together
- ( ) 3. remove effects of conscious centers
- ( ) 4. vary an electric current by means of pressures

54. The heart rate of birds
- ( ) 1. is a maximum after flying or excitement
- ( ) 2. is a minimum at 30° to 32°C.
- ( ) 3. is doubled under conditions of exercise
- ( ) 4. must be measured in times per minute.

SECTION B: The 6-inch cube shown in the diagram is made up of pieces each 1 inch thick, 2 inches wide, and 6 inches long. Each block is painted in three colors, red, blue, and yellow according to its position as shown in the diagram. The top side of each block is red. The bottom side of each piece is blue, and the vertical sides are yellow.



QUESTIONS FOR SECTION B:

55. How many 1 x 2 x 6 blocks are there in the 6-inch cube?
- ( ) 1. 15
- ( ) 2. 18
- ( ) 3. 27
- ( ) 4. 36

56. How many square inches of block are painted blue?
- ( ) 1. 150
- ( ) 2. 180
- ( ) 3. 210
- ( ) 4. 256

57. What is the largest number of plane surfaces of other blocks touched by the plane surfaces of any one block?
- ( ) 1. 8
- ( ) 2. 11
- ( ) 3. 13
- ( ) 4. 15

58. How many square inches of blue surface are touching red surfaces?
- ( ) 1. 94
- ( ) 2. 108
- ( ) 3. 144
- ( ) 4. 196

59. Which arrangement of the blocks, forming a 6-inch cube, painted in the fashion described in the paragraph, would require the smallest possible area of yellow paint?
- ( ) 1. all blocks laid with a 2 x 6 side horizontal
- ( ) 2 all blocks laid with a 1 x 6 side horizontal
- ( ) 3. all blocks laid with a 1 x 2 end horizontal
- ( ) 4. the arrangement makes no difference

PART C

101 At 9:50 a.m. every morning a group of 100 factory workers (50 men and 50 women) stop work for 10 minutes and each drinks one cup (8 ounces) of hot coffee (44°C.). Between 10:00 and 10:30 their rate of output increases. What conclusion can you draw from this? *(Answer in less than 10 words.)*

102. A mariner is attempting to forecast the weather. He has available for ready reference accurate records of past fluctuations of wind, temperature, and humidity, and changes in cloud forms. He also knows what changes in weather accompanied them. He can predict the weather more accurately if he also has records available of past fluctuations of what? *(Answer in less than 10 words.)*

103 If each of N light waves (that is, all of the component simple waves making up a group of light waves) travels with the same velocity V, with what velocity

104 A variety of different things are listed below in Column I. A variety of other things are listed in Column II, which are found in or derived from those in Column I. For each item in Column I, put the number of the appropriate item in Column II which is found in or derived from it.

Column I	Column II
( ) Adrenal glands	1. Acetylene
( ) Blood	2. Agglutinin
( ) Calcium carbide	3. Cortin
( ) Collagens (in vertebrate animals)	4. Ganglion
( ) Grain	5. Gelatin
( ) Mould	6. Helium
( ) Nerve tissue, nerve cells	7. Lignin
( ) Poppy	8. Opium
( ) Shale, coal, petroleum	9. Paraffin
( ) Uranium minerals	10. Penicillin
( ) Wood	11. Riboflavin

DIRECTIONS: Four pos
question. Put an *X* in
the number of that answ
correct.

1. What is the name c
equal straight lines b
angles?
- ( ) 1. diamond
- ( ) 2. pentagon
- ( ) 3. square
- ( ) 4. trapeziod

2. Which of the followi
of an achromatic col
- ( ) 1. black, red,
- ( ) 2. orange, wh
- ( ) 3. red, yellow
- ( ) 4. red, blue, g

3. Which one of the f
amalgam?
- ( ) 1. gold
- ( ) 2. tin
- ( ) 3. lead
- ( ) 4. mercury

4. Which of the followi
- ( ) 1. magnetizin
kilogram
- ( ) 2. burning or
heat capaci
- ( ) 3. mixing flak
- ( ) 4. vaporizing

5. How many half-inc
square?
- ( ) 1. 2
- ( ) 2. 4
- ( ) 3. 8
- ( ) 4. 16

36. "A pigment cell, es
form or concentrati
color in the skin" i
- ( ) 1. chromatin
- ( ) 2. chromatop
- ( ) 3. chromogen
- ( ) 4. chromopla

37 How many half-inc
cube the inside of
width, and height?
- ( ) 1. 4
- ( ) 2. 8
- ( ) 3. 16
- ( ) 4. 32

38. Which of the follo
thermic?
- ( ) 1. alligator
- ( ) 2. armodillo
- ( ) 3. opossum
- ( ) 4. ostrich

39. One old theory of
in which substances
as follows. Some s
substances will no
flames ascend often
seems to be escapin
giston. Substances
and substances wh
not burn at all. Th
confirmed by the
ashes, left after a s
in both weight and
it was burned. Thi
the
- ( ) 1. atomic we
- ( ) 2. gaseous p
- ( ) 3. heat of th
- ( ) 4. weight an

TALENT
Examinat
complete
"My Scie
ington M

PART A

IONS: Four possible answers are given for each . Put an *X* in the answer box corresponding to iber of that answer which you think is most nearly

it is the name of a plane figure formed by four il straight lines bounding two obtuse and two acute es?

) 1. diamond
) 2. pentagon
) 3. square
) 4. trapeziod

ch of the following series does *not* contain the name n achromatic color?

) 1. black, red, blue, yellow
) 2. orange, white, blue, green
) 3. red, yellow, brown, gray
) 4. red, blue, green, yellow

ch one of the following metals is always in an ilgam?

) 1. gold
) 2. tin
) 3. lead
) 4. mercury

ich of the following is a chemical change?

) 1. magnetizing a rod of iron which weighs one kilogram
) 2. burning one pound of coal to determine its heat capacity
) 3. mixing flake graphite with oil
) 4. vaporizing one gram of mercury in a vacuum

v many half-inch squares would make an inch are?

) 1. 2
) 2. 4
) 3. 8
) 4. 16

pigment cell, especially one capable of changes of n or concentration of pigment, causing changes of or in the skin" is called

) 1. chromatin
) 2. chromatophore
) 3. chromogen
) 4. chromoplast

w many half-inch cubes completely fill a hollow e the inside of which measures an inch in length, ith, and height?

) 1. 4
) 2. 8
) 3. 16
) 4. 32

ich of the following may be said to be *poikilo-rmic*?

) 1. alligator
) 2. armodillo
) 3. opossum
) 4. ostrich

e old theory of combustion was that it is a process which substances give off phlogiston. The proof was follows. Some substances are seen to burn. Other stances will not burn. When a substance burns. nes ascend often with considerable force. Something ms to be escaping in the flame. This is named phlo-ton. Substances which contain phlogiston will burn, substances which do not contain phlogiston will burn at all. The existence of phlogiston is further ıfirmed by the fact that the visible residuum of ıes, left after a substance is burned, is generally less, both weight and bulk, than the substance was before was burned. This theory fails to take into account

) 1. atomic weight of phlogiston
) 2. gaseous products of combustion
) 3. heat of the burning
) 4. weight and bulk of ashes

9. A sphygmomanometer is a device used in the measurement of

( ) 1. auditory acuity
( ) 2. blood pressure
( ) 3. muscle tension
( ) 4. neural conductivity

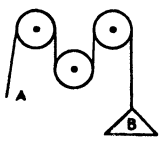
10. A prefix meaning hardness is

( ) 1. hypo
( ) 2. macro
( ) 3. sclero
( ) 4. seismo

11. A decigram equals 1.5432 grains. How many grains are there in ten grams?

( ) 1. .15432
( ) 2. 1.5432
( ) 3. 15.432
( ) 4. 154.32

12. Through what minimum distance will rope A have to be pulled to raise weight B a distance of 1 meter? All pullies shown are in fixed positions.

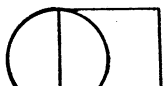


( ) 1. ¼ meter
( ) 2. ½ meter
( ) 3. 1 meter
( ) 4. 2 meters

13. A solid all of whose plane surfaces are regular hexagons

( ) 1. does not exist
( ) 2. has 6 plane hexagonal facets
( ) 3. has 8 plane hexagonal facets
( ) 4. has 12 plane hexagonal facets

41. A circle of diameter d overlaps a square as shown in the diagram. If the area of a circle is π times the square of half the diameter, what is the area of the part of the square not in the circle?



( ) 1. $d^2 - \frac{\pi d^2}{2}$
( ) 2. $4d - 2\pi d^2$
( ) 3. $d^2\left(1 - \frac{\pi}{8}\right)$
( ) 4. $\pi d^2 - 4d$

42. Which figure best typifies the path traced by a point on the circumference of a wheel, the wheel rolling in a plane along a line in the plane?

( ) 1 
( ) 2 
( ) 3 
( ) 4

43. *Paramorphism* is a term most likely to be used by which of the following?

( ) 1. a geologist
( ) 2. a mathematician
( ) 3. a serologist
( ) 4. a zoologist

TALENT TEST—These are sample questions from the Science Aptitude Examination, taken by 16,000 high school seniors. Only 3,000 were able to complete all the requirements, including this examination and an essay on "My Scientific Project." The 40 top winners have been invited to Washington March 1 to 5 to attend the Science Talent Institute and compete for the Westinghouse Science Scholarships, totaling $11,000.

GENERAL SCIENCE

Test Your Science Ability With These Questions

➤ HERE'S A SCIENCE aptitude test. Spend about 40 minutes taking it. You will then have some inkling of whether your own particular abilities include reasoning of the sort that scientists have to use. You won't necessarily be able to go out and solve problems in atomic energy, disease control, technology and other fields of physical and biological science so important today. But you will have some new insight into what it takes to be a scientist.

The questions on these pages are reproduced from the aptitude test of the Fifth Annual Science Talent Search. Thousands of boys and girls in their senior year in the nation's secondary schools took the full test as part of their entry in the search. Three hundred have been selected for honors and 40 are being invited to the Science Talent Institute at Washington, March 1-5, to compete for $11,000 in Westinghouse Science Scholarships.

Try these test questions on yourself or some friend. This is the way to do it. There are three kinds of questions.

Answer all questions in Part A by putting an X in the answer box corresponding to the number of the answer which is most nearly correct. In the case of Part B, first read each paragraph and then answer in a similar way each of the questions based on the information given. In Part C answer as directed.

Finish all the questions in one sitting and do not look at the answers printed elsewhere in the magazine until you are through.

The Science Aptitude Examination was made difficult purposely to eliminate those students who do not have the perseverance to finish a job, a prime requisite for a research scientist. Since no senior is required to take the test, any of these 14-to-18-year-olds were privileged to get up and leave after one look —and many did.

The test is only one of the techniques used in selecting boys and girls who are scientifically gifted. In addition each contestant filled out a personal data blank and wrote an essay describing some scientific project he has done or wishes to do. Teachers filled out a recommendation form and principals reported scholarship. All these are used in choosing winners.

Of the thousands of boys and girls who have taken the examination, not one made a perfect score. (*Turn to page 92*)

Do You Know?

Hydrogen cyanide is used to control parlatoria scale on olive trees.

Powdered dried red *blood cells* have been dusted on wounds to hasten healing.

Citrus fruit production in the United States increased seven-fold in the past 30 years.

Over 2,000,000 tons of fine *alloy steel* were used in the United States during the war to build airplane engines and airframes.

Dolomite found in northern Chile is said to be the only deposit in South America; it is of a good quality and is used to make hydraulic cement.

Scrap metal from partly completed military aircraft not needed by the Army because of the end of the war is being salvaged and sold; all usable equipment is first removed.

Shipbuilding consumed more steel during the war than any other single industry; of the more than 35,000,000 tons used in shipbuilding, approximately three-fifths went into merchant ships.

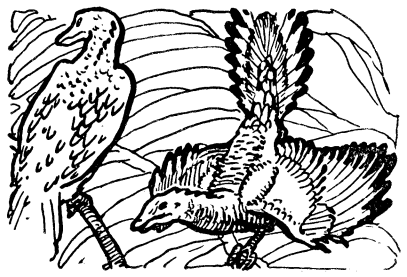
The lowly *coot,* or mudhen, might be called the "whitebill", it is suggested, to make this edible but unpopular fowl more acceptable on the dinner table; the coot is the third most plentiful waterfowl in America.

The name *"strawberry"* does not come from the common practice of using straw to mulch the plant, as many believe, but from the runners of the plant which at a certain season somewhat resemble scattered straws.

EVOLUTION

NATURE RAMBLINGS

by Frank Thone



Clothed for Coolness

➤ FEATHERS on birds and fur on beasts were evolved not to keep their wearers warm in a world that was growing colder but to enable the original, half-reptilian ancestors of present-day warm-blooded animals to stay out in the sun a little later in the forenoon without dying of heat-stroke. This theory, directly opposite to the one set forth in most zoology books, is offered by Prof. Raymond B. Cowles of the University of California at Los Angeles. (*Science*, Jan. 18).

The idea that feather and fur were developed to meet a need felt by their wearers strikes Prof. Cowles as a little too pat. It follows the Lamarckian line of reasoning, which seemed valid when first proposed, well over a hundred years ago, but which has been pretty well abandoned. New mutations, most biologists now believe, "just happen"—and if one of them by chance helps its possessor in the struggle for existence, that's *his* good luck. But mutations aren't made to order.

A mutation that resulted in the development of fur or feathers would prevent the glare of a hot sun from reaching the animal's skin and thus enable the wearer to keep on hunting food after the heat of the day had begun, Prof. Cowles suggests. This would have an obvious survival value. Of course, such a heat-insulating layer would work both ways, and when the climate took a change for the cooler a new kind of survival value would attach to it.

There is reason to suppose, Prof. Cowles argues, that warm-bloodedness in animals is of comparatively late evolutionary origin. An examination of all the higher vertebrate groups shows that the more recent, highly evolved members are also the warmest-blooded, while the more primitive types are nearer to the reptiles in the way their body temperatures react. Also, the young of some animals, especially nestling birds, are for a time less warm-blooded in their physiology than birds, and do not become completely warm-blooded until some time after hatching.

Science News Letter, February 9, 1946

From Page 89

When you try this selection of questions from the examination you should, therefore, not expect to find that you have checked all the right answers.

To save your time, only typical questions out of the original three-hour examination are reproduced on this page. You should be able to answer the 30 questions in about 40 minutes.

Don't read further. Cover up the following paragraph until you have taken the test.

The correct answers to part A are: *1*, 1; 2, 4; 3, 4; 4, 2; 5, 2; 9, 2; *10*, 3; *11*, 4; *12*, 3; *13*, 1; *36*, 2; *37*, 2; *38*, 1; *39*, 2; *41*, 3; *42*, 3; *43*, 1. The right answers to Part B include: *51*, 3; *52*, 2; *53*, 4; *54*, 1; *55*, 2; *56*, 2; *57*, 2; *58*, 3; *59*, 4. In Part C, the correct answer to the first three questions can be any one of the following, or anything similar to it: *101*, none, no conclusion is possible, increased output due to chance, no conclusion without data from control group; *102*, barometric pressure; *103*, V, V velocity, velocity V, same velocity. The items in column I of question *104* should have the following numbers beside them in this order: 3, 2, 1, 5, 11, 10, 4, 8, 9, 6, 7.

If you answered correctly 22 of the questions, you did about as well as the average high school student completing the examination. Those of you who got only ten correct did no worse than some of the contestants with lowest scores. Anyone giving the proper answer to 27 of the questions probably is gifted in science. But remember, the questions given here are the easier ones included in the examination.

Science News Letter, February 9, 1946

Celery tops can be dehydrated and used as human food or feed for cattle.

Jack *pines* produce cones at an early age; as the trees grow older, woody tissues engulf the old cones along the main trunk and eventually completely entomb them in the trunk wood.