SAMPLE PAGES FROM THE EIGHTH SCIENCE TALENT SEARCH EXAMINATION.

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THE EIGHTH ANNUAL

Science Talent Search

Conducted by Science Clubs of America, administered by Science Service for the

WESTINGHOUSE SCIENCE SCHOLARSHIPS

SCIENCE APTITUDE EXAMINATION

Full Legal Name: _____
(last name) (first name) (middle name)

Present Address: _____

Age: _____ Date of Birth: _____

What is your present profession? _____

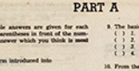
Give the name and address of your school: _____

What is your principal interest? _____

PART A

DIRECTIONS: Four possible answers are given for each question. Put an x in the parentheses in front of the number corresponding to that answer which you think is most nearly correct.

1. Plasmagene is a new term introduced into
( ) 1. astronomy
( ) 2. biology
( ) 3. geology
( ) 4. physics

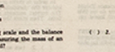
2. In this diagram of the hydrogen atom,


e represents
( ) 1. a proton
( ) 2. a proton's charge
( ) 3. an electron
( ) 4. an electron's orbit

3. An oscudenbron is a
( ) 1. form of electron tube
( ) 2. Mesozoic rock formation
( ) 3. pendent mass of ice
( ) 4. solid with twenty faces

4. Two kinds of devices—the spring scale and the balance —could possibly be used for measuring the mass of an object. Which one should be used?
( ) 1. either
( ) 2. neither
( ) 3. the balance
( ) 4. the spring scale

5. If the driver turns clockwise, the gear will
( ) 1. move back and forth
( ) 2. not turn
( ) 3. turn clockwise
( ) 4. turn counterclockwise

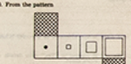


6. The simplest animals are
( ) 1. bacteria
( ) 2. amoebas
( ) 3. polyps
( ) 4. protozoa

7. Rh factor is a term used in
( ) 1. astronomy
( ) 2. biochemistry
( ) 3. radiography
( ) 4. psychology

8. Each of three containers has a volume of 2,300 cc. One container is a sphere, one a cube, and one a cylinder whose diameter equals its height. Each container is made of glass of .06 cm. thickness. Which container has the least surface?
( ) 1. all have equal surfaces
( ) 2. the cube
( ) 3. the cylinder
( ) 4. the sphere

9. The basic formula for atomic energy was devised by
( ) 1. Karl T. Compton
( ) 2. Albert Einstein
( ) 3. Henry D. Smyth
( ) 4. J. R. Oppenheimer

10. From the pattern

which of the figures can be made?
( ) 1.
( ) 2.
( ) 3.
( ) 4.

11. Which of the following normally flow from the cathode to the anode in a gaseous rectifier tube?
( ) 1. electrons
( ) 2. neutrons
( ) 3. positrons
( ) 4. protons

12. What is the missing word in the following sentence? "An emulsion is a mixture of two or more ——liquids in which suspension takes place very slowly."
( ) 1. concentrated
( ) 2. miscible
( ) 3. non-miscible
( ) 4. saturated

13. Amines are ——— of ammonia in which there is replacement of one or more of ammonia's by alk— group( ), e.g., methyl or ethyl, or by ——— group, e.g., phenyl or naphthyl. Which is the correct order for the four missing words?
( ) 1. derivatives—hydrogens—alkyl—aryl
( ) 2. derivatives—hydrogens—aryl—alkyl
( ) 3. hydrogens—derivatives—alkyl—aryl
( ) 4. hydrogens—derivatives—aryl—alkyl

14. Radioactive carbon, C^{14}, with a measured half-life of 5,000 years, is
( ) 1. not normally present in living tissue
( ) 2. present in all living things
( ) 3. present only in animals having a skeleton
( ) 4. present only in green plants

15. Which of the following is least related to the other three?
( ) 1. aeroperin
( ) 2. hexylresorcinol
( ) 3. streptomycin
( ) 4. tyrothricin

16. What is the missing word in the following sentence? "A ——— lost in a theoretical force having a contact area equal to the cross-sectional area with the area of the surface of the body upon which the force acts."
( ) 1. central
( ) 2. concentrated
( ) 3. distributed
( ) 4. non-uniform

17. The existence of a number of different infantile-paralysis-causing viruses
( ) 1. is a handicap to preparing a vaccine against the disease
( ) 2. makes children more susceptible than adults
( ) 3. makes diagnosis of the disease too fallible
( ) 4. prevents any systematic treatment of the disease

18. Light travels about 11,000,000 miles a minute. This may be written as 11 x 10^6 miles a minute. A light year, a unit of distance used by astronomers, is about
( ) 1. 365 x 11 x 10^6 miles
( ) 2. 365 x 11 x 60 x 24 x 10^6 miles
( ) 3. 365 x 11 x 60 x 24 x 60 x 10^6 miles
( ) 4. 180 x 365 x 11 x 24 x 10^6 miles

19. Which of the following belongs least well with the other three?
( ) 1. bamboo
( ) 2. bumpout
( ) 3. zinc
( ) 4. zirconium

20. In the manufacture of a paper product, the paper is first cut to form the square ABCD. The length AB is 7 inches. The first operation is to fold the paper along the line BD. The second operation is to fold point B over to point a so that bB falls along line ab and parallel to BD. Which of the following statements is true?
( ) 1. Line Ab is of the same length as bB.
( ) 2. Line Aa is of the same length as bB.
( ) 3. Line aD is longer than bB.
( ) 4. Line Ab is of the same length as Aa.

21. The otoscope is an instrument used in examining the
( ) 1. ear
( ) 2. eye
( ) 3. esophagus
( ) 4. uterus

22. The dosage for penicillin taken orally to penicillin injected hypodermically is
( ) 1. about unity
( ) 2. greater than unity
( ) 3. less than unity
( ) 4. unknown

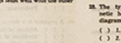
23. Heat-resistant plastics are called
( ) 1. thermographs
( ) 2. thermoplics
( ) 3. thermosbestics
( ) 4. thermosets

24. The word hypophysic refers to a
( ) 1. derivative of tryosphosphorous acid
( ) 2. gland attached to the brain
( ) 3. larval form of certain mites
( ) 4. layer of the skin

25. Titanium, a metallic element, is
( ) 1. found primarily in mountainous regions
( ) 2. never found free, but only in compounds
( ) 3. the basis for making synthetic opals
( ) 4. used primarily as a catalyst

26. *Stratigraphic throw* is a term in
( ) 1. animal husbandry
( ) 2. astronomy
( ) 3. geology
( ) 4. statistics

27. A tarsier is best classified as
( ) 1. a form of coral
( ) 2. a Malayan unit of length
( ) 3. a mammal
( ) 4. an herb

28. The type of electromagnetic horn shown in the diagram is


( ) 1. biconical
( ) 2. pyramidal
( ) 3. sectoral
( ) 4. undeveloped

29. It is convenient to classify volcanoes as of three types. Which of these is not one of the three?
( ) 1. effusive
( ) 2. expanding
( ) 3. explosive
( ) 4. intermediate

30. The most abundant element, in as much of the universe as our telescopes have enabled us to probe, are
( ) 1. carbon and silicon
( ) 2. hydrogen and helium
( ) 3. iron and nickel
( ) 4. oxygen and nitrogen

31. The new 200-inch telescope on Palomar Mountain enables astronomers to penetrate into space twice as far as has been possible before. About what increase in the volume of space will it be possible to explore?
( ) 1. twice as much
( ) 2. four times as much
( ) 3. eight times as much
( ) 4. sixteen times as much

PART B

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 upon the facts or information which you find in the Section belong. Four possible answers are given for each question. Put an x in the parentheses in front of the number corresponding to that answer which you think is most nearly correct.

SECTION A: A hydrogen ion scale is used as a means of expressing the alkalinity or acidity of a solution. The units on this scale are called pH values. Values of pH greater than 7.0 denote alkalinity, and of pH less than 7.0 denote acidity. The smaller the number on the scale of 14 units, it may be stated that a solution which has a pH of 7.0 is not only as acid as one with a pH of 6.0. A similar relationship holds on the alkaline side of the scale.

QUESTIONS FOR SECTION A:

31. How much more alkaline is a solution which has a pH of 10.0 than one which has a pH of 8.0?
( ) 1. 0.5
( ) 2. 1.0
( ) 3. 10.0
( ) 4. 100.0

32. A solution having a pH of 7.0 is
( ) 1. acid
( ) 2. acid or alkaline, depending on which has the greater volume added to give it a pH of 7.0
( ) 3. alkaline
( ) 4. neither acid nor alkaline

33. From the paragraph, one may conclude that
( ) 1. the higher the pH, the greater the acidity of the solution
( ) 2. the lower the pH, the greater the acidity of the solution
( ) 3. the lower the pH, the greater the alkalinity of the solution
( ) 4. the point pH = 7.0 is an average value

SECTION B: The modern method of determining mean sea level is to establish a tide gauge and record the tides for an extended period of time. Figure 1 shows a simple diagram of the installation, and you will note that the recording instrument is mounted on the table or bench inside the tide-gauge house, and that the bench and instrument are below the level of the water outside. A pipe leads from the float to the recording instrument and hangs in the center of the well and keeps the float from dragging on the sides of the well. The float counterweight is not shown. One is in a tight in the wire leading from the flashgauge, spool on the gauge and through suitable pulleys to the counter-weight and then to an anchorage in the roof. The other furnishes the power for the take-up spool to keep the counterweight taut and operates the recording pencil on the clock that controls the feeding of the paper over the main roller, along an element of which the recording pencil moves back and forth.

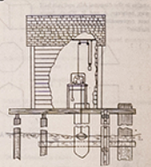


FIGURE 1

In a close-up of the recording gauge, we would notice two clocks. One of these is a 24-hour clock which has a pencil set at the side of one inch per hour and the other graduating the time marks at hourly intervals on the curve traced by the recording pencil. A fixed pencil traces a datum line for the graph of the curve as the paper passes under it.

The curve is traced by means of a pencil which is made to move along an element of the main roller by means of a fine wire attached to the float. The wire is also connected to the spool over which the wire passes in leaving from the float to the counter-weight. This counter-weight keeps the wire taut at all times and prevents slipping on the spool, which is grooved and carries several turns of wire at one time in order to insure sufficient friction between the wire and the spool.

The tide staff is simply a long board, graduated in feet and tenths from the bottom up, and is mounted in a vertical position on some suitable structure so that its zero is at the level of mean low water and the top is above the highest stations. The staff is read daily at the time the gauge is inspected and serviced, and the staff reading is noted directly on the curve at the point indicated by a manually-made jog, similar to an hourly time mark, put in the curve by the clock. The purpose of the tide staff readings is to serve to define the height of the datum line on the curve with respect to the zero of the staff gauge.

At suitable intervals of time, the staff is connected, by means of spirit leveling, with the bench marks on shore. These are set at suitable locations on shore and near the tide station. They serve to furnish the permanent points to which the observations are referred.

QUESTIONS FOR SECTION B:

34. "Mean sea level" refers to the sea surface's
( ) 1. amount of fluctuation
( ) 2. average height
( ) 3. greatest height
( ) 4. lowest point

35. A tide gauge produces a graphic record of the
( ) 1. gravity
( ) 2. height of the bench marks
( ) 3. rise and fall of the surface of the water
( ) 4. rise of the surface of the water

36. Which of the following is least essential in recording mean sea level?
( ) 1. intervals on the graph paper
( ) 2. location of the bench marks
( ) 3. size of the float
( ) 4. time of recording

37. To measure mean sea level, it is essential to have
( ) 1. a mechanical timepiece
( ) 2. a method for recording time
( ) 3. at least one clock
( ) 4. two clocks

SECTION C: Sixty newly-hatched loggerhead turtles placed in an open pit on the beach milled around but showed no oriented movements in the direction of the water. When violets of the surf was permitted by placing them on the beach, the turtles moved down to the water's edge. The animals, released on the beach on a quiet, moonless night when the surf was absent, failed to find the water; but when released later, at the same point on the beach, after the moon had risen, they crawled quickly into the ocean.

A group of 5 animals placed on the beach at night were observed to follow a beam from a flashlight as it was moved from side to side in front of them. Similar results were reproduced in a group of 50 turtles by releasing them on the beach on a moonlit night and by stimulating them, simultaneously, by a spot of light directed near them on the sand. About half of the animals followed the spot of light as it was moved from side to side in front of them for short distances. Some individuals could be induced to reverse their direction of crawl, even after getting into the water, by moving the light from the edge of the ocean up onto the slope of the beach.

Gravity as a stimulus was compared with light directly by releasing the animals on an inclined plane with a lighted window at the top. The results are shown in Table 1.

TABLE 1

NUMBER OF TURTLES RESPONDING POSITIVELY TO SIMULTANEOUSLY PRESENTED LIGHT AND GRAVITATIONAL STIMULATION

Angle of incline	Number of animals used	Number showing positive geotropism	Number showing positive phototropism	Number showing positive heliotropism	Number showing ambiguous response
5°	18	1	8	9	0
10°	11	2	8	1	0
15°	11	2	8	1	0
Total	50	5	24	11	0

* This group includes inactive animals as well as 4 animals which moved in no particular direction around the release point on the inclined plane.

QUESTIONS FOR SECTION C:

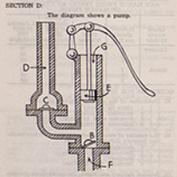
38. The purpose of the experiments was to determine the critical stimulus or stimuli for
( ) 1. direction of the migration
( ) 2. learning to swim
( ) 3. leaving the nest
( ) 4. various types of illumination

39. The experiments show that the critical stimulus for newly hatched loggerheads in their movement from the nest to the sea is normally
( ) 1. gravity
( ) 2. light reflected from the surf
( ) 3. moonlight
( ) 4. moving light

40. Under the conditions of the experiments, the following was found to be relatively ineffectual:
( ) 1. geotropism
( ) 2. phototaxis
( ) 3. phototropism
( ) 4. photokinesis and phototropism

SECTION D:

The diagram shows a pump.



QUESTIONS FOR SECTION D:

41. In the operation of the pump, when the handle is raised,
( ) 1. valve B is closed and valve C is closed
( ) 2. valve B is open and valve C is closed
( ) 3. valve B is closed and valve C is open
( ) 4. valve B is open and valve C is open

42. Water is discharged from the pump through
( ) 1. D
( ) 2. F
( ) 3. G
( ) 4. an opening not shown in the diagram

SECTION E: In order to prevent loss of potency by injection in aqueous solution as well as contamination by traces of blood, the pituitary hormone, oxytocin, is usually dried in the form of a powder. Samples of this powder were stored at 94°C. for 48 hours, and stored in desiccators until injected. A control group of 10 guinea pigs injected showed from an average of 0.0 to 0.2 cc. Similar observations demonstrated that as few as 4 dried anterior pituitary glands from young rats will induce ovulation in rats although as many as 7 or more may be needed on some frogs. Subsequent tests in January (3) frogs and March (4) frogs of large individual showed from anterior pituitaries to be as effective as fresh glands in inducing ovulation.

Glands removed from freshly-caught frogs (E. pipiens) and dried in mid-January were compared in ovulation-inducing capacity with glands removed and dried in mid-March. The recipients, females in the pre-breeding condition, were injected subcutaneously with 0.2 cc. of saline. Controls, furthermore, were tested for ovulation by stripping and shown to be negative prior to injection. Control frogs did not ovulate throughout the duration of the experiment, terminated the last of April. Whereas an average

of 4 January glands were necessary to cause at least 50 per cent ovulation (within one week after injection), 1–3 March glands induced ovulation in frogs in the same stage of breeding activity (See Table II).

TABLE II

OVULATION-INDUCING CAPACITY OF DRIED PITUITARY GLANDS FROM FROGS COLLECTED IN JANUARY AND MARCH AND TESTED BY RESPONSE OF MARCH FROGS

Gland source and date	Number glands per injected	Number frogs per injected	% showing at least 50% ovulation	% showing at least 50% ovulation
January	2	9	1	0
	3	10	4	30
	4	7	4	66
March	1	8	2	0
	2	8	4	50
	3	8	8	100

QUESTIONS FOR SECTION E:

43. Desiccation of the anterior pituitary probably
( ) 1. alters its potency
( ) 2. decreases its potency
( ) 3. does not alter its potency
( ) 4. increases its potency

44. The number of donor glands required to induce ovulation between January and March
( ) 1. increases, then increases
( ) 2. increases, then decreases
( ) 3. decreases, then increases
( ) 4. decreases, then decreases

45. Between January and March, the gonadotropic potency of the pituitary
( ) 1. decreases, then increases
( ) 2. decreases, then decreases
( ) 3. increases, then increases
( ) 4. increases, then decreases

SECTION F: Gamasia (*Marrus hexacus*) were selected as the best available species for this experiment on bird navigation, since they are large, black, easily observed from an airplane, and since they are strictly marine and have a limited flight range of 100 miles from shore. Thus, we could be sure that the 17 gamasia released were not 100 miles from the nearest salt water when they were released over Kansas territory. None of them were released on an airplane, the remainder being controls against the 10 which were released on airplanes flying at 1,500–2,000 ft. where the best wind conditions for homing performance. Since both groups showed roughly the same percentage of returns (40% of those released in group 1 and 35% of those released in good physical condition), it seemed clear that the airplane had no significant effect on their homing.

The performance of gamasia as to speed and percentage of returns is summarized in Table I. Only gamasia which have been transported in sufficient numbers to equivalent distances to permit a valid comparison.

TABLE I

Species	Returns (%)	Avg. speed (miles/day)
Herring gull		
(Inland release)	97	90
Swallow	97	141
Gannet	67	93
Leach's petrel	50	35
Starling	94	17
Roddy and sooty tern	35	114
Common tern		
(Inland release)	39	100

Figure 1 shows the actual routes flown by 8 gamasia followed for portions of their return flight ranging from 1 to 24 hours and from 20 to 250 miles. Five of these birds were released on airplanes flying at altitudes of from 300 to 2,000 ft. Nos. 29, 30, 48 from Nov. 22, 49 from Nov. 23, and No. 76, 78 from Nov. 24 were lost. Nos. 2, 6, 21, and 36 did not return.

FIGURE 1

Flight paths of homing gamasia as observed from an airplane. The 8 gamasia were released at the point marked MOMEP (Manhattan, Ottawa, Minneapolis, Emporia, Pratt). Solid lines indicate observed flight paths; dotted lines indicate probable flight paths. Arrowhead indicates each bird's direction of flight when last seen.

QUESTIONS FOR SECTION F:

46. According to the Table, one of the best species for experiments on bird navigation is probably the
( ) 1. common tern
( ) 2. gannet
( ) 3. herring gull
( ) 4. starling

47. The flight paths of the gamasia indicate
( ) 1. the confusion of homing pigeons
( ) 2. good orientation
( ) 3. observation of landmarks
( ) 4. possible spraying

48. The evidence from this experiment suggests that, in reaching their nests, birds may rely on
( ) 1. the direction of the wind
( ) 2. the position of the sun
( ) 3. their sensitivity to the earth's magnetic field
( ) 4. unidentified environmental cues

SECTION G: The lead type of storage cell consists of lead plates immersed in sulfuric acid. When the lead cell is charged, the active material on the plates goes into a less porous condition. The plate has a reddish-brown color. The substance of the negative plate is spongy lead. (The positive plate is the one of higher potential—the one from which the current flows in the external circuit.) When the cell is discharged, lead sulfate is formed on both plates.

When the cell is being charged, the density of the acid increases, when it is discharging, the density decreases.

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THE EIGHTH ANNUAL SCIENCE TALENT SEARCH (1949)
SCIENCE APTITUDE EXAMINATION ANSWERS

Quest.	Ans.	Quest.	Ans.	Quest.	Ans.	Quest.	Ans.	Quest.	Ans.	Quest.	Ans.
1.	2	26.	3	51.	4	76.	2	101.	3	126.	3
2.	3	27.	3	52.	4	77.	1	102.	4	127.	33
3.	4	28.	3	53.	2	78.	3	103.	3	128.	1 or 21
4.	3	29.	2	54.	2	79.	1 or 3	104.	2	129.	18

Therefore, a test of the density of the acid affords a simple way of telling when the cell needs charging. The curves in Figure 2 show the changes that take place in the voltage of the terminals on charge and discharge, and the changes in the density of the acid on discharge.

FIGURE 1

SECTION H: In the course of a comprehensive investigation dealing with the influence of heredity on the carotene content of corn, crude carotene values were determined on 1,000 samples of corn. Each sample consisted of 100 g. of ground corn. Duplicate samples of the same ground material were run, and the average of the two results is recorded in the following table, which gives the carotene content of corn grown in various localities. The values given represent micrograms of carotene per gram of corn. Thus, each single result recorded in the table is the average of two determinations, each of which is based on 1 g. of corn.

CAROTENE CONTENT OF CORN
(mg./lb.—13.5 per cent moisture basis)

	Nebraska A	Nebraska B	Wisconsin 38	Illinois A	Illinois M14	Indiana WF9	Ohio 38	Wisconsin 22	Ohio 51A	Wisconsin 27	Iowa 3395
Nebraska	0		1.81	1.66	1.80	1.50	1.43	1.20	1.44	1.68	.87
Wisconsin 8	1.81		0	1.68	1.39	1.37	1.17	1.51	1.15	1.00	.94
Illinois M14	1.80		1.68	0	1.38	1.35	1.16	1.17	.94	.76	1.11
Illinois A	1.50		1.37	1.38	0	.97	.97	.95	.97	.74	.91
Indiana WF9	1.43		1.20	1.44	.97	0	.97	.95	.97	.74	.91
Ohio 38	1.50		1.23	1.35	.95	.95	0	.88	.75	.74	.62
Wisconsin 22	1.20		1.51	1.17	.95	.95	.88	0	.75	.74	.62
Ohio 51A	1.69		1.51	1.17	.92	.79	.88	.75	0	.74	.62
Wisconsin 27	1.68		1.00	.76	.74	.74	.62	.74	.74	0	.53
Iowa 3395	.87		.94	1.11	.91	.91	.62	.62	.62	.53	0

Least significant difference between single crosses = .38 mg.

QUESTIONS FOR SECTION H:

71. Which of the single cross combinations tested showed the highest per cent yield?
( ) 1. Insufficient data are given to answer the question
( ) 2. Ohio 38 and Iowa 3395
( ) 3. Wisconsin 8 and Illinois M14
( ) 4. Wisconsin 8 and Nebraska 4

72. On the average, the crosses involving white line produced each of the highest carotene content?
( ) 1. Nebraska A
( ) 2. Ohio 38
( ) 3. Nebraska 4
( ) 4. Ohio 51A

73. The use of an experimental design which provided for repetition of the experiment would
( ) 1. be desirable only with references to the inbred lines of corn
( ) 2. help to control soil type and fertilizer treatment
( ) 3. probably give identical results
( ) 4. provide more adequate experimental evidence

QUESTIONS FOR SECTION G:

69. When the cell begins discharging
( ) 1. lead peroxide is no longer formed on the positive plate
( ) 2. the current begins flowing to the positive plate
( ) 3. the positive plate is no longer of higher potential
( ) 4. the positive plate loses its reddish-brown color

70. Figure 1 shows that
( ) 1. the cell can generate current for a little over 13 hours
( ) 2. the cell cannot be recharged
( ) 3. the density of the acid is changing
( ) 4. the specific gravity of the acid is not dependent on voltage changes