name_____(req'd)   .

Answer every question (1-59) with a single bubble. If not specified otherwise, assume

A = True/yes   B =False/no

Italicized statements should be taken as true.
If any part of a question is wrong, treat the entire question as wrong.

Realms of Science

1-5. (10 pts) Which of the following are valid possible uses of, conclusions or outcomes from the SM? Mark as false any option that lies outside the realm of science. **(A) = True, (B) = False**

1. (A)(B) Disagreement among scientists over the status of a model (e.g., that exposure to electromagnetic fields causes cancer) indicates that the scientific method has been incorrectly applied.

2. (A)(B) *Nearly half of our class thought that Bigfoot's existence was plausible*. These opinions constitute data to support Bigfoot's existence.

3. (A)(B) Evaluation of a model is the last step in the scientific method to address a particular goal. When the evaluation has been completed, the goal is resolved and the process ends.

4. (A)(B) A diet trial shows that patients eating lots of fruits and vegetables have lower heart disease rates than patients eating few fruits and vegetables. These observations can be used to help evaluate whether diet affects heart disease.

5. (A)(B) When the scientific method has led to an erroneous conclusion (e.g., rejected a model that should not have been rejected), the fault is necessarily bad data. Evaluation is not a step where the process can go wrong.

Scientific Method (SM)

6-9. (7pts) *A single cycle of the SM is completed: a goal is used to propose several models, data are generated to test the models and the models then evaluated against the data*. What are possible outcomes from the evaluations? Each option should be considered independently of others.

(A) a possible outcome if the SM is done right   (B) not a possible outcome

6. (A)(B) The goal is rejected by the data.

7. (A)(B) One of the models is proven to be true, the others rejected.

8. (A)(B) All models are rejected.

9. (A)(B) None of the models are rejected.

10-14. (8 pts) Using shortcuts to identify improper SM. Each of the following questions describes a claim or method that could have a scientific basis. Indicate whether the question indicates anything that appears to violate a legitimate use of the Scientific Method (option A) or does not obviously deviate (option B). The goal here is to identify suspicious practices that suggest a fundamental violation of normal use of SM.   Note that these descriptions do not allow you to assess all 5 elements of the S.M., so you must rely on what we called shortcuts.

(A) is suspicious -- likely a fundamental violation of one or more elements of SM

(B) not suspicious – very possibly consistent with how SM is usually conducted

10. (A)(B) A researcher who believes that electrical fields cause cancer says that no evidence can convince him otherwise.

11. (A)(B) A researcher conducting a study of diet uses only those data to which she is legally allowed access.

12. (A)(B) A professor who wants to provide the best possible educational methods for his students continues to use the same teaching methods throughout his career without trying new methods and technologies.

13. (A)(B) A drug company testing a new anticancer compound discards one of its correctly-conducted experimental trials because the outcome of that trial looks unfavorable to regulatory approval.

14. (A)(B) A published paper is later found to have reached an erroneous conclusion (evaluation) because of an accidental mistake in a statistical test.

15-30. Identifying SM elements. Below are paragraphs, each giving a description of a process with possible parallels to the scientific method (SM). In the questions that follow each paragraph, you are asked either to match a scientific method element with a quote taken from the paragraph or to interpret something about the SM parallel. In each paragraph, the goal is underlined. Answers should be based only on what is explicitly described.

15-18. (7pts) Luke Tonnemaker wants to run a financially successful business as a farmer selling fruit. Initially, he makes his money by selling at farmer's markets in Moscow, Pullman, and Spokane. Each year, he keeps track of his income and expenses. After the first 10 years, he finds that he is not making enough money to maintain his operation in the long term, so he changes his practices to sell only at Moscow's and Spokane's markets. Options (A)-(E) may be used once, more than once, or not at all. A model that constitutes a revision should use (D).

<div align="center">

(A) Model   **(B)** Data   **(C)** Evaluation   **(D)** Revision   **(E)** None

</div>

15. (A) (B) (C) (D) (E) selling at farmer's markets in Moscow, Pullman, and Spokane

16. (A) (B) (C) (D) (E) not making enough money to maintain his operation in the long term

17. (A) (B) (C) (D) (E) sell only at Moscow's and Spokane's markets

18. (A) (B) (C) (D) (E) income and expenses

19-22. (7pts) As a student, Mary wants to maintain good grades in all her classes. She attempts this by carefully reading the assignments for her classes. Her first exam scores are failing, not to her satisfaction. She hopes to score higher on the next tests. Options (A)-(E) may be used once, more than once, or not at all. A model that constitutes a revision should use (D).

<div align="center">

(A) Model   **(B)** Data   **(C)** Evaluation   **(D)** Revision   **(E)** None

19. **(A) (B) (C) (D) (E)** not to her satisfaction

20. **(A) (B) (C) (D) (E)** first exam scores are failing

21. **(A) (B) (C) (D) (E)** carefully reading the books for her classes

22. **(A) (B) (C) (D) (E)** As a student

</div>

23-26. (7pts) In searching for a method of improving student exam performance that could be used by any US college student, researchers tested whether caffeine leads to higher scores. They gave one group of Cors236 students caffeinated coffee before exam 1 and another group of Cors236 students decaffeinated coffee (decaf) before the same exam. Students who consumed caffeinated coffee had an average 10 points higher than the students who had decaf. For the second exam, the treatment was switched so that the students who were given caffeinated coffee before the first exam now got decaf before the second exam (and vice versa). Again the group that got caffeine performed better (by 8 points on average). The researchers concluded that caffeine does indeed increase test performance for the average US student. **(A)** = TRUE **(B)** = False

23. **(A)(B)** For the conclusion stated, the students in this test are used as models of other US students.

24. **(A)(B)** The study lacks abstract models but has physical models (the students, the coffee used)

25. **(A)(B)** Revision is illustrated by reversing who got caffeinated coffee between the first and second exams.

26. **(A)(B)** Evaluation is indicated by the conclusion that "caffeine does indeed increase test performance."

27-30 (7pts). Holly and Jim are both occasional gardeners. Both want to grow as many tomatoes as possible. Each year, Holly actively tries different combinations of strains, fertilizer and watering schemes in different parts of the garden. In the following year, she changes her strains, fertilizer and watering scheme to match the best tomato production of the previous year. In contrast, Jim always uses one tomato strain, fertilizer and watering method throughout his part of the garden, and it is the same every year. Holly usually grows more tomatoes than Jim, and although Jim realizes his tomato output is not good, he is too lazy to change.

<div align="center">

(A) = TRUE **(B)** = False

</div>

27. **(A)(B)** Jim and Holly have different goals.

28. **(A)(B)** Jim and Holly use different models to achieve their goals.

29. **(A)(B)** Jim's gardening strategy does not incorporate all elements of the scientific method.

30. **(A)(B)** It can be inferred from the paragraph that both Jim and Holly have data to test their models

Models (A,C,U = Accuracy, Convenience, Uniformity)

31-34. (7pts) Which of the general points about models are true? **(A) = TRUE, (B)** = FALSE

31. (A)(B) The importance of a model's limitations cannot be identified until we know the goal.

32. (A)(B) A model's limitations (differences from what it represents) cannot be identified until we know the goal.

33. (A)(B) Scientific progress is defined by finding models that have fewer total limitations than their predecessors.

34. (A)(B) One way to overcome a model's limitations is to gather data that avoid the limitations.

35-37 (6pts) Matching models to goals. In which of the following contexts is a bacterium used as a model of humans? That is, bacteria can be considered similar enough to us that we learn something about ourselves. If the possible human use is ambiguous, mark it as 'false.' **(A) = TRUE – bacteria are used as models of humans   (B) = False**

35. (A)(B) Bacteria are studied for their resistance to antibiotics to understand which are high risk for causing human infections. Bacteria resistant to antibiotics are considered prone to cause incurable human infections because they are not easy to treat.

36. (A)(B) As a simple way of screening possible cancer causing agents in ourselves, the 'Ames test' measures a chemical's ability to cause mutations in bacteria. If the compound causes mutations in the bacteria, it is considered mutagenic in people and thus is not allowed to be put in food or drugs.

37. (A)(B) Scientists study bacterial genomes to understand which bacterial genes allows the bacterium to cause human infections.

Condom Testing (ABT is 'airburst test')

38-47. (16 pts) Which major points were made from the condom-testing lectures? **(A) True (B)** False

38. (A)(B) Volunteer studies were sometimes used to decide if a batch of condoms can be marketed.

39. (A)(B) At least some of the models used for testing condoms are decidedly not Accurate models of sex.

40. (A)(B) The government-mandated models for testing condom quality (models used to decide if a batch can be sold in the US) were the only models described for determining whether condoms protected against HIV transmission.

41. (A)(B) There are no government-mandated condom tests using 'trained technicians' because such tests are too 'inconvenient'

42. (A)(B) 'One condom is a model of all condom brands' applies to the use of destructive tests such as the airburst test

43. (A)(B) 'One condom is a model of all condoms in the batch' applies to the use of destructive tests such as the airburst test

44. (A)(B) Some condom-testing models mandated by the government are so inaccurate that they are considered useless.

45. (A)(B) The ABT is weak on Uniformity because not all condoms break at the same air volume

46. (A)(B) The ABT is not useful for assessing small pores in an intact condom

47. (A)(B) None of the airburst test, water leak test and stretch test are considered models of sex between people. (These are some of the models used to decide whether a batch of condoms can be marketed.)

DWI

(*SFST is the standardized field sobriety test, BAC is blood alcohol concentration*)

48-51. (7pts) Order the following models of DWI testing in terms of A, C, or U. We are interested in these tests as models of driving performance. (*The 3 tests are the SFST, BAC, and a hypothetical Road Test mentioned in class.*)

    48. Which model is least accurate?   (A) BAC   (B) SFST   (C) Road test

    49. Which model is most accurate?   (A) BAC   (B) SFST   (C) Road test

    50. Which model has the greatest uniformity?   (A) BAC   (B) SFST   (C) Road test

    51. Which model is least convenient?   (A) BAC   (B) SFST   (C) Road test

52-54 (5pts) The SFST is considered a *convenient* model for assessing driver impairment. Why?

          (A) True and also answers the question   (B) False and/or does not answer the question

    52. (A)(B) It measures behaviors pertinent to driving performance.

    53. (A)(B) It can be administered the same way to each subject.

    54. (A)(B) It can be administered almost anywhere and without any equipment.

55-58. (7pts) Which limitations (or other considerations) are relevant to 'back calculations' of blood alcohol concentration (BAC) as a model to determine whether a driver exceeded 0.08% when stopped by the police. These back calculations use a Widmark plot. (The goal here is to <u>determine whether someone exceeded the 0.08% limit at the time they were stopped</u>)?

          (A) True and answers the question (B) False or does not answer the question

    55. (A)(B) The main data on how fast alcohol is cleared from the body come from computer models rather than from

        people.

    56. (A)(B) The BAC of a person whose actual BAC increased between the time stopped on the road and the time the BAC was read would definitely be miscalculated by the back calculation method based on a Widmark plot.

    57. (A)(B) Although the back calculation based on a Widmark plot accounts for many factors that may affect alcohol clearance, such as food in stomach, male-female differences and body size differences, it does not account for how long ago the person finished drinking alcohol.

    58. (A)(B) Different people may be differently impaired at the same level of BAC.

59. (3 pts): Correctly identify your exam and answer sheet

<u>Key code **B**</u>. Bubble **B** on #59 of your exam form to indicate which version of the test you have; do not fill in any other bubbles.

To ensure you get full credit, bubble in the last 4 digits of your Vandal email address in the ID field – include leading zeros. Put your name on the first page of this exam form and turn it in with the answer sheet.