Science Olympiad

2012 Battle of Valley Forge

Water Quality

Section A

School Name: _____

Team Number _____

Directions: Fill in your response for each question in the space provided on the answer sheet corresponding to that question. Incorrect or missing units will count as an incorrect answer. Ambiguous or illegible responses will be scored as incorrect. Unless noted otherwise, all questions have point value of 1.

Do not open this pack until instructed to do so.

Section A – General Water Quality (25 points)

Multiple Choice – Identify the choice that **best** completes the statement or answers the question.

1. Which stage of the hydrologic cycle can be the most direct cause of algal blooms?
   A) Evaporation
   B) Precipitation
   C) Transpiration
   D) Infiltration
   E) Runoff

2. Which nutrient is most often limiting in aquatic ecosystems?
   A) Nitrogen
   B) Phosphorous
   C) Carbon
   D) Hydrogen
   E) Sulfur

3. The addition of a limiting nutrient to an ecosystem may lead to an algal bloom. What effect will this algal bloom have on the oxygen content of the water?
   A) The algal bloom will cause the oxygen content in the water to increase.
   B) The algal bloom will cause the oxygen content in the water to decrease, leading to hypoxic conditions.
   C) The algal bloom will have no impact on the oxygen content of the water.
   D) The algal bloom will cause rapid fluctuations of oxygen in the water.
   E) The oxygen content will vary based on the depth of the water.

4. What impact have humans had on the phosphorous cycle?
   (I) Use of phosphorous containing fertilizers.
   (II) Increased urbanization of forested areas.
   (III) Increased use of phosphorous containing detergents.
   A) I only
   B) II only
   C) III only
   D) I and II only
   E) I and III only

5. What is a watershed?
   A) Network of streams leading to a large river.
   B) Network of rivers and bays that lead to the ocean.
   C) Reservoir of water stored underground.
   D) Area of land that drains to a water body.
   E) Extensive wetland system leading to a bay.

6. Which of the following are types of wastewater?
   (I) Sewage from toilets.
   (II) Water from showering and bathing.
   (III) Water from washing clothes.
   A) I only
   B) II only
   C) III only
   D) I and II only
   E) I, II, and III

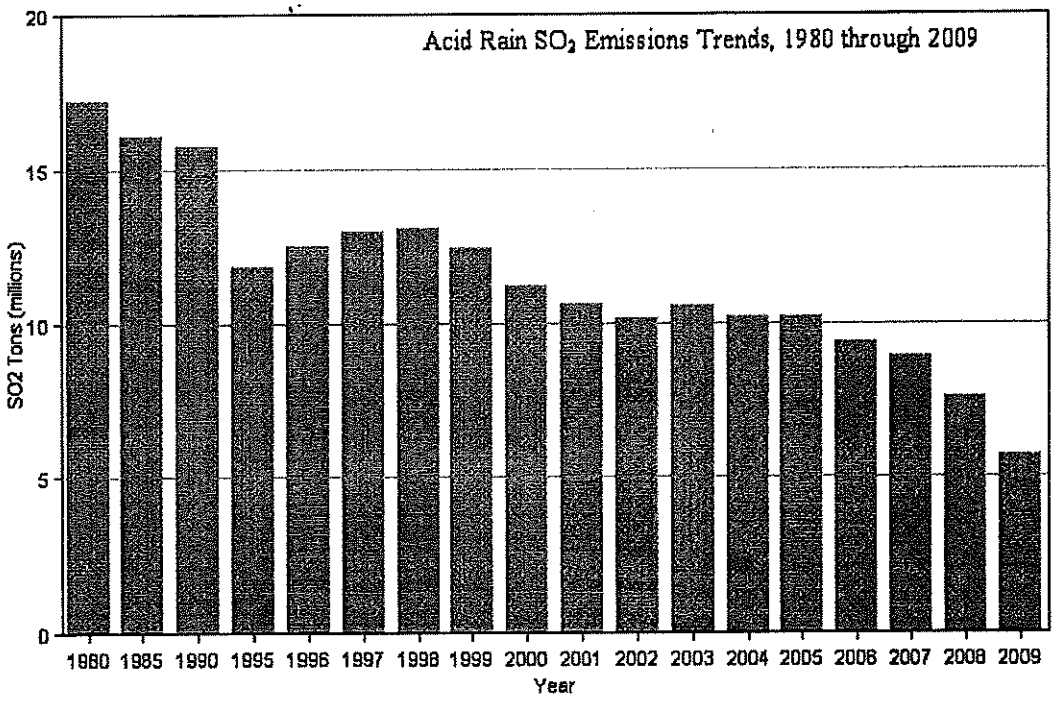
7. Tests on water can be used to indicate the likelihood of human wastewater contamination by testing for indicator species such as
   A) Crypstosporidium.
   B) Fecal coliform bacteria.
   C) Vibrio Cholerae bacteria.
   D) Influenza.
   E) Salmonella Typhi bacteria.

8. What is the first step of treating wastewater at a municipal sewage treatment plant?
   A) Use of bacteria to break down organic matter.
   B) Solid waste material settles out.
   C) Disinfection using chlorine or ozone.
   D) Water is removed from sludge.
   E) Water undergoes aeration to reduce offensive odors.

9. Bacteria are beneficial to wastewater treatment because
   A) they help solid material settle out of the wastewater.
   B) they naturally break down organic matter.
   C) the nutrients produced are beneficial to the treated water.
   D) a and b are true.
   E) all of the above are beneficial aspects.

10. Refer to Figure A.1 below. It can be interpreted from the graph that the greatest environmental threat due to acid deposition most likely occurred
   A) In the 1980s.
   B) In the 1990s.
   C) From 2000 to 2005.
   D) From 2005 to the present.
   E) There is no correlation between sulfur dioxide emission and acid deposition.

Figure A.1



11. The pollution of waterways creating conditions in which productivity is decreased and gills of bottom dwelling organisms are clogged is due to

A) Erosion and sedimentation.
B) Runoff and flooding.
C) Urbanization.
D) Mining dams.
E) Thermal pollution.

12. Freshwater accounts for what percent of the total water in the world?

A) 1 **B)** 3 **C)** 10 **D)** 20 **E)** 33

13. Which of the following is NOT true regarding the Chesapeake Bay?

A) It is one of many small estuaries along the east coast of the United States.
B) A large amount of sediment travels down the watershed into the bay.
C) It receives anthropogenic chemicals that adversely affect the local fish populations.
D) It receives nutrients from sewage treatment facilities.
E) It experiences algal blooms from the fertilizers used on the land of its watershed.

14. What health threat is commonly found in the water of older homes due to old plumbing systems?

A) Lead
B) Sulfates
C) Mercury
D) Arsenic
E) Phosphates

15. Which pollutant or pollutants are most likely to create eutrophic areas?

A) Nitrates and phosphates
B) Synthetic organic compounds
C) Heavy metals
D) Solid waste
E) Pharmaceuticals

16. Genetically engineered bacteria are useful in the remediation of

A) synthetic organic compounds.
B) oil spills.
C) nitrates and phosphates.
D) heavy metals.
E) sedimentation,.

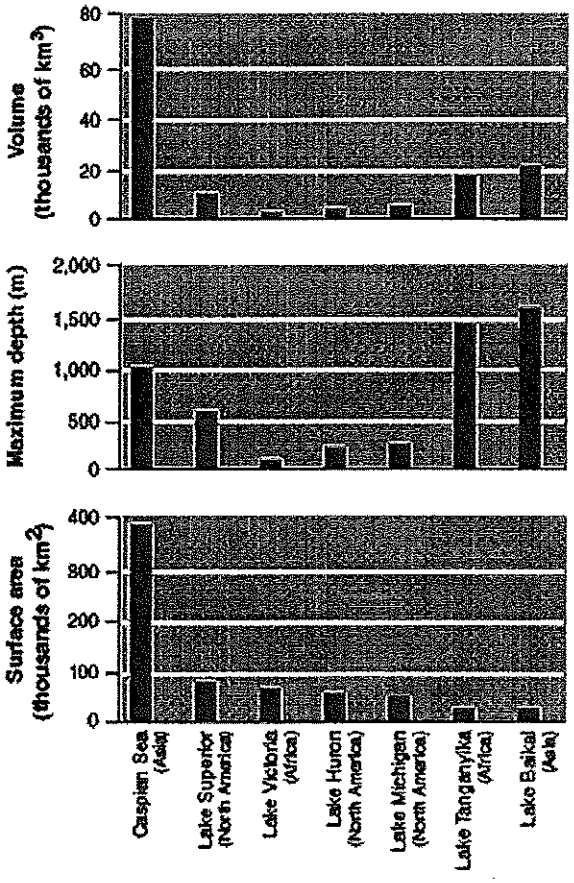
17. Waste from which of the following is an example of a nonpoint source of water pollution?

A) Waste overflow from a water treatment plant due to excessive rains.
B) Mercury emissions from coal burning power plants.
C) Runoff from sprayed agricultural fields.
D) Dumping at an abandoned landfill.
E) Acid drainage from an empty mine.

18. Refer to Figure A.2 below. According to Figure A.2, the lake with the largest water volume is

A) Lake Victoria.
B) Lake Superior.
C) Lake Tanganyika.
D) Lake Baikal.
E) Lake Huron.

Figure A.2



19. On the pH scale, _____ is neutral.

A) 3 **B)** 4 **C)** 5 **D)** 6 **E)** 7

20. What is a nutrient cycle?

A) The movement of energy from higher to lower trophic levels of a food chain.
B) The movement of organic and inorganic matter back into the production of living matter.
C) The movement of energy through an organism as food is metabolized.
D) An alternate name for food web.
E) The movement of minerals through a food web.

Short answer (5 points)

21. Explain the term "invasive species" and give an example of one that is currently in the US.

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Water Quality

Section B

School Name: _____

Team Number _____

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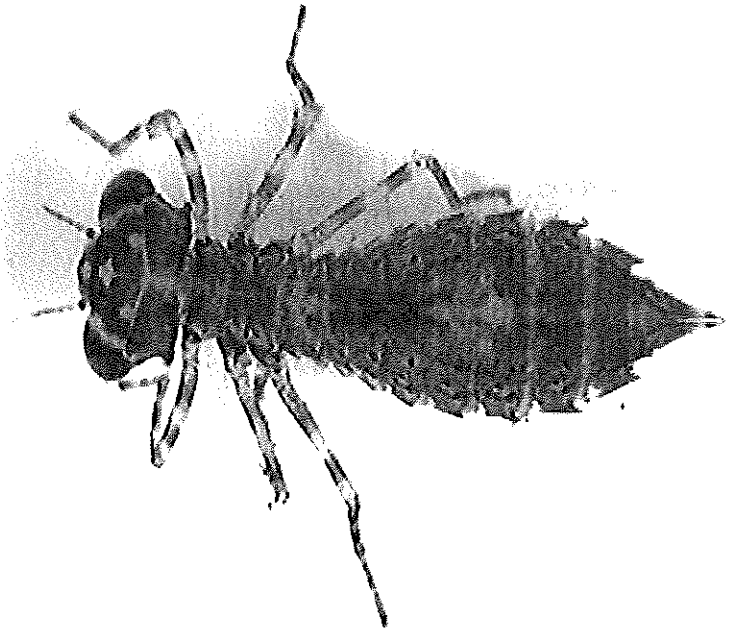
Section B – Macro-flora Macro-fauna (25 points)

Identification – Indicate the **organism** and its **life stage** (Adult, Larva, etc.)

22. 

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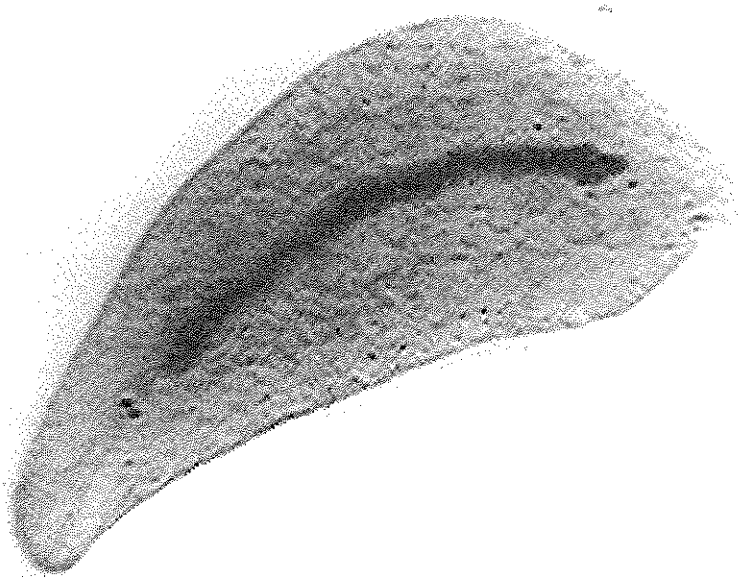

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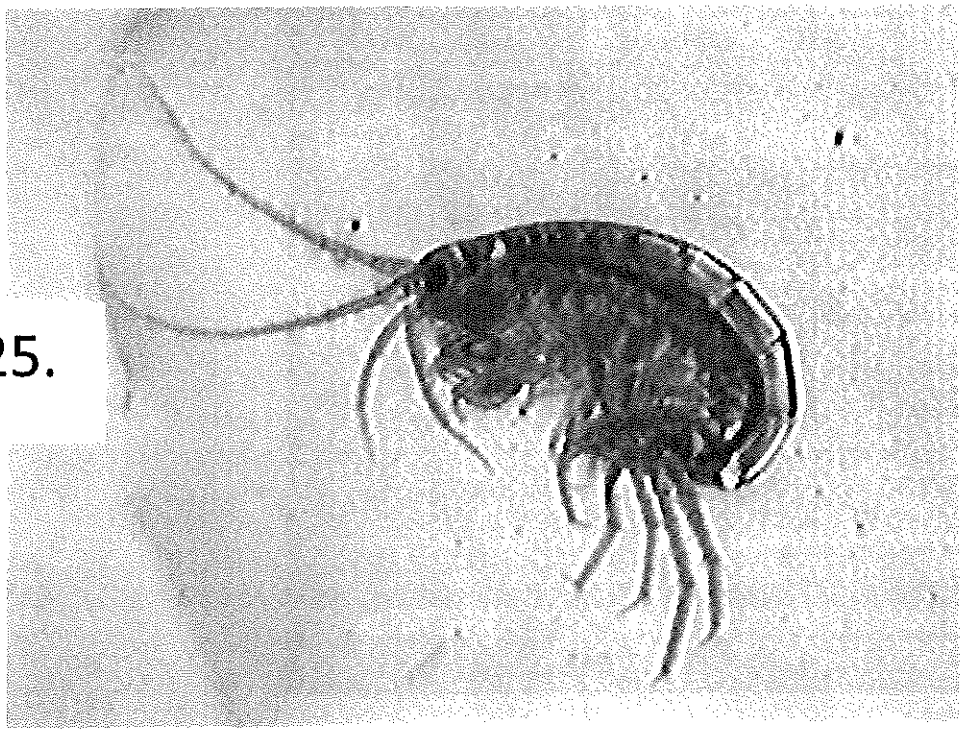

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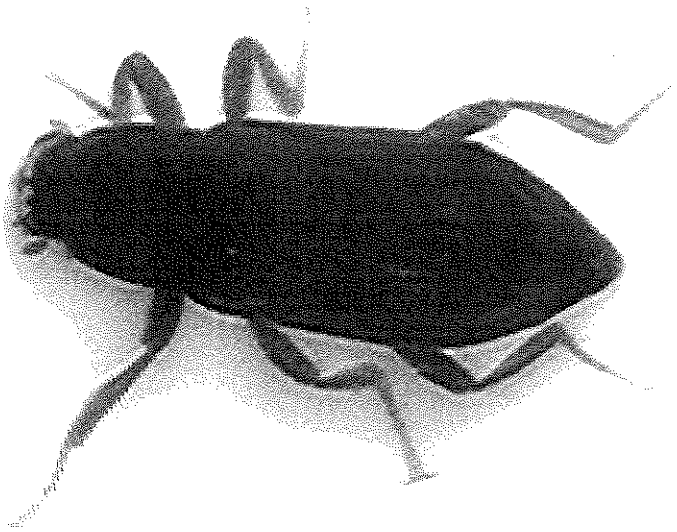

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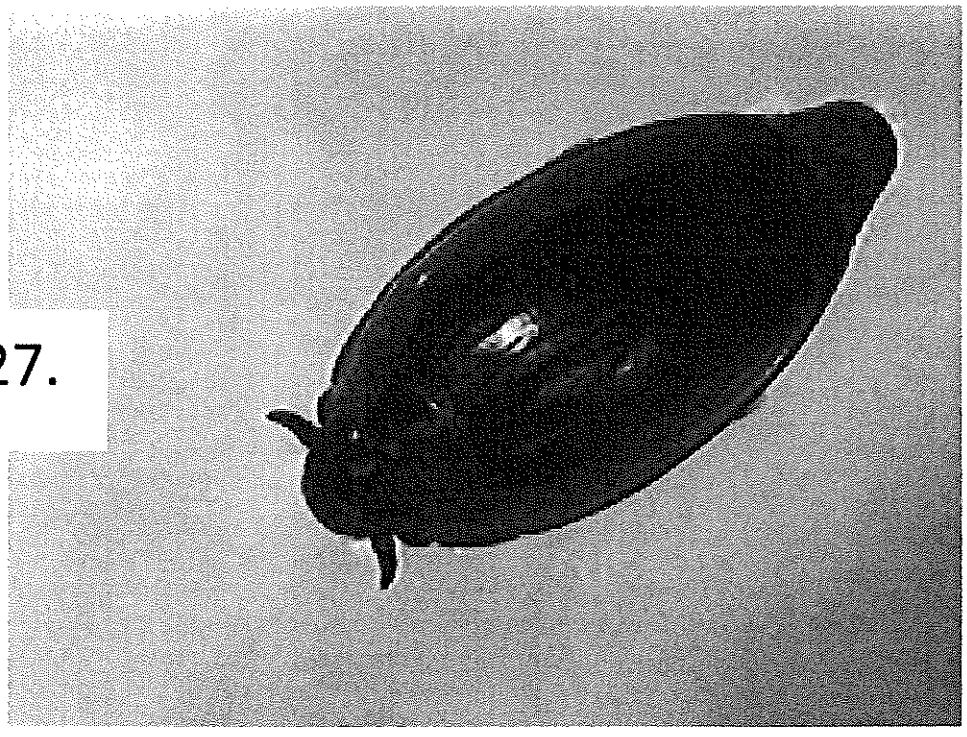

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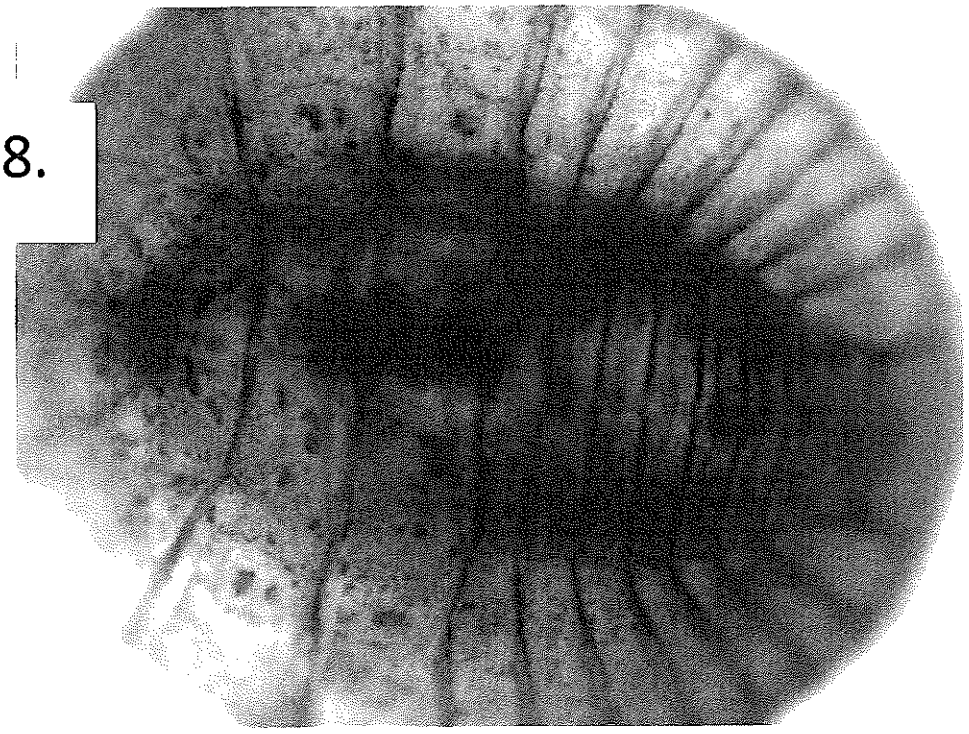

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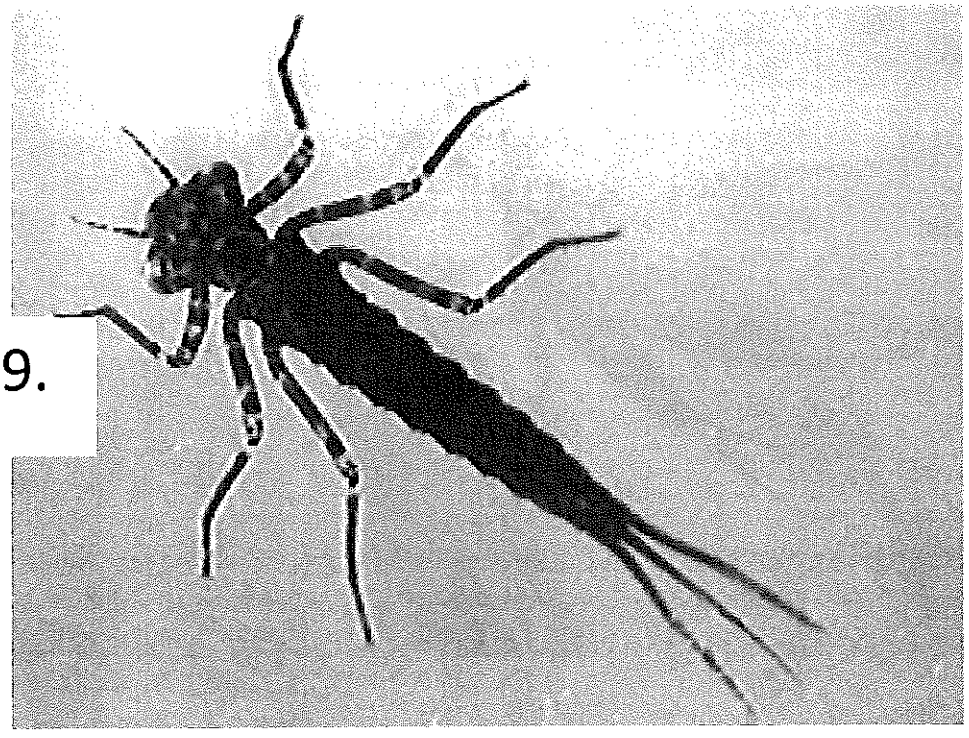

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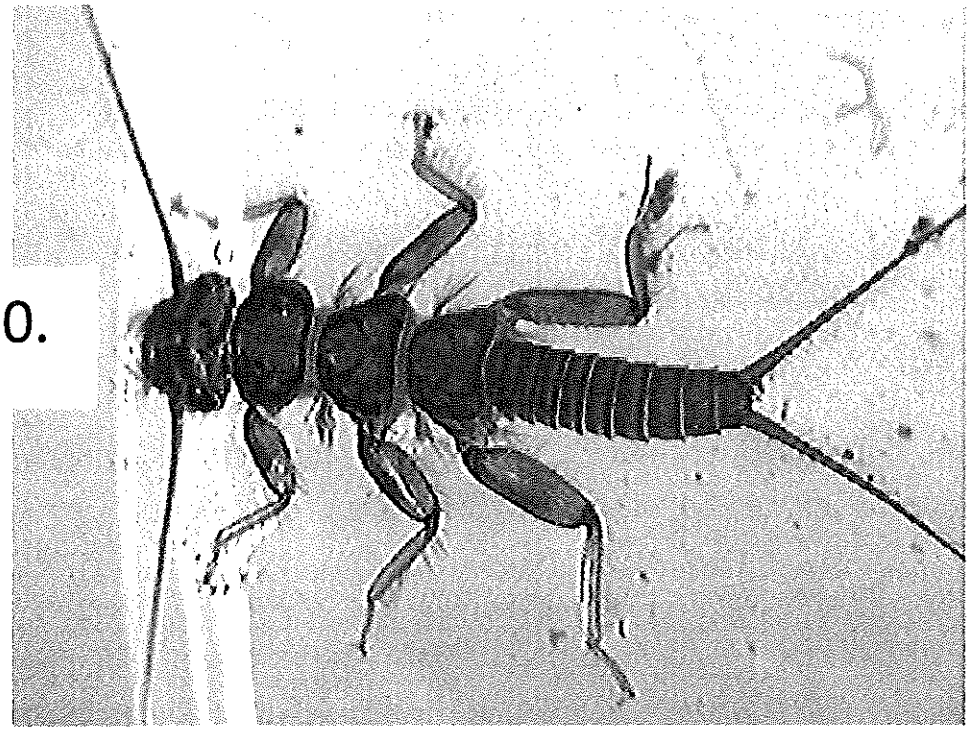

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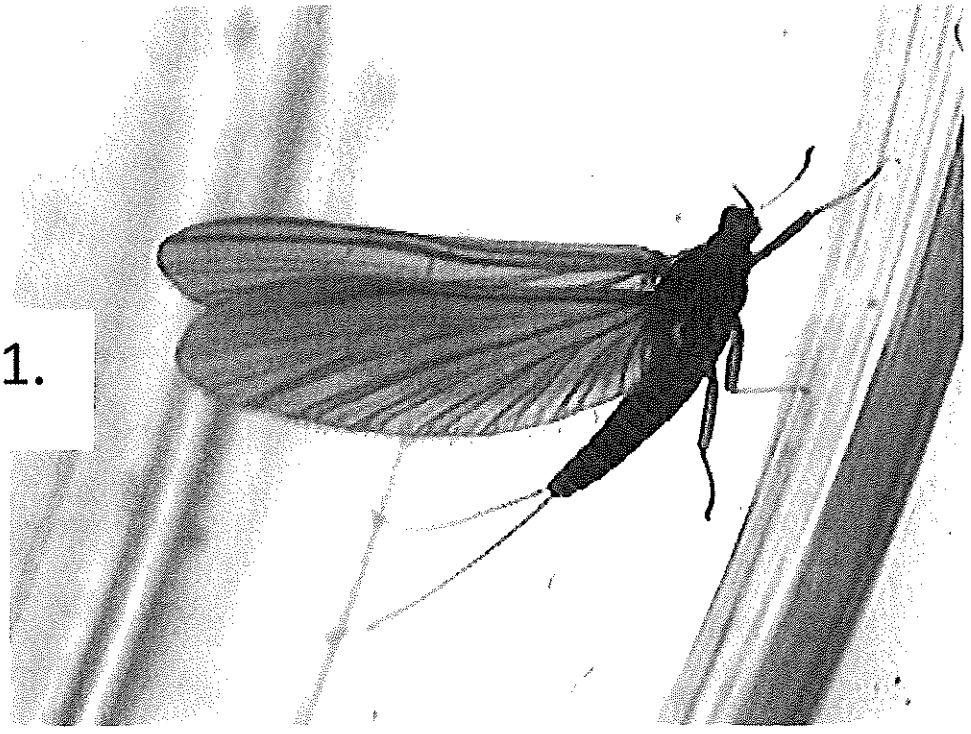

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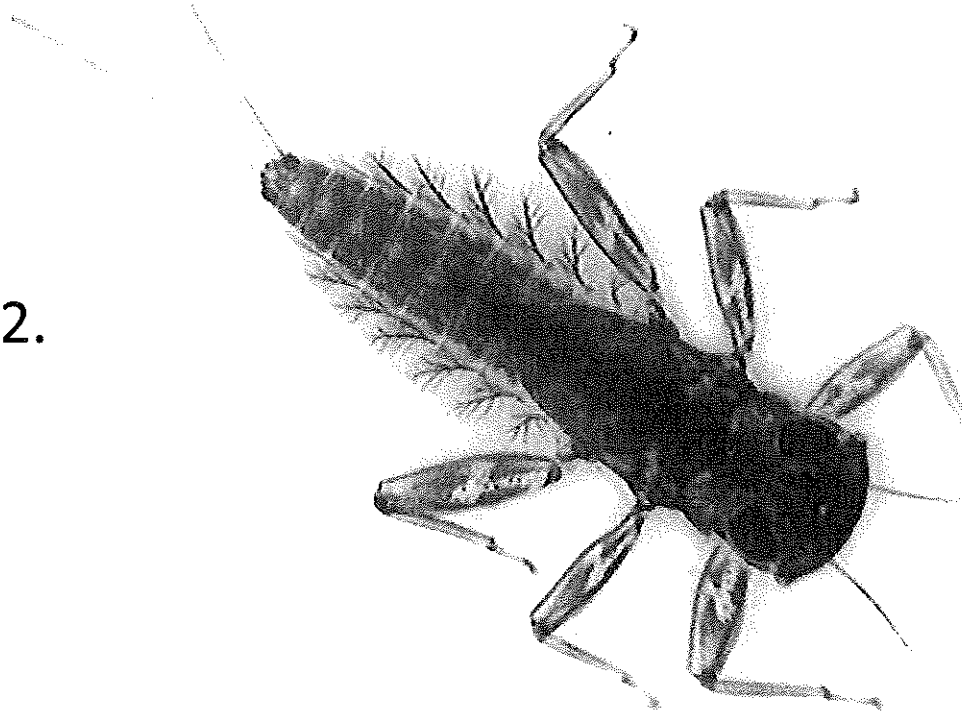

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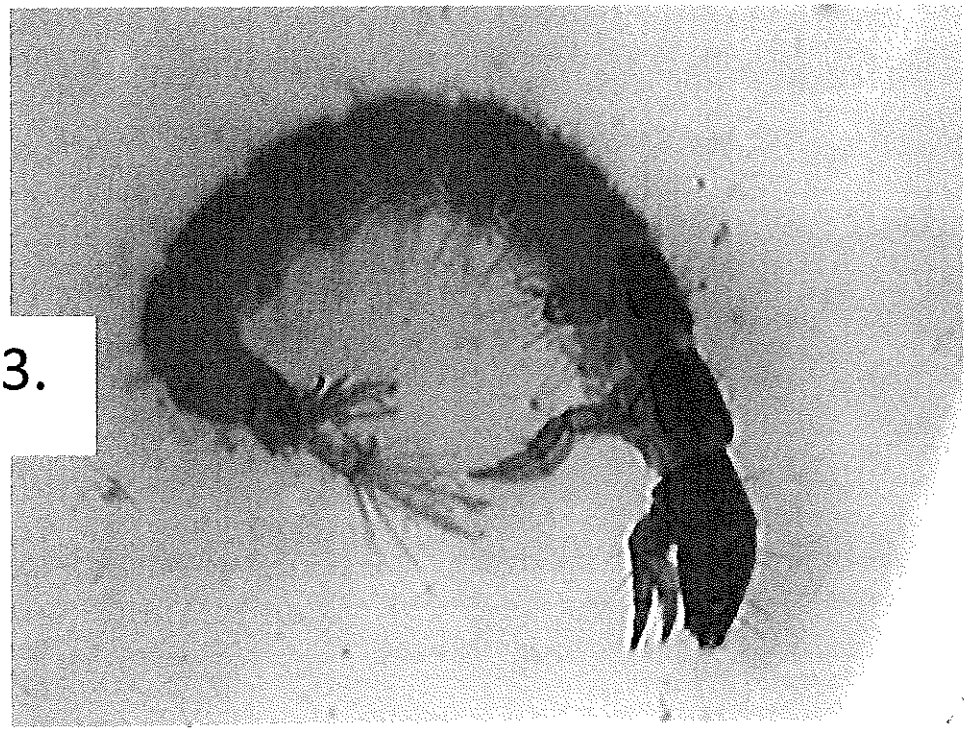

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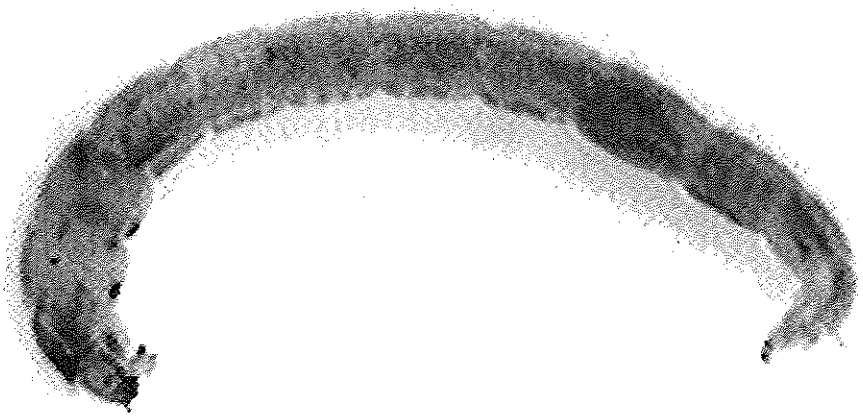

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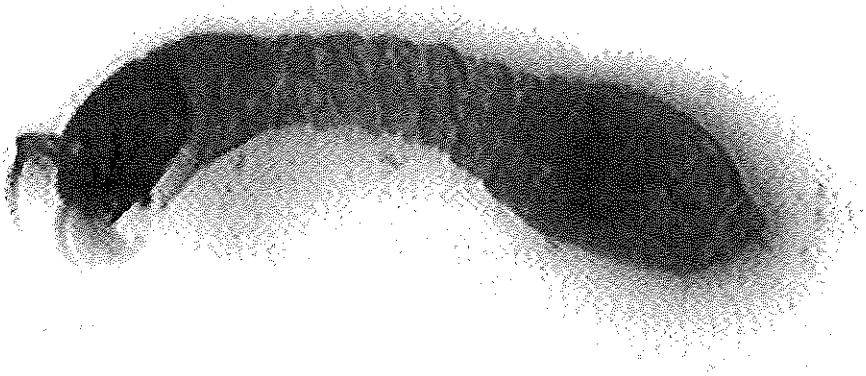

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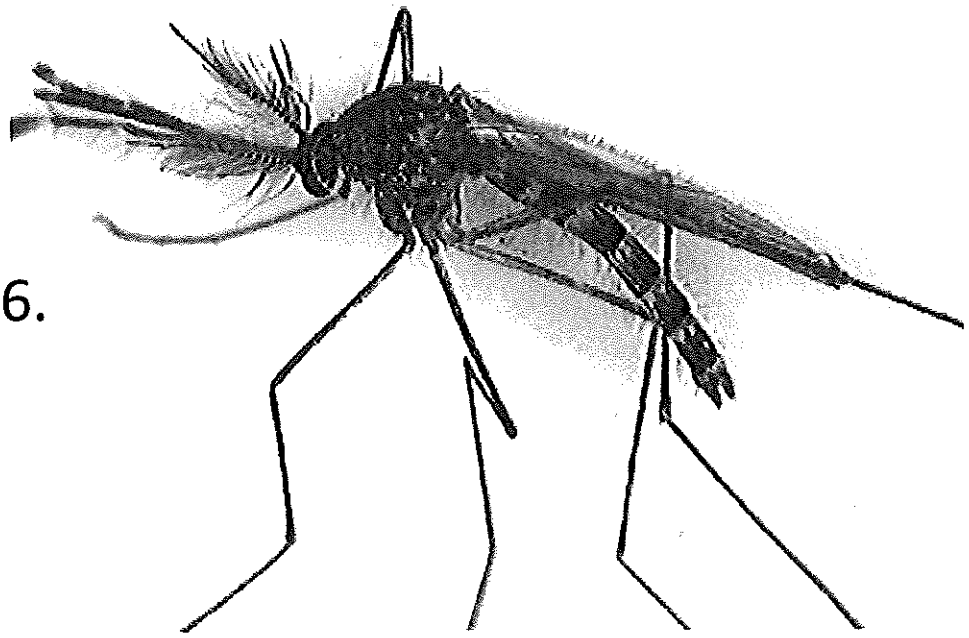

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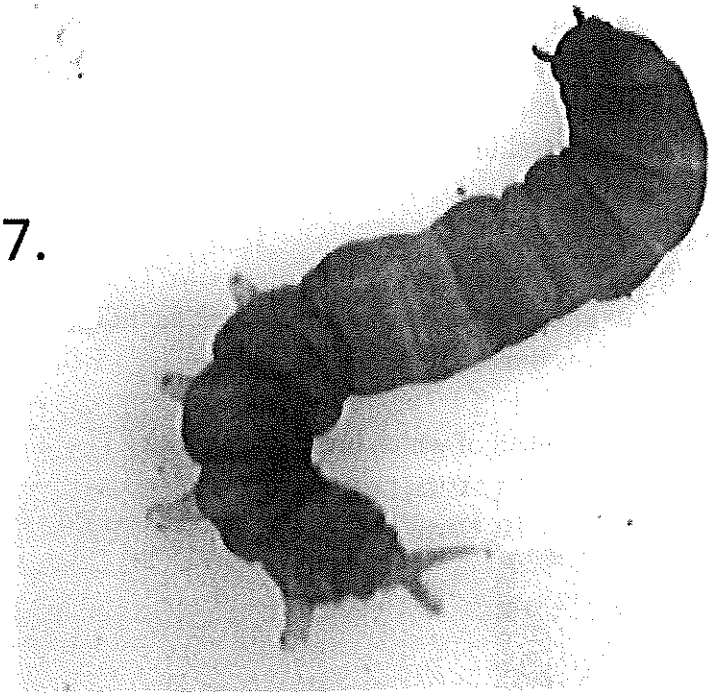


38.

39. Which of these statements about water hyacinths is FALSE?

A) Water hyacinths are a nuisance because they form thick mats and can block boat traffic along waterways.

B) Water hyacinths can lead to reduced dissolved oxygen in the water beneath them.

C) Water hyacinths can tolerate high latitude, cold temperatures

D) Water hyacinths cost the state of Florida millions of dollars in waterway restoration costs

40. What is the most significant effect of the zebra mussel invading non-native areas?

A) They are poisonous to native fish

B) They are free-floating organisms and prey on small fish

C) They prevent sunlight from reaching the bottom of lakes

D) They attach themselves to surfaces such as intake pipes for water treatment facilities, clogging them to the point where water flow is drastically reduced

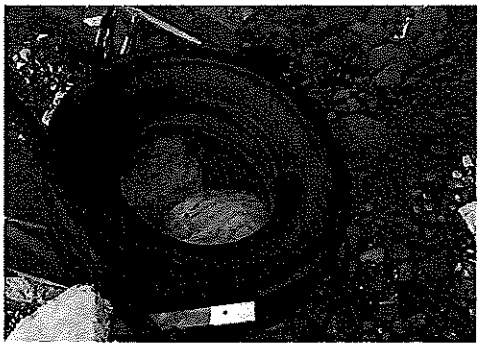
41. An old tire filled with rainwater might aid in the spread of which invasive species?

A) Zebra Mussel

B) Spiny water flea

C) Asian tiger mosquito

D) Carp



42. Macroinvertebrate sampling problem (5 points)

Quarterly macroinvertebrate monitoring of Happy Valley Stream yielded the following results:

1 mayfly nymph
3 damselfly nymphs
2 blackfly larvae
1 blood midge
1 stonefly larvae

- Determine the Tolerance Index for Happy Valley Stream. Show your work on back of answer sheet.
- Determine whether the stream quality is excellent, good, fair, or poor.

How to determine water quality of a stream by calculating the cumulative pollution tolerance index from the macroinvertebrates found there.

Calculate the tolerance index by multiplying the index value times the number of organisms found for each value. For example, if two total macroinvertebrates are found in class 1, then multiply, 2 (total individuals) X 4 (index value =4), for a partial index score of 8. If one organism was found in class 2 (1 X 3), four organisms in class 3 (4X2), and three organisms in class 4 (3 X 1), then the calculated tolerance index would be:
Class 1 = 8 plus Class 2 = 3 plus Class 3 = 8 plus Class 4 = 3; or 8+3+8+3 = 22

Tolerance Index Scale: Excellent >= 23; good = 17-22; fair = 11-16; poor <=10
Water Quality for the above example = Good.

Class 1 (pollution sensitive)	Class 3 (moderately tolerant)
INDEX VALUE = 4	INDEX VALUE = 2
Mayfly nymph	Water mite
Caddisfly larvae	Midge larvae
Stonefly larvae	Blackfly larvae
Dobsonfly larvae	Flatworm
Gilled snails	Leeches
Water penny larvae	
Riffle beetle larvae	
Class 2 (moderately sensitive)	Class 4 (pollution tolerant)
INDEX VALUE = 3	INDEX VALUE = 1
Aquatic Sowbug	Air breathing snail
Damselfly nymph	Maggot
Dragonfly nymph	Tubifex
Scuds	Blood midge
Crane fly larvae	

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Water Quality

Section C

School Name: _____

Team Number _____

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Section C – Water Monitoring and Analysis (35 points)

Multiple Choice – Identify the choice that **best** completes the statement or answers the question.

43. A low pH in water bodies can result from all of the following EXCEPT
- **A)** passing water through limestone treatment facilities.
- **B)** Acid rain.
- **C)** flooded, abandoned, underground mines.
- **D)** mountaintop mining.
- **E)** acid snow.

44. A water sample with a pH of 3 is considered to be
- **A)** basic.
- **B)** acidic.
- **C)** neutral.
- **D)** perfect for most aquatic life.

45. A secchi disk is used to measure
- **A)** the dissolved material in water.
- **B)** flow of a stream or river.
- **C)** the depth of silt on the bottom of a lake.
- **D)** light penetration of a lake or pond.

46. Pollutants have a tendency to concentrate in higher life forms because
- **A)** higher life forms drink water.
- **B)** the evaporation of lakes and streams concentrates the pollutants.
- **C)** bioaccumulation of pollutants occurs in the food chain.
- **D)** pollutants become more toxic as time passes.

47. Where should O_2 samples be taken in a stream?
- **A)** Surface
- **B)** Middle
- **C)** Bottom
- **D)** Does not make a difference since O_2 levels are uniform throughout depths.

48. The water quality index (WQI) is used to evaluate and compare waters around the world. Which of the nine tests is weighted the highest?
- **A)** Phosphates
- **B)** pH
- **C)** O_2
- **D)** Nitrates

49. As the temperature of a stream increases, the

A) Dissolved oxygen increases.
B) Dissolved oxygen decreases.
C) Dissolved oxygen is not affected.
D) There is no correlation between temperature and dissolved oxygen.

50. Hard water is a term commonly used to describe

A) water with many dissolved ions.
B) frozen springs.
C) groundwater found in arid areas.
D) water distilled from acid rain.

51. The turbidity test indicates

A) the odor of water.
B) suspended material in water.
C) mineral concentration of water.
D) metal concentration of water.

52. The pH of natural water falls between 9 and 14.

A) True
B) False

Short answer

53. Name two nutrients needed for plant and animal growth that are fundamental elements in metabolic reactions. (1 pt)

Using the test strip that has been tested in the freshwater sample, compare the color of the sample to the comparison chart. (1 pt each)

54. What is the result of the nitrate test in ppm nitrate?

55. Is this safe or unsafe water?

Again use the test strip that has been tested in the freshwater sample. (1 pt each)

56. What is the pH of the sample?

57. Is this sample acidic, neutral, or alkaline?

58. Explain why fecal coliform bacteria is used as an indicator of poor water quality. (2 pts)

59. Name two reasons why people would be interested in sampling water for its quality. (2 pts)

60. Alkalinity is the result of three negatively charged ions which shift pH to the alkaline (basic) side of neutrality. Name these three negatively charged ions. (2 pts each = 6 pts)

61. Determine the percent salt water concentration of provided sample in the graduated cylinder. (10 pts.)

WATER QUALITY ANSWER SHEET

School Name _____

Team Number _____

Section A

1_____
2 _____
3 _____
4 _____
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6 _____
7 _____
8 _____
9 _____
10_____
11 _____
12 _____
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14 _____
15 _____
16 _____
17 _____
18 _____
19 _____
20 _____
21 below

Section B:

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36 _____
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40 _____
41 _____
42:Tolerance Index _____
Water Quality_____

Section C:

43_____
44 _____
45 _____
46 _____
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57 _____
58 see below
59 _____
_____
60 _____
_____
_____

61 _____

21
58

ANSWER KEY

Tie Break Sequence: #60, #42, #21, #61, #53

Section A

1 E
2 B
3 B
4 E
5 D
6 E
7 B
8 B
9 B
10 A
11 A
12 B
13 A
14 A
15 A
16 B
17 C
18 D
19 E
20 B
21 below **(5)**

Section B:

22 dragon fly - larva
23 leech
24 flatworm (planaria)
25 scud
26 riffle beetle
27 whirligig beetle
28 water penny
29 damselfly - larva
30 stonefly - larva
31 mayfly - adult
32 mayfly - larva
33 caddisfly - larva
34 midge
35 blackfly - larva
36 mosquito - adult
37 cranefly - larva
38 aquatic snail (snail)
39 **C**
40 **D**
41 **C**
42:Tolerance Index **22** **(5)**
Water Quality **good**

Section C:

43 A
44 B
45 D
46 C
47 B
48 C
49 B
50 A
51 B
52 F
53 nitrogen
phosphorous
54 _____
55 _____
56 _____
57 _____
58 below **(1)**
59 check for pollution
Aquatic animal health
60 HCO_3 bicarbonate **(2)**
CO_3 carbonate **(2)**
OH^- hydroxide **(2)**

61 _____ [point value = (100 - % error) / 10]

21) Species that evolved elsewhere(1), and have been purposefully or accidentally (2)relocated. These species often find no natural enemies(3) in their new habitat, and therefore spread easily and quickly(4). Zebra mussels, Kudzu, etc. (5)

58) The presence of fecal coliform bacteria is an indicator of sewage bacteria.

#42 Happy Valley Calculation

Class	Index Value	# of organisms	Index subscore
1	4	2	8
2	3	3	9
3	2	2	4
4	1	1	1

Tolerance Index	22