2008 MENTOR SCIENCE OLYMPIAD INVITATIONAL
FIVE STAR SCIENCE

SCHOOL:___ANN SWERKEY_____

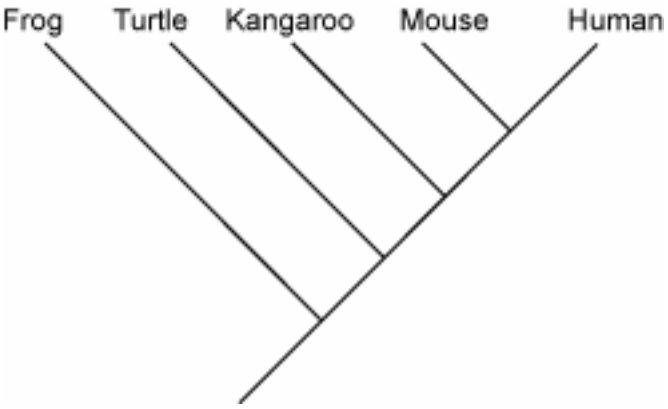
TEAM NUMBER: _____

- For each station you will get only 10 minutes so you will have to work efficiently!
- Answers must be in proper units and significant figures when necessary

BIOLOGY STATION: CLASSIFY THIS!

1. **3 & 4** 2. **B** 3. **D**

4.

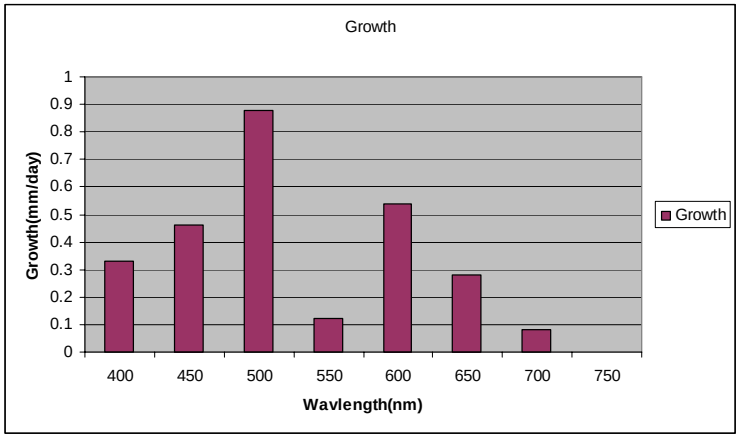


5.

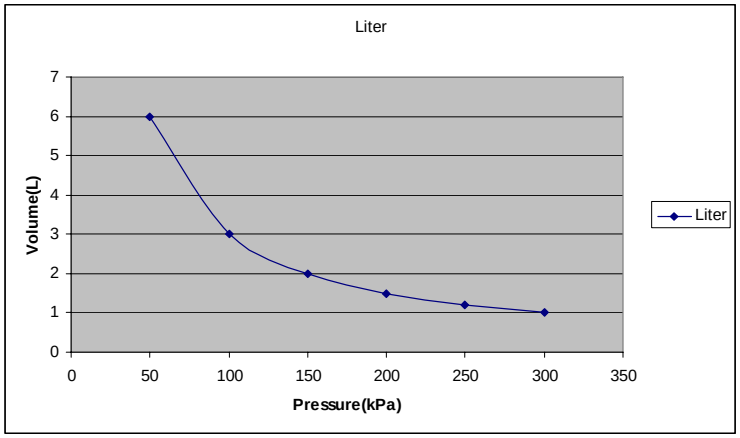
A. ___Walleye
B. __Goby___
C. _Bullhead catfish
D. _Pike
E. _Salmon
F. Perch
G. Smallmouth bass
H. _Whitefish

Tiebreakers: Charles Darwin

DATA STATION: AMERICAN GRAPHITTI



7. **550nm Frequency= 6.0e16 Hz**
8. **750**
9. **red**



11. _Boyle's Law

Tie Breaker: AM = amplitude modulated FM = frequency modulated

CHEMISTRY STATION:

12. 19.6 kPa

13. Sudden expansion of the air inside the lungs can cause a rupture of the alveoli within the lungs causing internal bleeding

14. $Na_2O(s) + H_2O(l) \rightarrow \underline{2}NaOH(aq)$

15. Synthesis

16. 93 g

17. 111 g

18. .625g

19. $^{222}_{86}Rn \longrightarrow {}^{218}_{84}Po + {}^{4}_{2}He$ **22.9 days**

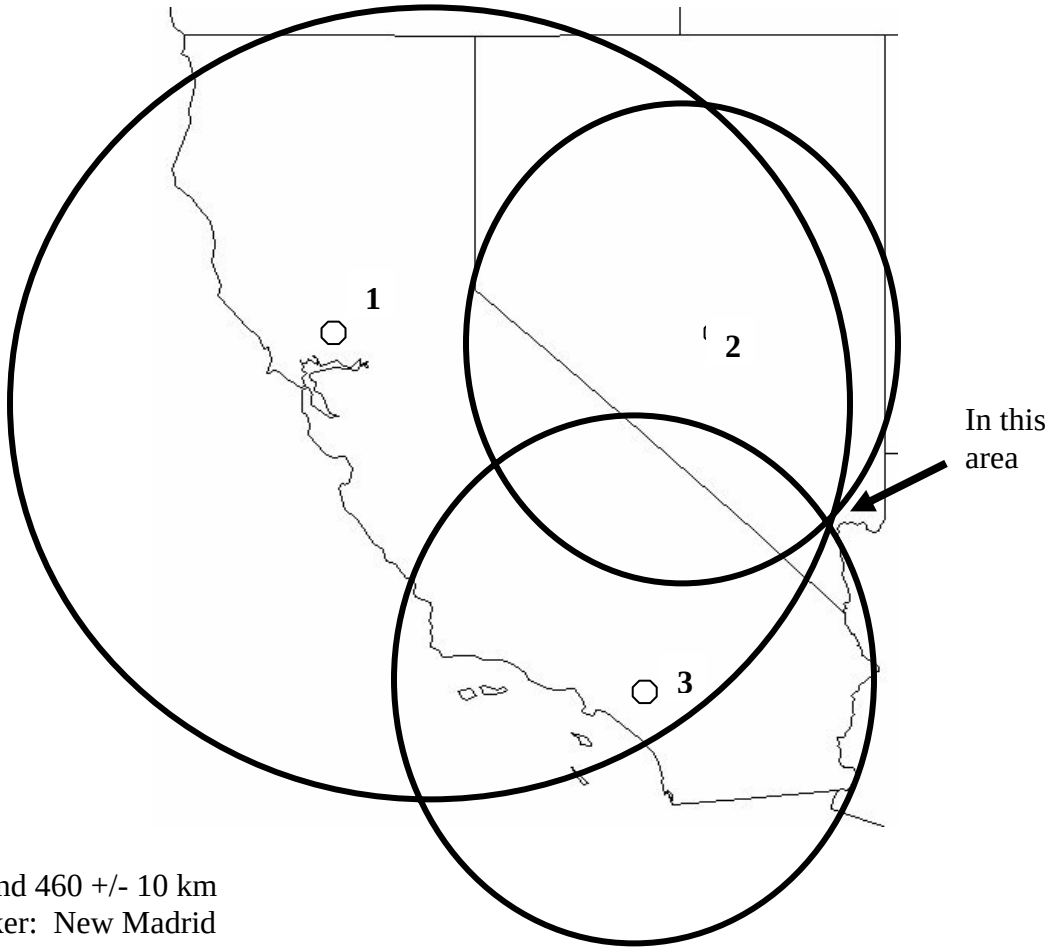
Tie Breaker: piece of paper

EARTH SCIENCE STATION: SHAKE ‘N STEAK

21. A. **strike slip** B.**normal** C. **thrust**
22. A. **P waves** B._**S waves**
23.

Seismograph	Time between P & S wave	Distance from station
Station 1	**3 minutes 30 seconds**	7 cm
Station 2	1 minutes 30 seconds	3 cm
Station 3	**2 minutes**	4 cm

24.



25. around 460 +/- 10 km
Tiebreaker: New Madrid

PHYSICS STATION: MIRROR, MIRROR ON THE WALL

26. **Angle B** is the angle of **incidence** (angle between the incident ray and the normal).
27. **Angle C** is the **angle of reflection** (angle between the reflected ray and the normal).
28. The angle of reflection is **60 degrees**. (Note that the angle of incidence is not 30 degrees; it is 60 degrees since the angle of incidence is measured between the incident ray and the normal.)
29. Answer: **d_i = 22.5 cm** and **h_i = -2.5 cm**
    Use $1/f = 1/d_o + 1/d_i$ where f = 15 cm and d_o = 45 cm
    Then use $h_i / h_o = - d_i / d_o$ where h_o = 5 cm, d_o = 45 cm, and d_i = 22.5 cm
30. Frequency and wavelength are inversely proportional to each other. The wave with the greatest frequency has the shortest wavelength. Twice the frequency means **one-half the wavelength**. For this reason, the wavelength ratio is the inverse of the frequency ratio.
31. **Amplitude = 16 cm**
    (Amplitude is the distance from the rest position to the crest position which is half the vertical distance from a trough to a crest.)
    Wavelength = 96 cm
    (Wavelength is the distance from crest to crest, which is twice the horizontal distance from crest to nearest trough.)
    Period = 0.42 s
    (The period is the reciprocal of the frequency. T = 1 / f)
    Speed = 230 cm/s
    (The speed of a wave is calculated as the product of the frequency times the wavelength.)
32.
    32

$$F_{grav} = \frac{(6.673 \times 10^{-11}\ N\ m^2/kg^2)\cdot(5.98 \times 10^{24}\ kg)\cdot(70\ kg)}{(6.38 \times 10^{6}\ m)^2}$$

$$F_{grav} = 686\ N$$

33. **a: +40 (add the momentum of the bat and the ball)**
c: +40 (the total momentum is the same after as it is before the collision)
b: 30 (the bat must have 30 units of momentum in order for the total to be +40)