

SCORE: / 33

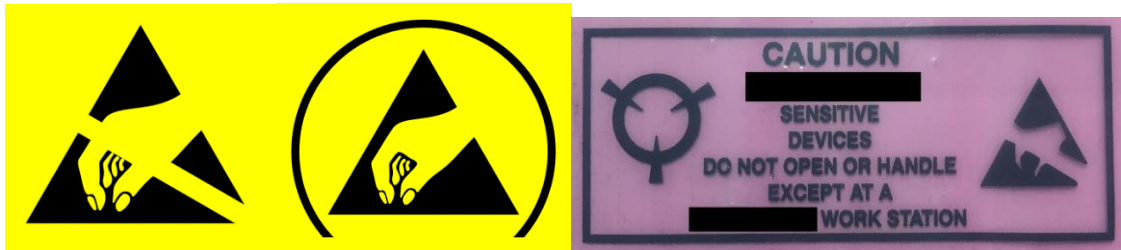
Interlake High School Science Olympiad

Circuit Lab

Tryout Test – Binder and Calculators Allowed

Interlake High School Science Olympiad Officer Team
Fall 2018

1. [1] Who created the voltaic cell, a pile of alternating zinc and copper disks separated by cloth or cardboard soaked in brine or acid? _____
2. [1] Who constructed the first electric dynamo? _____
3. [1] Who invented the induction motor? _____
4. [1] Who is the law of electrical resistance named after? _____
5. [1] Who invented the dipole antenna? _____
6. [1] Given an arrangement of static electric charges, each with charge q_i and location (x_i, y_i, z_i) , determine the work done on a test charge after it traces a closed loop defined by the parametric functions $(x(t), y(t), z(t))$. Express your answer in terms of $q_i, x_i, y_i, z_i, x(t), y(t), z(t)$, and any necessary fundamental constants. _____
7. [2] List the following materials from most positively charged to most negatively charged in the triboelectric series: Gold, Fur, Amber, Glass, Plastic Wrap. _____



8. [1] These warning symbols, most notably found on CMOS ICs and MOSFET transistors, refer to what hazard often fixed with special bracelets, anklets, mats, or shoes? _____
9. [1] What is the magnitude of the electric field (in $\frac{V}{m}$) at a point 5 meters away from the center a solid, conductive sphere of radius 1 meter carrying 5 coulombs of charge? Express your answer in terms of ϵ_0 and π . _____

10. [1] What is the capacitance, in farads, of two parallel square plates of side length 30 cm, separated by a 3 mm dielectric with dielectric constant ϵ_r ? Express your answer in terms of ϵ_r and any necessary fundamental constants. _____
11. [1] What is the general term for a device that converts AC to DC? _____
12. [1] What is the general term for a device that converts DC to AC? _____
13. [1] What is the name of the effect that causes current to be distributed towards the surface of a conductor when AC is used? _____
14. [1] T / F (circle one) Electricity produced by most turbine generators must be first converted to AC before it is transmitted.
15. [1] T / F (circle one) Transformers used to step down electricity from extremely high voltages in transmission lines to 110V for residential use work well with AC but not DC.
16. [1] What is the RMS voltage, in volts, of a sinusoidal AC source with peak voltage 1000V? Give your answer in simplest form. _____
17. [1] If 50 coulombs of charge pass through a point in 8 seconds, what is the current in amperes to the second decimal place? _____
18. [1] Given a uniform electric field of $15 \frac{\text{N}}{\text{C}}$ north, what is the positive voltage difference, in volts, between a point and another point 6 meters south and 9 meters east? _____
19. [1] What is the resistance, in ohms, of a cylindrical copper wire with diameter 1 mm and length 50 m? The resistivity of copper is $1.68 \times 10^{-8} \Omega\text{m}$. Round your answer to the nearest hundredth of an ohm. _____
20. [1] What is the power dissipated, in watts, by the 3Ω resistor in a circuit consisting of a 9V power source connected to a 3Ω and 6Ω resistor in parallel? _____

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21. [1] What is the potential energy, in joules, stored by a capacitor holding 2 coulombs of charge at a voltage of 7500V? _____
22. [1] Something has gone wrong in a 9V battery, and it has been shorted. If the battery's internal resistance is 2Ω , what is the current, in amperes, flowing through the battery? _____
23. [1] Which law, fundamental to electromagnetism, prohibits the existence of magnetic monopoles? _____
24. [1] Given an electromagnet composed of a solenoid, by what factor does its strength increase if the number of turns is increased by a factor of 6 and the current is decreased by a factor of 2? _____
25. [1] An ideal transformer has 900 coils on the input side and 300 coils on the output side. If the input is 110V, what will the output voltage be, in volts rounded to the first decimal place? _____
26. [1] An electron travels due east through a uniform magnetic field pointing due south. In which direction, if it exists, is the net force on the electron? _____
27. [1] What is the general name for a safety device designed to melt when too much current passes through it? _____
28. [1] What is the name of the phenomenon that allows a LED to emit light? _____
29. [1] $(\text{NOT}(((0 \text{ AND } 1) \text{ OR } 0) \text{ XOR } 1)) \text{ NOR}((0 \text{ XOR } 1) \text{ XOR} (\text{NOT}(0 \text{ XOR } 0))) =$ _____
30. [1] What is the time constant, in milliseconds, of an RC circuit comprised of an 800Ω resistor and a 2-microfarad capacitor? _____
31. [1] A silicon wafer doped with phosphorous would create what type of semiconductor? _____
32. [1] Current tends to flow which way through a P-N junction? _____