

IDEA EXCHANGE

CATALYST 2004

SCIENCE 10 UNIT REVIEWS

These are the unit reviews I used this year (and last year for Earth Science) in Science 10. They are based mainly on *Science Probe 10* (Nelson edition), which I used for the first time this year, and the *Dynamic Earth* and *Cells* (Prentice Hall) texts.

These reviews use the Teams-Games-Tournaments strategy of Cooperative Learning. It can be quite an organized affair, but I tend to simplify it to just a game.

Each sheet has 30 questions with the answers on the back. In envelopes, I have tags with the numbers 1-30. Students are arranged in groups of 4 (or less) with 1 sheet. Students draw a number from the envelope and the lowest can go first. The 1st student draws a number and attempts to answer the question. If the student gets it right, they keep the tag and the next student draws. If they get it wrong, the number simply goes back into the envelope for another student to draw (i.e no challenging). The winner is the student with the most tags at the end of the game.

The review sheet is great for studying for the test since it has questions and answers. It makes it easy for parents or friends to quiz the student before the test.

If you would like an electronic copy please contact me.

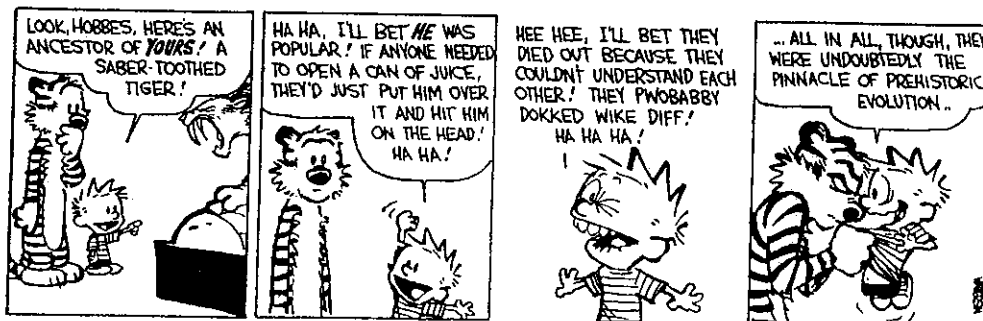
Steve Williams
Shuswap Jr. Secondary
Salmon Arm, B.C.
Email: smwillia@sd83.bc.ca



Name: _____
 Date: _____
 Block: _____

Bacteria/Virus, Asexual, Sexual, & Genetics Tournament

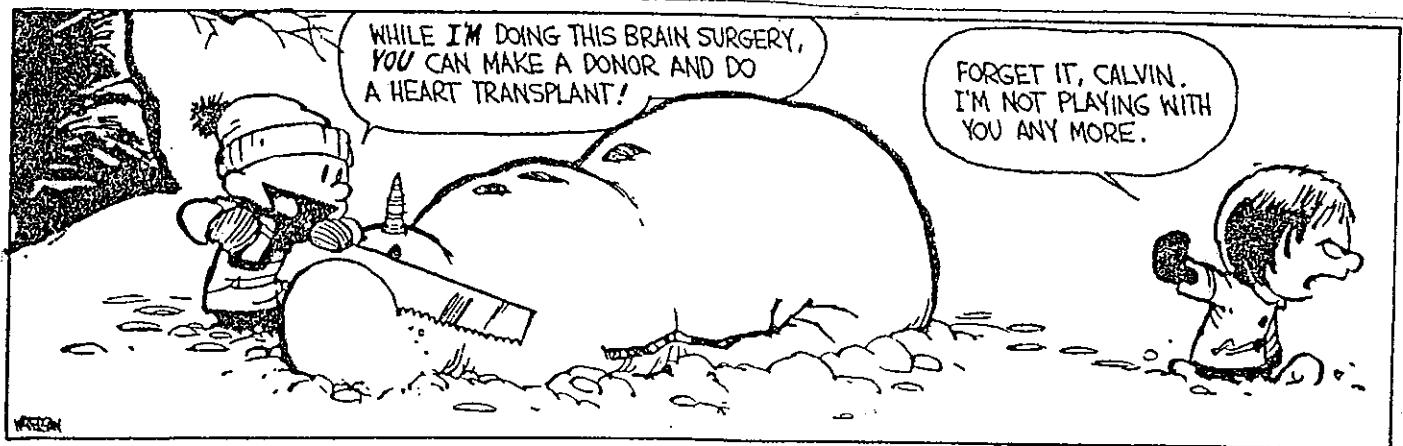
1. What are bacteria?
2. Are bacteria helpful or harmful? Explain.
3. Name three diseases caused by bacteria.
4. How are viruses like living cells?
5. Name 3 diseases caused by viruses.
6. Contrast asexual reproduction and sexual reproduction.
7. What is binary fission? Give an example.
8. What is budding? Give an example.
9. What is regeneration? Give an example.
10. What is vegetative reproduction? Give an example.
11. What is grafting? Give an example.
12. What is cloning? Give an example.
13. Why are the testis located outside of the male body?
14. Do females continually produce eggs?
15. What is fertilization? Where does it occur?
16. What is the major role of testosterone?
17. The rod-shaped structures found in the nucleus of a cell are called...
18. Proteins are made up of long chains of...
19. Genes are located on...
20. Which sex chromosomes would be found in a male fruit fly? XX, YY, XY, or XYY
21. Name two causes of chromosome mutations.
22. Are all chromosome mutations harmful? Explain.
23. What does DNA stand for?
24. How does DNA make a protein? Explain.
25. What is the difference between homozygous and heterozygous?
26. What is the difference between phenotype and genotype?
27. If a homozygous normal-vision mother and a color-blind father have a child, what is the probability (%) that the child will be color-blind? (Hint - the color-blindness gene is on the X chromosome)
28. If a heterozygous brown-eyed mother and a blue-eyed father have a child, what is the probability (%) that the child will have brown eyes?
29. Why are people upset with using animals as factories for human proteins?
30. Sheep are being used to produce human proteins to treat people with...





Answers:

1. simplest life form, or smallest living cells
2. Both, helpful because they produce vitamins, digest food, and decay dead things; harmful because they cause disease, infections, tooth decay, etc.
3. tuberculosis, pneumonia, salmonella, plus others
4. they can reproduce
5. rabies, polio, warts, colds, chicken pox, cold sores, pneumonia, hepatitis
6. asexual - one parent; sexual - two parents *asexual = identical offspring; sexual = not identical*
7. single cell splitting into two equal halves; paramecium, bacteria, amoeba
8. an offspring begins as a growth on its parent; yeast or hydra
9. ability to grow new parts; planaria (new head, tail), earthworm (new tail), *Starfish* crayfish/crab/lobster (new claw, antenna, or leg), salamander, lizards
10. starting a new offspring at some distance from the main plant; runners (strawberries, mint, begonia, spider plant) or stem-rooting (raspberry, willow)
11. insert a bud or shoot from one tree into another; apples, oranges, pear
12. producing an exact copy from a single cell; carrots, frogs, "Dolly" the sheep
13. sperm require lower temperature to develop properly
14. No, they are born with all (~ 400,000) their eggs
15. joining of sperm and egg (nuclei); Fallopian tube (oviduct)
16. produce male characteristics (facial hair, broad shoulders, deep voice)
17. chromosomes
18. amino-acids
19. chromosomes
20. XY
21. radiation (X-rays, ultraviolet light) and certain chemicals; *viruses*
22. No, some mutations are helpful because they cause desirable traits (i.e. seedless navel oranges, oil-eating bacteria)
23. deoxyribonucleic acid
24. DNA is copied as messenger RNA, which leaves the nucleus, enters a ribosome, and codes for an amino-acid sequence which makes a protein
25. homo: two genes the same; hetero: two different genes (capital and small)
26. phenotype: physical appearance; genotype: actual gene make-up
27. 0%
28. 50%
29. exploiting animals, treat animals like machines, violate rules of nature, moral questions (do we have the right to?), dangerous
30. hemophilia and lung disorder/disease





Name: _____

Date: _____

CHEMICAL FORMULAE (CH. 8-9) REVIEW

1. For a proton, what is its charge and where is it located in an atom?
2. For an electron, what is its charge and where is it located in an atom?
3. For a neutron, what is its charge and where is it located in an atom?
4. The atomic number of an element is equal to the number of _____?
5. How many protons, electrons, and neutrons are in a neutral atom of titanium?
6. How many protons, electrons, and neutrons are in a neutral atom of carbon-14?
7. What is an isotope?
8. Why do atomic mass values for elements have decimals?
9. Draw a Bohr model of a sulphur atom.
10. Draw a Bohr model of a sulphur ion.
11. List 3 properties of Alkali Metals.
12. List 3 properties of Halogens.
13. List 3 properties of Noble Gases.
14. What is an acid-base indicator? Give an example.
15. What does litmus paper test for? What colours does it change?
16. List 3 properties of acids.
17. List 3 properties of bases.
18. How can you neutralize an acid? What does it produce?
19. How are ionic and covalent bonds similar? How are they different?
20. Calcium carbonate: Is this an acid, base, or salt? Why?

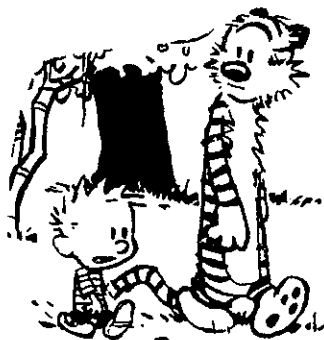


Name these compounds, and state the total number of atoms in each compound:

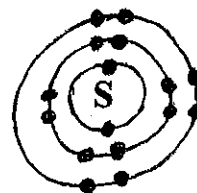
21. CaCl_2
22. HF
23. NiCO_3
24. N_2O_4
25. $\text{Re}_2(\text{Cr}_2\text{O}_7)_7$

Write the chemical formula for:

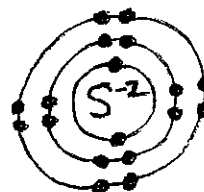
26. phosphorus triiodide
 27. chromic acid
 28. ammonium phosphate
 29. cobalt III chlorite
30. What would be produced when HNO_3 and $\text{Ca}(\text{OH})_2$ are mixed? Write the chemical formulae.



Answers:



1. positive, in the nucleus (centre) of the atom
2. negative, in the outer shells (orbits) of the atom
3. neutral, in the nucleus (centre) of the atom
4. protons
5. 22 protons, 22 electrons, 26 neutrons
6. 6 protons, 6 electrons, 8 neutrons
7. atoms of the same element but with a different mass number (same number of protons but different numbers of neutrons)
8. Atomic mass is an average of an element's naturally occurring isotopes (an average of all the different forms of the element), taking into account the percentages of each isotope in an ordinary sample.
9. see drawing above
10. see drawing below
11. most reactive metals, soft (can cut with a knife), 1 electron in their outer shells, charge of +1
12. most reactive nonmetals, poisonous, 1 less than a full outer shell of electrons, charge of -1
13. non-reactive nonmetals (do not form compounds), gases, full outer shells of electrons, do not form ions, no charge (zero)
14. shows the presence of an acid or a base by changing colour (e.g. litmus paper, bromothymol blue, phenolphthalein)
15. Red and blue litmus paper tests for acids, bases, and neutral solutions. Blue litmus turns red in an acid, red litmus turns blue in a base, and red and blue litmus do not change in neutral solutions.
16. turns blue litmus paper red, tastes sour, reacts with some metals to produce hydrogen gas, conducts electricity, formula starts with H (hydrogen)
17. turns red litmus paper blue, tastes bitter, feels slippery, conducts electricity, formula ends with OH (hydroxide group)
18. mix it with a base, it produces a salt and water
19. similar: both join atoms, fill outer electron shells; differences: *ionic* joins metal with nonmetals, and involves an electron transfer, *covalent* joins 2 nonmetals, and involves electron sharing
20. salt, its formula doesn't start with H (like an acid) or end with OH (like a base)
21. calcium chloride, 3
22. hydrofluoric acid, 2
23. nickel II carbonate, 5
24. dinitrogen tetroxide, 6
25. rhenium VII dichromate, 65
26. PI_3
27. H_2CO_3
28. $(\text{NH}_4)_3\text{PO}_4$
29. $\text{Co}(\text{ClO}_2)_3$
30. Since it's an acid mixed with a base, it produces salt and water. Rearrange the atoms: the H (from acid) and the OH (from base) form H_2O , the leftovers form $\text{Ca}(\text{NO}_3)_2$





Name: _____

Date: _____

Block: _____

CHEMICAL REACTIONS (Ch. 10) REVIEW

1. A change producing new substances with new properties is called a...
2. A change that changes the state, shape, or external appearance of matter, but does not produce a new substance is called a...
3. Give 4 changes that may indicate a chemical reaction has occurred.

Is a physical or chemical change occurring?

4. ice melting
5. popcorn popping
6. apple rotting
7. breaking a window
8. neutralizing an acid

How many atoms of each element are in the following?

9. ZnSO_4
10. 5NH_3
11. $3 \text{Ni}(\text{HCO}_3)_3$



Write the word equation:

12. Sodium chloride reacts with fluorine gas to produce sodium fluoride and chlorine gas.
13. Calcium phosphate and water are produced, when calcium hydroxide and phosphoric acid are mixed.

Balance these equations:

14. $\underline{\quad} \text{Br}_2 + \underline{\quad} \text{KI} \rightarrow \underline{\quad} \text{KBr} + \underline{\quad} \text{I}_2$
15. $\underline{\quad} \text{CuSO}_4 + \underline{\quad} \text{AlCl}_3 \rightarrow \underline{\quad} \text{Al}_2(\text{SO}_4)_3 + \underline{\quad} \text{CuCl}_2$
16. $\underline{\quad} \text{C}_3\text{H}_8 + \underline{\quad} \text{O}_2 \rightarrow \underline{\quad} \text{CO}_2 + \underline{\quad} \text{H}_2\text{O}$
17. $\underline{\quad} \text{Fe} + \underline{\quad} \text{HCl} \rightarrow \underline{\quad} \text{FeCl}_3 + \underline{\quad} \text{H}_2$
18. $\underline{\quad} \text{H}_3\text{PO}_4 + \underline{\quad} \text{NH}_4\text{OH} \rightarrow \underline{\quad} (\text{NH}_4)\text{PO}_4 + \underline{\quad} \text{H}_2\text{O}$

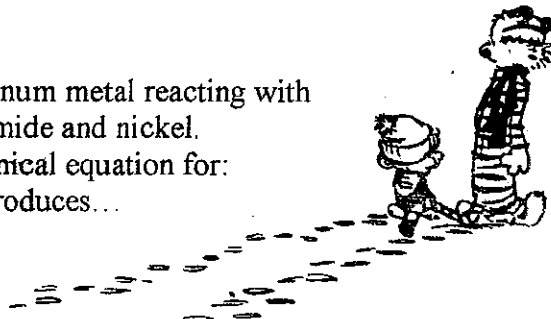
Write the chemical formula for:

19. potassium chlorate and potassium chloride
20. nitric acid and barium hydroxide
21. solid copper, chlorine gas, and copper II chloride

Give the type of reaction (synthesis, decomposition, single replacement, double replacement, or neutralization) for:

22. $2 \text{Al} + 3 \text{CuCl}_2 \rightarrow 2 \text{AlCl}_3 + 3 \text{Cu}$
23. $\text{Na}_2\text{S} + 2 \text{AgNO}_3 \rightarrow \text{Ag}_2\text{S} + 2 \text{NaNO}_3$
24. $\text{H}_2\text{CO}_3 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
25. $4 \text{Al} + 3 \text{O}_2 \rightarrow 2 \text{Al}_2\text{O}_3$
26. $\text{Ca}(\text{OH})_2 + \text{H}_2\text{SO}_4 \rightarrow \text{CaSO}_4 + 2 \text{H}_2\text{O}$

27. A reaction that releases energy is called...
28. A reaction that absorbs energy is called...
29. Write a balanced chemical equation for: aluminum metal reacting with nickel II bromide to produce aluminum bromide and nickel.
30. Predict the products and write a balanced chemical equation for: calcium iodide mixed with lead III nitrate produces...



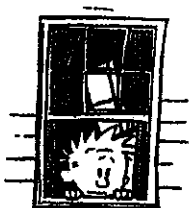


Answers:

1. chemical change
2. physical change
3. any 4: colour change, heat produced, new substance produced, starting materials are used up, bubbles form (gas produced), solution goes cloudy
4. physical
5. chemical
6. chemical
7. physical
8. chemical
9. 1 Zn, 1 S, 4 O
10. 5 N, 15 H
11. 3 Ni, 9 H, 9 C, 27 O
12. sodium chloride + fluorine \rightarrow sodium fluoride + chlorine
13. calcium hydroxide + phosphoric acid \rightarrow calcium phosphate + water
14. 1,2,2,1
15. 3,2,1,3,
16. 1,5,3,4
17. 2,6,2,3
18. 1,3,1,3
19. KCl, KClO₃
20. HNO₃, Ba(OH)₂
21. Cu, Cl₂, CuCl₂
22. single replacement
23. double replacement
24. decomposition
25. synthesis
26. neutralization
27. exothermic
28. endothermic
29. $2\text{Al} + 3\text{NiBr}_2 \rightarrow 2\text{AlBr}_3 + 3\text{Ni}$
30. $3\text{CaI}_2 + 2\text{Pb}(\text{NO}_3)_3 \rightarrow 2\text{PbI}_3 + 3\text{Ca}(\text{NO}_3)_2$

} 1 means: leave it blank



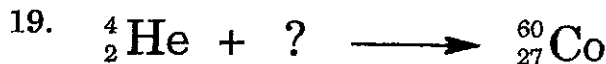
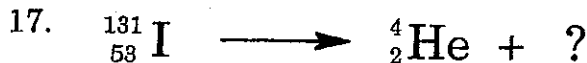
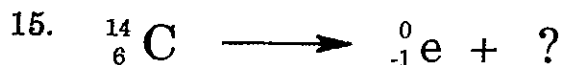
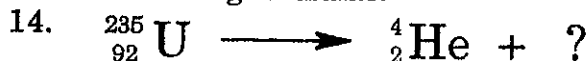


Name: _____
 Date: _____
 Block: _____

RADIOACTIVITY TOURNAMENT

1. What are the three types of radiation?
2. List the three types of radiation from most to least penetrating.
3. What is an alpha particle made of? What is the charge on it?
4. What does a beta particle consist of? What is the charge on it?
5. What is a gamma ray?
6. A force known as the _____? _____ holds protons and neutrons together in the nucleus of an atom.
7. _____? _____ is a change in the nucleus of an atom.
8. Draw or describe the graph of how the activity of a radioactive sample changes with time.
9. What does half life mean?
10. In alpha decay, what happens to the atomic mass? Why?
11. In beta decay, what happens to the atomic mass? Why?
12. In alpha decay, what happens to the atomic number? Why?
13. In beta decay, what happens to the atomic number? Why?

Complete the following formulae:

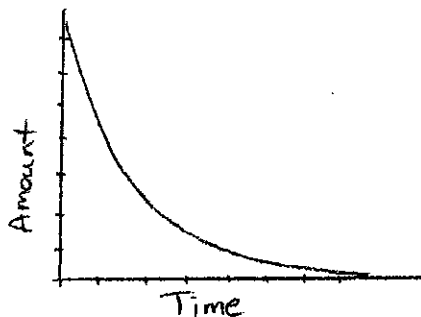


20. Write the formula for sodium-24 undergoing beta decay.
21. Write the formula for chlorine-36 undergoing alpha decay.
22. List 2 health effects that radioactive elements can cause.
23. Compare radio waves and ultraviolet rays, using wavelength, frequency, and energy.
24. List three uses of radioactive elements.
25. Which types of radiation from the electromagnetic spectrum can cause cancer?
26. Name a use for microwaves.
27. Name a use for X-rays.
28. Name a use for radiowaves.
29. What are two differences between fission and fusion?
30. How are fission and fusion similar?

I'LL NEVER BE ABLE
 TO WRITE THAT MUCH!
 IT'S NOT FAIR!!



Answers:



1. alpha, beta, gamma
2. gamma, beta, alpha
3. 2 protons and 2 neutrons, +2
4. an electron, -1
5. high energy wave, it has an extremely high frequency and short wavelength
6. nuclear strong force
7. (nuclear) transmutation
8. see graph above, or the nuclei decay rapidly at the start and then decay slows down
9. the amount of time required for half the nuclei in a sample of a radioactive isotope to decay

10. decreases by 4, because 2 protons and 2 neutrons are lost
11. stays the same, because a neutron changes to a proton which has the same mass, and the electron which is lost has almost no mass
12. decreases by 2, because 2 protons are lost
13. increases by 1, because another proton is produced
14. ${}_{90}^{231}\text{Th}$
15. ${}_{7}^{14}\text{N}$
16. ${}_{2}^{4}\text{He}$
17. ${}_{51}^{127}\text{Sb}$
18. ${}_{85}^{216}\text{At}$
19. ${}_{25}^{56}\text{Mn}$

20. ${}_{11}^{24}\text{Na} \longrightarrow {}_{-1}^{0}\text{e} + {}_{12}^{24}\text{Mg}$

20. ${}_{17}^{36}\text{Cl} \longrightarrow {}_{2}^{4}\text{He} + {}_{15}^{32}\text{P}$
22. cancer, mutations, kill cells, radiation sickness, leukemia (bone marrow cancer), death
23. Radio waves have longer wavelengths, lower frequencies, and lower energy.
24. cancer treatment, disease treatment (e.g. thyroid), X-rays, test a person's blood flow, smoke detector, TV, tanning bed, microwave oven, detect structural flaws
25. gamma rays, X-rays, and ultraviolet rays (they have the highest energy)
26. cooking food, communications, cellular telephones
27. medical diagnosis (broken bones), cancer treatment
28. broadcasting, medicine
29. fission: splitting an atom (in almost two equal halves), produces extra neutrons
fusion: joining of smaller atoms to make larger ones, occurs at very high temperatures (over 1 million °C)
30. both produce large amounts of energy





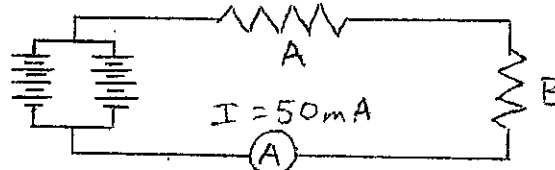
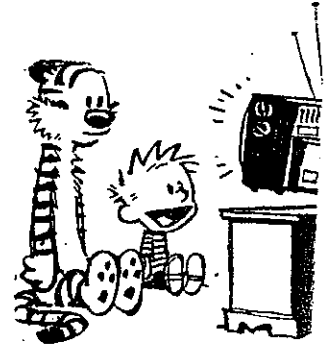
Name: _____

Date: _____

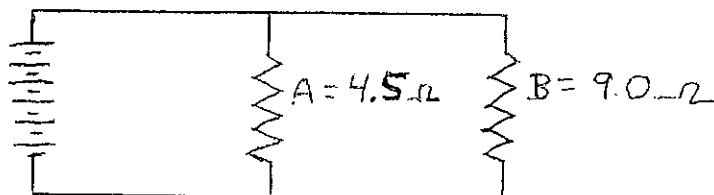
Block: _____

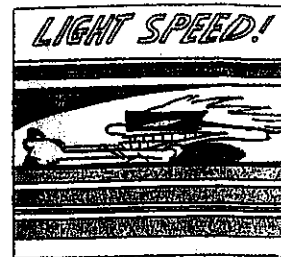
ELECTRICITY TOURNAMENT

1. Name the three subatomic particles (in an atom), and give the charge on each.
2. Which particles are located in the nucleus of an atom?
3. Why did the puffed rice fly off the Van de Graaff generator?
4. What are the 3 "laws" of electric charge?
5. How does an object develop an electric charge?
6. What is the difference between static and current electricity?
7. What is the difference between series and parallel circuits?
8. In BC, most electric current is produced by...?
9. How are a wet cell and dry cell alike?
10. What are the two main parts of a simple generator?
11. How does a simple generator generate a current?
12. Provide the symbol and units for current.
13. Provide the symbol and units for voltage.
14. Provide the symbol and units for resistance.
15. What does an ammeter measure?
16. What does a voltmeter measure?
17. How do you connect an ammeter into a circuit?
18. How do you connect a voltmeter into a circuit?
19. Define voltage.
20. How is conventional current different from the flow of electrons?
21. How is connecting dry cells (batteries) in series different from connecting dry cells in parallel?
22. What happens to the current in a series circuit when you increase the number of light bulbs?
23. Which allows more current to flow, series or parallel? Why?
24. Why are Christmas lights best connected in parallel?
25. What is the Ohm's Law formula for voltage?
26. Calculate the current through a kettle which has a resistance of 12Ω and is plugged into 120 V outlet.
27. When Ryan stuck his finger in 120 V outlet, 6.0 A of electric current went through him. What is the resistance of Ryan?
28. If there is a current of 3.0 A in a resistor with a resistance of 40Ω , what voltage is being applied to the resistor?
29. Each cell of the battery is 1.5 V and the resistors are identical. Calculate the resistance of A and B.



30. Each cell of the battery is 1.5 V. Calculate the current through resistor A.





Answers:

1. proton = positive, neutron=neutral, electron=negative
2. protons and neutrons
3. Each piece of puffed rice became charged with the same charge as the dome and was repelled off the dome
4. (1) Opposite charges attract, (2) similar charges repel, and (3) charged objects attract neutral objects.
5. It gains or loses electrons (electrons move onto it or off it).
6. static: the build up of non-moving electric charges on an object, current: a (moving) flow of electrons in a conductor
7. A series circuit has only one path for electrons (or electric current). A parallel circuit has more than one path for electrons
8. hydroelectric generators
9. They both have two different metals in a conducting solution or paste.
10. a magnet and a coil of wire
11. by moving a magnet inside a coil of wire (or moving a coil of wire near a magnet) which causes electrons to flow in the wire
12. I is the symbol, and the units are amperes (A).
13. V is the symbol, and the units are volts (V).
14. R is the symbol, and the units are ohms (Ω).
15. An ammeter measures current.
16. A voltmeter measures voltage.
17. An ammeter is connected in series into a circuit.
18. A voltmeter is connected in parallel (across what you're measuring) into a circuit.
19. Voltage is the amount of electric potential energy per unit of charge.
20. Conventional current flows from positive to negative; electrons flow from negative to positive.
21. When you connect dry cells in series, you add up the voltage. When you connect dry cells in parallel, you do NOT add up the voltage.
22. The current decreases (since resistance increases).
23. Parallel allows more current to flow because there are more paths (less resistance).
24. because when one burns out they don't all go out
25. $V=IR$
26. $I=V/R=120/12=10$ A
27. $R=V/I=120/6=20$ Ω
28. $V=IR=3.0 \times 40=120$ V
29. 60 Ω
30. 2.0 A





Name: _____
 Date: _____
 Block: _____

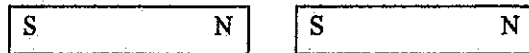
MAGNETISM & ELECTRICITY REVIEW



1. Are all metals magnetic? Explain.
2. Name the poles of a magnet.
3. Which magnetic poles attract? repel?
4. How does a permanent magnet become magnetic?
5. Why is a magnet's strength decreased when it is dropped, banged, heated, or stored improperly?
6. Magnetic lines of force are drawn from _____ to _____.
7. What is the difference between *magnetic north* and *true north*?
8. Why should you keep magnets away from video tapes, computer disks, and credit cards?
9. Do wires make magnetic fields? Explain.
10. Which way does conventional current flow in a wire of a circuit?
11. What is the right-hand rule?

Draw the magnetic lines of force around:

12. 2 bar magnets:



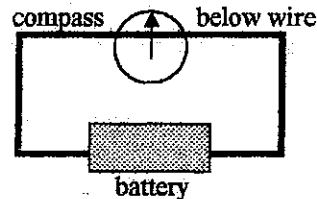
13. a wire carrying current into the page:



14. a solenoid:



15. On the diagram, label the battery terminals **positive (+)** and **negative (-)**.



16. How can you increase the strength of an electromagnet?
17. How does a generator generate a current?
18. What are the differences between generators and motors?
19. What are 3 ways to increase the amount of electricity from a generator?
20. What are two differences between AC and DC current?
21. What are the symbol and units for power?
22. What are the symbol and the 2 units for energy?
23. Calculate the power of a kettle which has a resistance of 18Ω and is plugged into 120 V outlet.
24. A 1200 W oven draws 5.0 A of current. What is the resistance of the oven?
25. If there is 6.0 A flowing through a refrigerator for 24 hours and it is plugged into a 120 volt outlet, calculate the energy used in kW·h.
26. List 3 ways to conserve electrical energy.
27. What are the similarities and differences between *circuit breakers* and *fuses*?
28. Why is the service panel (breaker box) in a house connected to the ground?
29. Why is electricity transmitted to homes at very high voltages?
30. What does a *transformer* do and where would you find one?

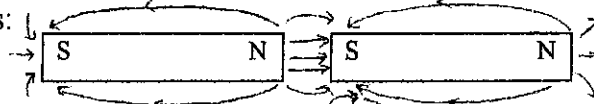


Answers:

1. No, not all metals are magnetic (only iron, cobalt, nickel and some others).
2. North and South
3. Opposite poles attract (North & South). Similar poles repel (North repels North, and South repels South).
4. The domains inside the magnet align in the same direction (North-South).
5. The magnetic domains become disordered, aligning in different directions.
6. North to South
7. Magnetic North: where a compass needle points to (where the Earth's magnetic field is most concentrated), about 1500 km from true North. True North: where the Earth spins on its axis (where all the lines of longitude meet).
8. They store information magnetically, and the information could be destroyed.
9. Yes, but only if an electric current flows through the wire. The magnetic field circles around the wire according to the right-hand rule.
10. Conventional current flows from positive to negative around a circuit.
11. It predicts the magnetic lines of force around a wire. Your thumb is the wire and points in the direction of the conventional current flow in the wire. The curl of your fingers indicates the direction of the magnetic lines of force around the wire.



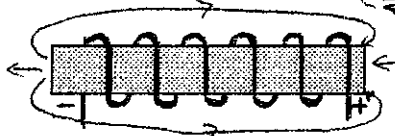
12. 2 bar magnets:



13. a wire carrying current into the page:



14. a solenoid:



15. Positive (+) on the left, negative (-) on the right side of the battery.
16. Increase the current in the wire, or increase the number of coils.
17. by moving a magnet inside a coil of wire (or spinning a coil of wire in a magnetic field) which causes electrons to flow in the wire
18. Generators and motors are opposites. Generators use mechanical (moving) energy to make electricity, and motors use electricity to make mechanical energy.
19. increase the number of coils of wire, increase the magnetic field, spin or move the coil faster
20. AC current alternates or changes direction, and it is produced from generators. DC current flows in one direction only, and it is produced from batteries.
21. The symbol is P and the units are Watts (W).
22. The symbol is E and the units are Joules (J) or kilowatt hours (kW·h).
23. $P = V^2/R = (120^2)/18 = 800 \text{ W}$
24. $R = P/I^2 = 1200/5^2 = 48 \Omega$
25. $P = IV = 6 \times 120 = 720 \text{ W}$ $720/1000 = 0.720 \text{ kW}$
 $E = P \times t = 0.720 \text{ kW} \times 24 \text{ hr} = 17.28 \text{ kW}\cdot\text{h}$
26. many answers: turning things off, not use appliances, use energy efficient appliances and light bulbs, dry clothes outside, use less hot water, etc
27. Similarities: they both prevent too much current flowing through a circuit (an overload which could damage the item or start a fire). Differences: a circuit breaker can be reset (used again) but a fuse must be replaced.
28. to carry any excess electricity or 'short circuit' to the ground so it won't hurt you
29. requires less current so there is less energy loss to heat
30. increases (step-up) or decreases (step-down) AC voltage; find them at: generating stations (increase voltage for transmission), substations or power poles (decrease V)

