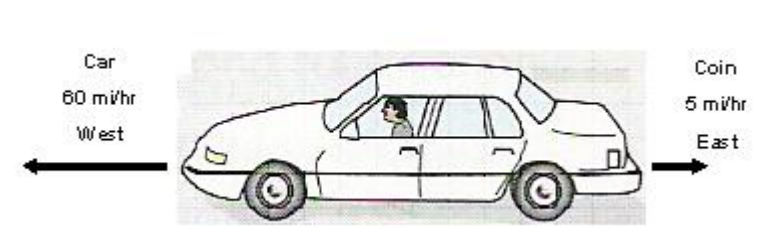
PHYSICAL SCIENCE EXAM
2nd Semester Exam Review Packet

Chapter 11: Motion (Velocity & Acceleration)

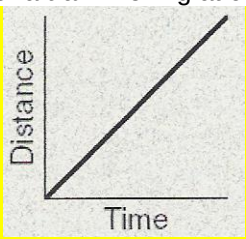
1. A car travels at a speed of 60 mi/hr west. Inside the car, a coin is thrown at 5 mi/hr east. To an observer on the street, how fast does the coin appear to move? (Include a drawing)

- 55 mi/hr west



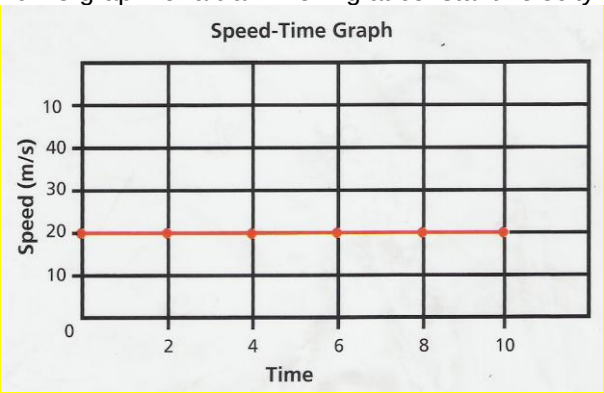
- If arrows point in the same direction, velocities are added
- If arrows point in the opposite direction, velocities are subtracted

2. Draw a ***distance vs. time*** graph for a train moving at constant velocity.



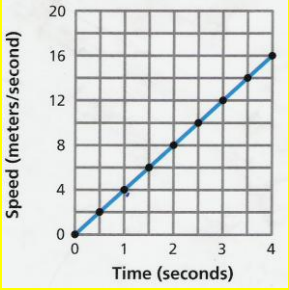
- On a distance vs. time graph, straight lines means that objects are moving with a constant velocity
- On a distance vs. time graph, curved lines mean objects are experiencing acceleration (speeding up or slowing down)

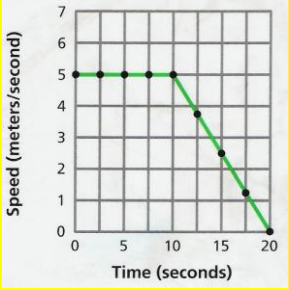
3. Draw a ***velocity vs. time*** graph for a train moving at constant velocity.



- On a velocity vs. time graph, horizontal lines represent constant velocities
- Remember, speed and velocity aren't exactly the same thing!

4. Draw ***velocity vs. time*** graphs for a car experiencing positive acceleration and for a car experiencing negative acceleration.





- On a velocity vs. time graph, sloping lines represent changing velocities

- Upward sloping line represents speeding up
- Downward sloping lines represent slowing down
- Remember, speed and velocity aren't exactly the same thing!

5. Give an example of a person traveling a long distance and having no displacement.

- Displacement is the straight line distance from the starting point to the finishing point (with no regard to the path taken).
- Distance is the total length of the path taken from the start to the finish.
- If someone goes on a long trip and returns right back to where they started, they will have a large distance traveled and a zero displacement.
- If you go on a driving vacation and return home (back to your garage where you started), you will have gone a large distance (whatever the odometer on the car says), but the displacement is zero.

6. Johnny runs 500 m in 93 seconds. What is Johnny's average speed?

$$v = \frac{d}{t} \qquad v = \frac{500m}{93s} = 5.37\ \frac{m}{s}$$

7. A plane traveling at 80 m/s is slowing down on the runway. In 15 seconds, the plane comes to a complete stop at the gate. Calculate the acceleration of the plane.

$$a = \frac{(v_f - v_i)}{t} \qquad a = \frac{(0\ \frac{m}{s} - 80\ \frac{m}{s})}{15s} = -5.33\ \frac{m}{s^2}$$

8. What is the difference between a vector and a scalar?

- A vector quantity tells magnitude (how much?) and direction (which way?)
- A scalar quantity only tells magnitude (how much?) with no regard to direction

9. Give 2 examples of vector quantities.

- velocity
- acceleration
- displacement
- force

10. What are the three ways an object can accelerate?

- speeding up
- slowing down
- changing directions

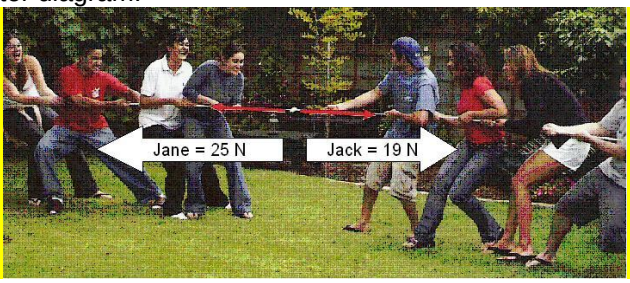
Chapter 12: Newton's Law of Motion & Force

11. Which has more inertia, a semi-truck or a matchbox car? Why?

- Semi Truck – truck has more mass than the matchbox car and mass is a measure of inertia.
- Inertia is the tendency for an object to maintain its current motion or the tendency of an object to keep doing what it is currently doing. If an object has more mass, it is harder to get it to change its motion, so it has more inertia

12. Jack and Jill are playing tug of war. Jill pulls the rope with 25 N of force and Jack pulls the rope with 19 N of force.

a) Draw a vector diagram.



b) What is the net force?

- 6 N towards Jane
- Remember, force is a vector, so it needs direction. That means you need to specify "towards Jane"

c) Are the forces balanced or unbalanced?

- Unbalanced because there is a bigger force in one direction than the other direction

d) Describe the rope's motion.

- The rope will accelerate towards Jane. It will go from rest to moving towards Jane.

e) Who wins the game?

- Jane will win the game because the rope will accelerate towards her.

13. Which of the following objects is experiencing unbalanced forces: a book sitting at rest on the table, a book slowing down as it slides across the table, or a book moving at a constant speed across the table?

- A book slowing down as it slides across the table.
- Forces are the cause of CHANGES in motion (please don't say that forces CAUSE motion…forces cause CHANGES IN MOTION)
- The book slowing down is the only object that is changing its motion. The other two objects are not changing their motion (even though the one is moving)

14. a) What is the difference between static friction and sliding friction?

- Static friction keeps things from ever starting moving.
- Sliding friction causes things to slow down when they are already moving.

b) Which is usually larger?

- Static friction is usually larger for the same object. It is harder to get something to start moving than it is to keep it moving once it already is moving.

c) Which direction does friction act?

- Friction always acts opposite of the way the object is moving (or the opposite direction from a force being applied)

15. List and explain Newton's three laws of motion.

- 1^{st} Law: Inertia – Objects will continue in their current state of motion. If they are at rest, they will remain at rest until they experience an unbalanced force. If they are currently moving, they will continue moving until they experience an unbalanced force.
- 2^{nd} Law: $\Sigma F=ma$ – The acceleration of an object is directly proportional to the unbalanced force acting on it ($\Sigma F\uparrow \rightarrow a\uparrow$). The acceleration of an object is inversely proportional to the mass ($m\uparrow \rightarrow a\downarrow$)
- 3^{rd} Law: Action-Reaction – when two objects interact, they each apply a force to each other that is equal in magnitude, but opposite in direction.

16. A swimmer pushes against the water with a force of 20 N. What is the reaction force in this situation?

- The water pushes against the swimmer with a force of 20 N in the opposite direction (usually the swimmer pushes backwards, so the water pushes forward, which makes the swimmer go forward)

17. Sally (35 kg) and Daniel (45 kg) are on swings at the playground. Their dad pushes both children with a force of 50 N, who has the greater acceleration? Explain.

- Sally will experience the greater acceleration. Mass is inversely proportional to acceleration. Sally has a smaller mass, so she experiences the greater acceleration.

18. Why do astronauts appear to be floating in the international space station?

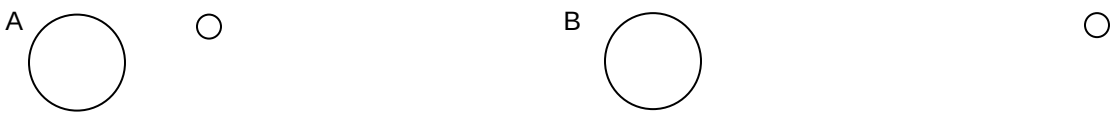
- Both the astronauts and the space station are being affected by the Earth's gravity. Gravity affects all objects with the same acceleration. As gravity pulls the space station closer, it also pulls the astronauts closer, but by the same amount. The astronaut gets no closer to the floor of the space station and appears to "float". Really both objects are falling, just at the same rate.

19. What 2 factors determine the gravitational force between objects?

- Mass of the two objects → direct relationship (mass goes up, gravitational force goes up; mass goes

down, gravitational force goes down)
- The distance between the centers of the two object → inverse relationship (distance increases, gravitational force decreases

20. Which picture (A or B) shows the greater gravitational forces between the two objects? Explain.



- Picture A – the objects are the same size, so the only thing that is different is the distance between them. In A, the objects are closer, so the gravitational force will be larger

Chapter 15: Forms of Energy

21. What is the formula for gravitational potential energy?

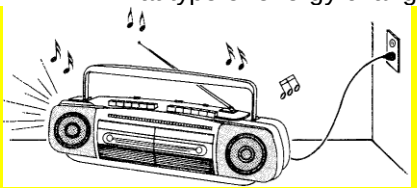
$PE_G = mgh$
- m = mass of the object
- g = acceleration caused by gravity on Earth – 9.8 m/s^2
- h = height of the object from the reference point (usually the ground)

22. What is the formula for kinetic energy?

$KE = \frac{1}{2} mv^2$
- m = mass of the object
- v = speed of the object

23. Describe the energy conversion involved with a child on a swing set.
- The child starts with gravitational potential energy when he is at the highest point (he is relatively high off of the ground)
- As he starts to swing downward, his height decreases, so the gravitational potential energy decreases, but his speed increases, so his kinetic energy increases.
- At the bottom of the swing, his has maximum kinetic energy, but the same amount of kinetic energy as he had potential energy when he started (if there was no friction, which isn't really the case)
- As he starts back up, he starts to slow down, so kinetic energy decreases, but he rises to a higher height, so potential energy starts increasing
- On the other side, he has no kinetic energy (because he stops) and maximum potential energy, which will be the same amount of potential energy that he originally started with (if there was no friction, which, once again, isn't really the case)

24. What type of energy change is represented in the diagram?



- Electrical energy into sound energy

25. List six renewable energy resources.
- Wind
- Solar
- Geothermal
- Hydroelectric
- Biomass
- Fuel Cells

26. Give an example of a nonrenewable resource.

Nonrenewable energy sources are sources that will run out in the relatively near future and the supply of which is limited
- Petroleum
- Coal
- Natural Gas
- Uranium (for Nuclear Fission)

27. A small technology company, called Orion Energy, has created a new solar cell that can provide enough energy to an average size automobile for 8 hours of operation at 45 mi/hr. Evaluate the ethics of a large oil company purchasing Orion Energy.

This is an open ended question. Remember, to get full credit on an ethics questions, you need to do two things:

- Clearly state your opinion (in this case, either it is OK or not OK for the large oil company to purchase Orion Energy)
- Provide relevant reasons to support your opinion

Remember…for ethics questions it's not WHAT you say, but HOW you say it that will get you credit!

28. A diver (40 kg) dives off a 3 m platform and a 10 m platform.
    a. Which platform does the diver have more gravitational potential energy?

- The 10 m platform
- The formula for Gravitational Potential Energy is $PE_G = mgh$. In both cases, the mass of the diver is the same, and g is a constant value, so the only thing that changes is the height. 10m>3m, so there is more PE_G on the 10m platform than the 3m platform

    b. In which situation, will the diver have more kinetic energy when they reach the water?

- The 10 m platform
- PE_G is converted into kinetic energy on the way down to the water (the diver's speed will increase on the way down)
- If the diver starts with more PE_G, he will end with more KE

29. When dropping a ball on the ground, the ball bounces lower with each bounce. Why does this occur?

- The floor does work on the ball during each bounce
- Work causes the energy of an object to change
- In this specific case, it is negative work, so the energy decreases, which means at the top of each bounce, when the ball has PE_G, the amount of PE_G it has will keep decreasing

Chapter 16: Thermal Energy

30. List and explain the three types of heat transfer.

- Conduction – transfer of energy without the transfer of matter. No actually material is moved from one place to another, just the energy. Requires that the objects transferring the energy are touching
- Convection – transfer of energy by the movement of fluids (gas or liquid). The fluid in contact with the substance will heat up (or cool down) and then it is moved away (by blowing, a fan, etc.) and new fluid then comes in contact with that hot (or cold) substance and more energy is transferred.
- Radiation – transfer of energy by waves traveling through space. Does not require any substance to carry the energy.

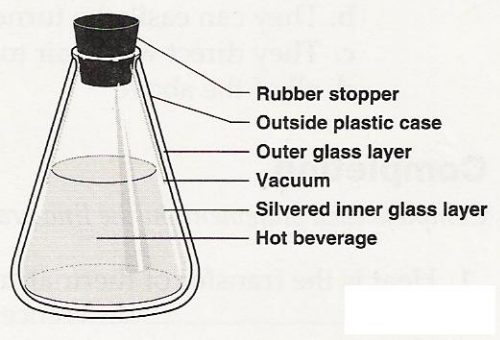
31. Give an example of a thermal conductor.

- Metals are good thermal conductors
- A cooking pot or pan

32. Give an example of a thermal insulator.

- Nonmetals are usually good thermal insulators (or bad conductors)
    - The wooden or plastic handle on the cooking pot/pan
    - Wooden spoon
    - Plastic spatula
- Gases are generally poor conductors
    - Styrofoam cups have a lot of air in them, which is why they keep hot drinks hot and cold drinks cold. They slow down all kinds of energy transfer.

33. A good thermos usually has a vacuum layer (a section with no matter at all). Explain how this prevents two types of heat transfer and keeps hot things hot and cold things cold.



- Two types of heat transfer require some kind of matter – conduction and convection.
- The vacuum layer means there is no matter in that area (that's what a vacuum is). If there is no matter, there can be no conduction or convection. If there is no conduction or convection, the amount of heat transferred is reduced and the substance in the thermos stays hot (no heat is lost to the environment) or cold (no heat from the environment can get in)

34. a) What is thermal contraction?

    b) Give an example.

- When things get colder, the particles slow down and the volume decreases (they take up less space)
- Taking a balloon outside in the winter will cause the balloon to shrink because the air inside takes up less space.

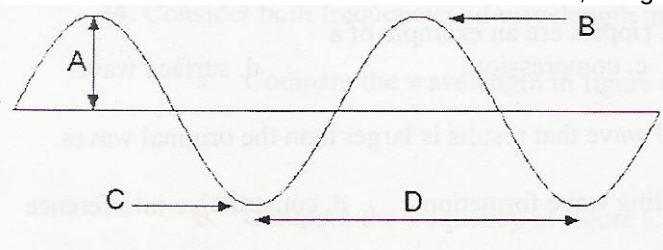
35. a) What is thermal expansion?

    b) Give an example.

- When things get warmer, the particles speed up and volume increases (things take up more space)
- In the summertime, there may be some doors in your house that don't close as well. The door has actually gotten bigger and doesn't fit in the door frame any more
- When baking, the dough of a cake (or bread, or whatever) is usually smaller than the cake itself

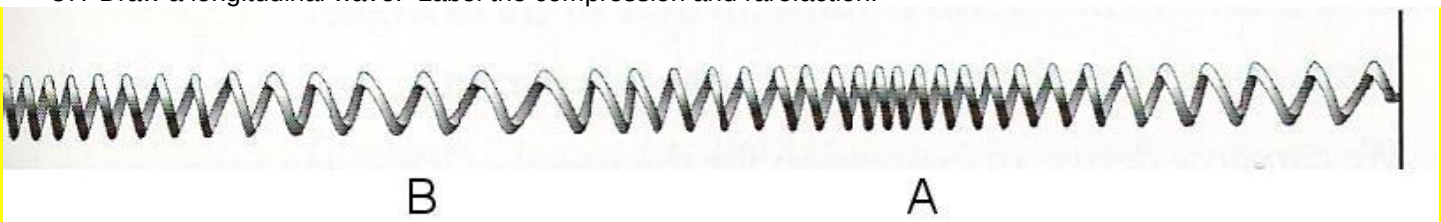
Chapter 17: Mechanical Waves & Sound

36. Draw a transverse wave. Label the crest, trough, amplitude, and wavelength.



A) Amplitude
B) Crest
C) Trough
D) Wavelength

37. Draw a longitudinal wave. Label the compression and rarefaction.



A) Compression – medium is closer together than normal
B) Rarefaction – medium is farther apart than normal

38. What is ultrasound?

- Ultrasound waves are waves with a frequency higher than the range of human hearing (generally greater than 20000 Hz)

39. What happens to the speed of sound in air as the temperature increases? As the temperature decreases?

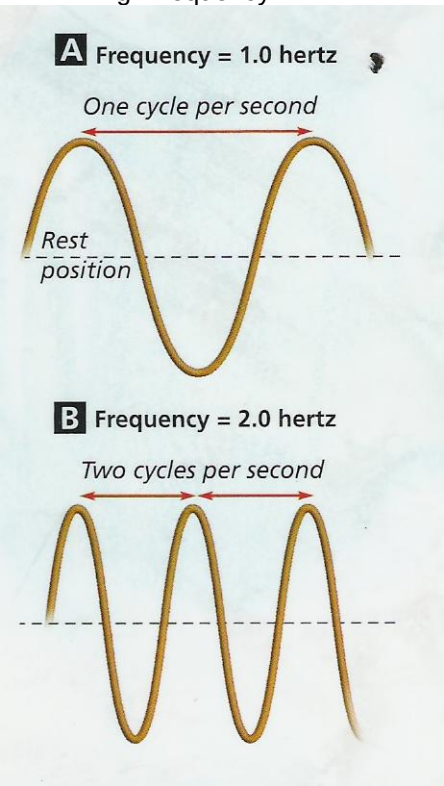
- Sound will travel faster when the temperature increases. Transfer of sound depends on contact between particles that are next to each other. When the temperature of a substance increases, the particles travel faster, so they run into each other more. If they run into each other more, sound will travel faster.
- Sound will travel slower as the temperature decreases. The particles move more slowly and run into

each other less often.

40. What wave characteristic describes how much energy a mechanical wave carries?

- Amplitude

41. Draw a wave with long wavelength and low frequency. Draw a wave with short wavelength and high frequency.

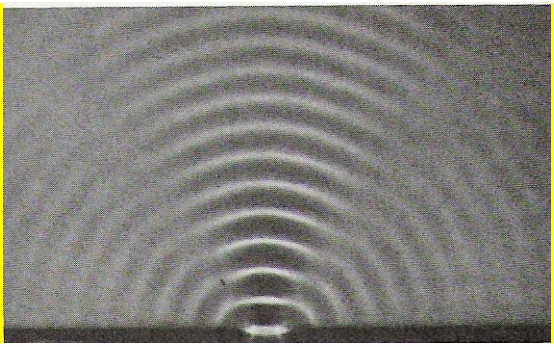


- Long Wavelength = Low Frequency
- Short Wavelength = High Frequency

42. What kind of wave is a sound wave?

- Sound waves are mechanical and longitudinal
- They require a medium (a substance to travel through), which makes them mechanical.
- They also cause the medium to vibrate parallel to the direction of wave movement, which makes them longitudinal

43. What is diffraction?



- Diffraction is the bending of waves as they travel around the edge of an object.

44. Give an example of a surface wave.

- A surface wave is a wave that travels along the boundary of two different media
- Water waves are surface waves

45. What is the Doppler Effect?

- The movement of a source of sound (or of the listener) will cause a change in the frequency of the waves, and a change in how they are perceived.
- If the source and the observer are getting closer, they frequency of the waves will appear to increase. This causes the pitch of a sound to increase or a shift towards the blue end of the visible spectrum.
- If the source and the observer are getting farther apart, the frequency of the waves will appear to decrease. This causes the pitch of a sound to decrease or a shift towards the red end of the visible spectrum.

Chapter 18: Electromagnetic Waves

46. What color of visible light carries the greatest energy?

- Blue

47. What color of visible light carries the least energy?

- Red

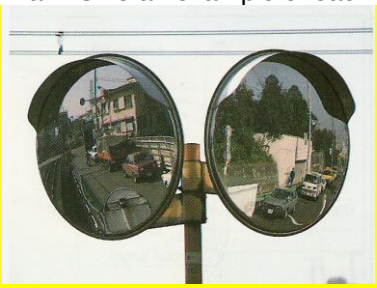
48. The speed of all electromagnetic waves in the same medium is constant, how are the frequency and wavelength related?

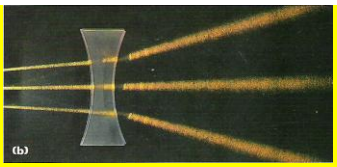
- Frequency and wavelength wave an inverse relationship.
- As frequency increases, wavelength decreases, and vice versa

49. What is the difference between reflection and refraction?

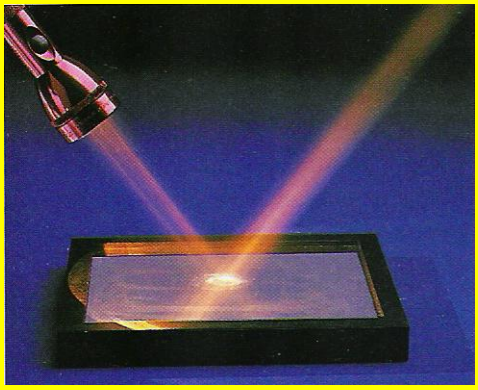
- Reflection is when waves bounce off of the boundary between two different media
- Refraction is when a wave changes speeds going from one medium to another, which results in the wave appearing to "bend"

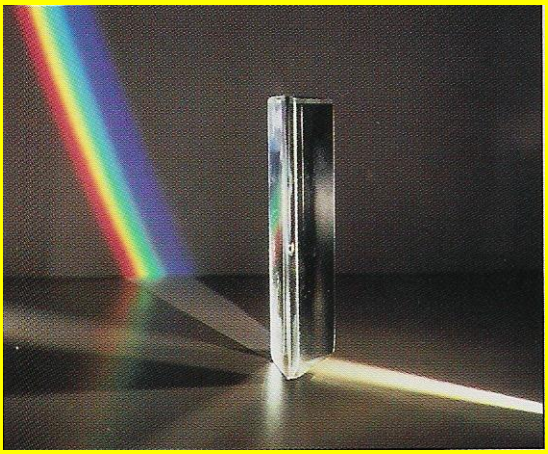
a. Give an example of each.





- The light waves appear to bend as they go from air to glass (lens) and back to air





- Light waves bounce off of a mirror and back to your eye
- An echo happens when sound waves bounce off of the boundary between two different media and back to the source (you)

- The different colors of light appear to bend as they go from air to glass (prism) and back to air

50. What determines the color an object will appear?

- The material that the object is made of (certain materials will only reflect certain colors of light)

- The color of light that shines on them

Chapter 26: Astronomy (Stars)

51. What characteristics of stars are shown on the H-R diagram?

- Surface Temperature
- Absolute Brightness (the amount of energy they give off)

a. Where are cool stars located?

- Bottom Right

b. Where are hot stars located?

- Top Left

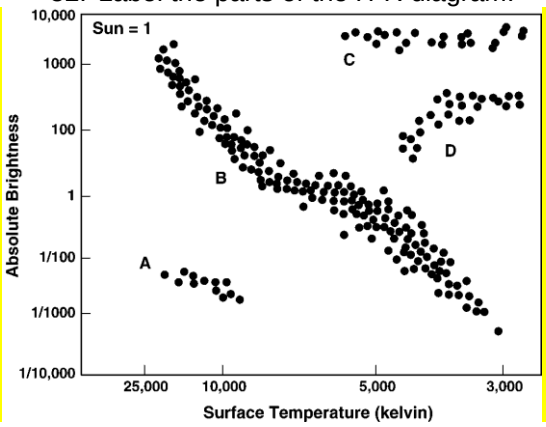
c. Where are bright stars located?

- Top edge of the diagram
- Could be hot, small stars (blue stars on main sequence)
- Could be cool, large stars (giants and supergiants)

d. Where are dim stars located?

- Bottom edge of diagram
- Could be cool stars (red stars on main sequence)
- Could be hot, small stars (dwarfs)

52. Label the parts of the H-R diagram.



A) Dwarfs
B) Main Sequence
C) Supergiants
D) Giants

53. Which two elements are most abundant in stars?

- Hydrogen and Helium

54. Give evidence of the universe expanding.

- Light from distance stars shows a “red shift”, where the light is all skewed towards the red end of the visible spectrum
- From the Doppler Effect, when the observed frequency of a wave is decreased, the source and the observer are moving apart
- This suggests that the source of this light is moving away from the Earth, which suggests that the universe is expanding

55. What process occurs in the core of stars to produce energy?

- Nuclear Fusion

56. Why does a large, bright star have a shorter life than a small, dim star?

- Because the star is bright, it gives off a lot of energy
- These huge amounts of energy are the result of fusion occurring rapidly in the core of these stars
- Because this fusion occurs at a greater rate than smaller, dimmer stars, the fuel required for fusion (hydrogen) is used up more quickly and the life cycle of the star is shorter

Chapter 22: Plate Tectonics

57. Explain the theory of plate tectonics.

- The upper layers of the Earth are broken into many large pieces
- These pieces have the ability to "float" and move on top of the lower layer, which are hotter and more "flowable"
- Convection Currents that occur in the mantle provide the mechanism for how these large plates move

58. Give 3 effects of plate tectonics.

- Mountains – when crustal plates come together, the force of the collision causes the plates to be forced upwards
- Volcanoes – when cracks appear in the plates, the less dense liquid rocks below (magma) find ways to make it to the surface
- Earthquakes – when the plates meet and move, the movements are not smooth. When the plates move across each other, energy is released and earthquakes occur

59. Where is new crust created?

- Mid Ocean Ridges (Divergent Boundaries, where plates are moving apart)

60. Where is old crust destroyed?

- Subduction Zones (Convergent Boundaries where Oceanic Crust and Continental crust meet. Oceanic crust is more dense than continental crust, so it moves downward into the mantle where it eventually melts to begin the process of a convection current)

61. Two fossils are found, one is deep in the ground, and one is near the surface. Which fossil is older? How do you know?

- The deeper one is older
- As time goes on, the top layer of the Earth is covered with debris, which results in fossils being buried deeper.

62. What is continental drift?

Continental Drift is the idea proposed by Wegener that all of Earth's continents were once together in one large "supercontinent" and they have moved to their present locations over a long period of time.

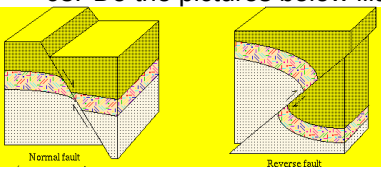
a. Give evidence for continental drift.

- Some continents look like they should "fit together" like puzzle pieces (i.e the eastern coast of South America and western coast of Africa)
- Similar plant and animal fossils have been found on different continents, which are currently separated by oceans. This would suggest that these areas were once adjacent to each other.
- Similar ages and types of rocks have been found on different continents. This suggests that same thing as above.

b. What is the name of the original super-continent?

- Pangaea

63. Do the pictures below illustrate faulting or folding? Explain.



- Both of the pictures illustrate faulting.
- In both cases, there has been a distinct break in the layers of rock, which is a characteristic of faulting

64. How do hotspots lead to the formation of volcanic island chains? Include a drawing.

- Hot spots are areas of the mantle that remain as magma over long periods of time.
- This magma is less dense than the solid rock above it, so it tries to make its way up
- It creates a volcano (an opening in the crust above it where magma can escape)
- The volcano continues to erupt and it eventually grows a mountain that rises above the surface of the water (an island)
- The hot spot stays stationary in the mantle, but the plate continues to move above it. The process detailed above repeats itself in a new location and a new island is formed.

For the figure to the right (which represents an island chain formed by a hot spot)…

- Island A is the youngest island and the one most likely to have active volcanoes. It is still located over the hot spot.
- Island D is the oldest island. It has moved off of the hot spot, so it does not grow, but the erosion from the ocean has diminished it's size over time.
- The plate would be moving south in this area. The oldest islands are to the south and they are there because they have moved with the plate. Wherever the oldest islands are, that is the way the plate is moving.