Exam 2 Exercises Questions

Set 5 Exercise Questions
Electrostatics (Chapter 22)

1. (i) Why are the electrons in the outer shell of copper weakly bound while the most inner electrons are tightly bound? (ii) What is the difference between a conducting and insulating materials?

2. Plastic food wrap can be used to cover a container by stretching the material across the top and pressing the overhanging material against the sides. (i) What makes it stick? (ii) Does the food wrap stick to itself with equal tenacity? (iii) Does it work with metallic containers?

3. (i) Your clothing tends to cling together after going through the dryer. Why? (ii) How do dryer (or antistatic cling) sheets help keep clothes from sticking together in the laundry dryer?

4. (i) Explain how a truck driving down the road can become electrically charged? (ii) Why are the tires for trucks carrying gasoline and other flammable fluids manufactured to be electrically conducting?

5. (i) Using the concepts of dielectric breakdown and electric potential, explain how lightning occurs? (ii) Why is it safe to remain inside a car during a lightning storm?

6. If you are caught outdoors in a thunderstorm, why should you not stand under a tree? Can you think of a reason why you should not stand with your legs far apart? Or why lying down can be dangerous? (Hint: Consider electric potential difference.)

Set 6 Exercise Questions
Electric Circuits (Chapter 23)

1. Explain the role of the voltage source (battery) in keeping electrical current continuously flowing in an electric circuit.

2. Suppose you leave your car lights on while at a movie. When you return, your battery is too “weak” to start your car. A friend comes and gives you a jump start with his battery and battery cables. What physics occurs when your friend gives you a jump start?

3. The wires are all made of the same material; the length and area of each wire is noted. Rank in order, from largest to smallest, the resistance R₁ to R₅ of these wires. Explain.

4. Why is the electrical wire attached to your home clothes drier much larger than the electrical wire attached to a house lamp?

5. Why is the current in an incandescent bulb greater immediately after it is turned on, than a few moments later?

6. A car's headlights dissipate 40 W on low beam, and 50 W on high beam. Is there more or less resistance in the high-beam filament?

7. In the circuit shown, rank the individual lightbulbs (i) voltage, (ii) resistance of each branch, (iii) current and (iv) the power dissipated (brightness). (v) What will happen if bulb A is unscrewed? If C is unscrewed?
Set 7 Exercise Questions
Magnetism (Chapter 24)
1. (i) A magnet is used to pick-up three paper clips as shown on the right. Explain how the magnet is able to do this? (ii) The ability of the magnet to pick-up these paper clips implies that the earth’s gravitational field is very weak compared to the magnetic force of the magnet. Why is this so?

2. (i) What is a magnetic domain and how do these create a magnet? (ii) Although all atoms have moving electric charges, not all materials are magnetic (for example, copper or wood are not magnetic). Why, then, aren’t all materials magnetic?

3. When iron-hulled naval ships are built, the location of the shipyard and the orientation in the ship while in the shipyard are recorded on a brass plaque permanently fixed to the ship. Why?

4. Moss Landing burns oil to boil water and create steam. Explain the process how electrical power is generated and the role that Faraday’s Law plays in this process.

5. Explain how the earth’s geomagnetic field is created? Hint: be sure to include the direction of the earth’s current.

6. A beam of electrons passes through a magnetic field (assume the B-field is pointing to the right). What is the direction of the electron’s velocity relative to the direction of the magnetic field when (i) the beam passes through without being deflected and (ii) when the beam is deflected? With this information explain why northern Canada is bombarded by more intense cosmic radiation (solar wind) than Mexico is. Draw a picture to help explain your answer.

7. Why do astronauts keep to altitudes beneath the Van Allen radiation belts when doing space walks? (Note that this was not covered in lecture.)

Set 8 Exercise Questions
Transverse Waves & Resonance (Chapter 19 & 20)
1. Is the time required to swing to and fro (the period) on a playground swing longer or shorter when you stand rather than sit? Explain.

2. If the speed of the wave doubles while the frequency remains the same, (i) there are two ways to increase the wave speed – what are these two ways? (ii) What happens to the wavelength in this case? Explain.

3. (i) When you speak after breathing helium, there is a change in gas inside your mouth. Does the speed of your voice increase, decrease or stay the same? Hint: compare air to helium. (ii) The frequencies emitted by your vocal cords do not change since they are determined by the mass and tension of your vocal cords. (ii) So what does change when your vocal tract is filled with helium rather than air?

4. The figure shows a standing wave on a string that is oscillating at some frequency. (i) How many nodes and antinodes does this mode have? (ii) What harmonic is this wave mode?

5. A pair of loudspeakers on two sides of a stage is emitting identical pure tones (tones of a fixed frequency and fixed wavelength in air). (i) When you stand in the center aisle, equally distant from the two speakers, you hear the sound loud and clear. Why is this
so? (ii) Why does the intensity of the sound diminish considerably when you step to one side?

Hint: [http://ngsir.netfirms.com/englishhtm/Interference.htm](http://ngsir.netfirms.com/englishhtm/Interference.htm) and click on the diagram to see how these waves interfere to produce standing waves.

6. The sitar, an Indian musical instrument, has a set of strings that vibrate and produce music, even though they are never plucked by the player. These “sympathetic strings” are identical to the plucked strings and are mounted below them. Explain the physics here.

7. A special device can transmit sound out of phase from a noisy jackhammer to its operator using earphones. Over the noise of the jackhammer, the operator can easily hear your voice while you are unable to hear his. Explain this challenging question.

Set 9 Exercise Questions

**Light, Color and Scattering (Chapters 26, and 27)**

1. (i) Explain in detail how electromagnetic waves can be created by (i) an electric charge and (ii) by an atom? (iii) List the types of electromagnetic waves, from low to high frequency, that are in the electromagnetic spectrum?

2. (i) Atoms can emit photons (light particles) or absorb them. Explain how this is done. (ii) Explain how blue, green and red light can be created by atoms?

3. When astronomers observe a supernova explosion in a distant galaxy, they see a sudden, simultaneous rise in visible light and other forms of electromagnetic radiation. Is this evidence to support the idea that the speed of light is independent of frequency? Explain.

4. Using the spring model of the atom, explain how (i) UV and IR light frequencies are absorbed by glass, however, (ii) glass is transparent for visible light frequencies? Explain why.

5. (i) On a red rose tree, explain why roses are red and leaves are green. (ii) Fire engines used to be red. Now many of them are yellow-green. Why the change?

6. (i) What is the actual color of the Sun? Explain. (ii) Now explain why the Sun appears yellow here on earth in terms of light scattering and reflection.

7. (i) Why is the sky blue? (ii) Why is the sky red at sunsets?

8. (i) Why can't we see stars in the daytime? (ii) Can stars be seen from the moon in the “daytime” when the sun is shining?

9. (i) What is the color of the sun? Why is the color of the sun on earth yellow? (ii) Fire engines used to be red, however, now many of them are yellow-green. Why the change?

10. Red sunrises occur for the same reason as red sunsets. But sunsets are usually more colorful than sunrises - especially near cities. What is your explanation?

Set 10 Exercise Questions

**Reflections and Refractions (Chapter 28)**

1. Trucks often have signs on their backs that say; “If you can't see my mirrors, I can't see you.” Explain the physics here.

2. Car mirrors are uncoated on the front surface and silvered on the back surface. When the mirror is properly adjusted, light from behind reflects from the silvered surface into the driver’s eyes. Good. But this is not so
good at nighttime with the glare of headlights behind. This problem is solved by the wedge shape of the mirror (see sketch). When the mirror is tilted slightly upward to the “nighttime” position, glare is directed upward toward the ceiling, away from the driver’s eyes. Yet the driver can still see cars behind in the mirror. Explain.

3. A person in a dark room looking through a window can clearly see a person outside in the daylight, whereas the person outside cannot see the person inside. Explain.

4. Why does reflected light from the sun or moon appear as a column in the body of water as shown? How would it appear if the water surface were perfectly smooth?

5. If while standing on a bank you wished to spear a fish out in front of you, would you aim above, below, or directly at the observed fish to make a direct hit? If instead you zapped the fish with a laser, would you aim above, below, or directly at the observed fish? Defend your answers.

6. When a fish in a pond looks upward at an angle of 45°, does it see the sky above the water’s surface or a reflection from the water-air boundary of the bottom of the pond? Defend you answer.

7. What exactly are you seeing when you observe a “water-on-the-road” mirage?

8. How is a rainbow similar to the halo sometimes seen around the moon on a frosty night? How are rainbows and halos different?