Physical World 1 - 11.30am
Test 4a - April 29, 2005

NAME: Answers
(Last name, first name)

Academic honesty statement.
This exam will NOT be marked unless you sign the academic honesty statement below indicating that you understand and have complied with the meaning of this statement.

On my honor as a student I have neither given nor received unauthorized aid on this assignment.

Signature: _____

Twenty short answer questions. Each question is worth 4 points. (Total points = 80.)

1. a) On the atomic scale what is the fundamental cause of magnetism?

The motion of electrons around the nucleus

b) What is the difference between an unmagnetized iron nail and a magnetized iron nail?

Unmagnetized nail – magnetic domains are random.
Magnetized nail – magnetic domains are aligned.

2. a) True or false? A **stationary** magnet near a **stationary** coil of wire can create a current in the wire.

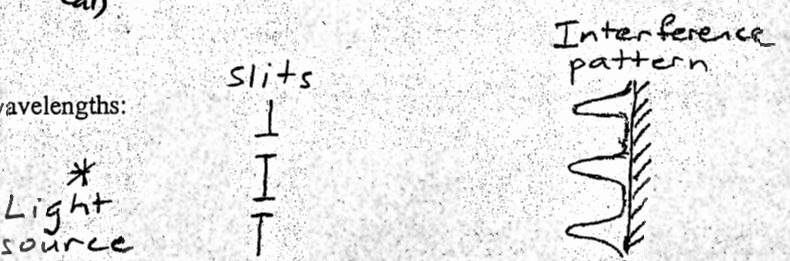
False

b) If false, describe how you would get current to flow in the wire.

You need to move either the magnet or coil so that the B field through the coil is changing

3. In an electric motor electric energy is converted to kinetic (or mechanical) energy.
In an electric generator kinetic (or mechanical) energy is converted to electric energy.

4. Light of various colors has the following wavelengths:
Blue light, $\lambda = 4.5 \times 10^{-7}$m
Yellow light, $\lambda = 5.5 \times 10^{-7}$m
Green light, $\lambda = 5.0 \times 10^{-7}$m
Red light, $\lambda = 6.5 \times 10^{-7}$m



a) In the double slit experiment shown above which of these colors will exhibit the **most** widely spread out interference pattern?

Red light

b) Which of these colors will exhibit the **least** widely spread out interference pattern?

Blue light

5. a) Strictly speaking, will a penny be slightly more massive if it has a negative charge or a positive charge?

Negative charge

b) Explain.

For a negatively charged penny you are adding electrons to the penny.
~~(Positively charged penny – electrons are removed)~~

6. a) Are the headlights for a car connected in series or in parallel?

Parallel

b) Explain how you know this fact.

~~The other headlight stays on~~
When a headlight blows the other headlight stays on.

7. X-rays, visible light, and radio waves
(a) all travel with the same speed in a vacuum.
b) all have the same period of vibration.
c) are different forms of matter.
d) all have the same wavelength.

8. Relative to the distance of an object in front of a plane mirror, how far behind the mirror is the image?

The image is the same distance behind the mirror as the object is in front.

9. In a demonstration white light was reflected from a soap film. In the thinnest part of the film, the film appeared black because

a) black light was reflected from the soap film.
b) of destructive interference between waves reflected from the front and back surfaces of the soap film.
c) of constructive interference between waves reflected from the front and back surfaces of the soap film.
d) no light was reflected from this part of the soap film.

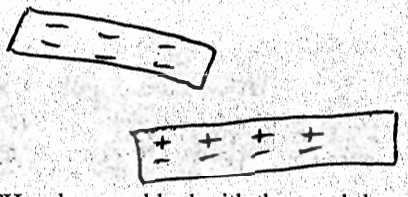
10. In an electric circuit

a) electrons flow from the positive terminal to the negative terminal.
b) electrons flow from the negative terminal to the positive terminal.
c) protons flow from the negative terminal to the positive terminal.
d) current is the flow of both electrons and protons in a circuit.

11. In a demonstration we have two identical plastic rods and a wool cloth.

a) If one rod is rubbed with wool and brought near the other (unrubbed) rod, the two rods attract each other. Explain with a diagram why they attract each other.

Rubbed rod is charged



neutral

Unrubbed rod you get charge separation & a net attraction due to electric induction

b) If, however, BOTH rods are rubbed with the wool they repel each other. Explain why they repel each other in this case.

Both rods have same charge and therefore repel each other.

12. When combing your hair, you scuff electrons from your hair onto the comb.

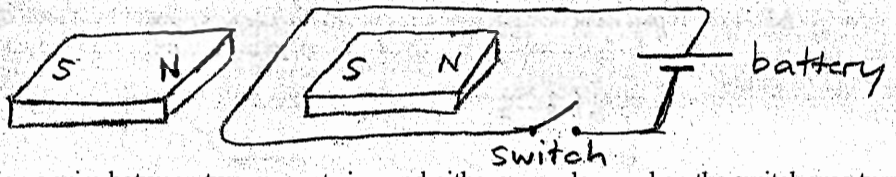
a) Is your hair then positively or negatively charged?

positively charged

b) How about the comb?

negatively charged

13.



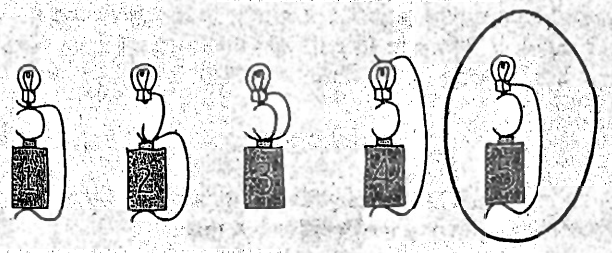
In a demonstration a wire between two magnets jumped either up or down when the switch was turned on (see diagram above).

This occurred because

a) the current created a magnetic field around the wire which interacted with the magnets.
b) the current created an electric field around the wire which interacted with the magnets.
c) the current created an electric field in the magnets.
d) the current caused the magnet domains of the magnets to change.

14. Two 12Ω bulbs are hooked up **in series** to a 12V battery. Another two 12Ω bulbs are hooked up **in parallel** to another 12V battery.
Circle the true statement.
a) The bulbs in series are brighter than the bulbs in parallel.
b) The bulbs in series have more current flowing through them than the bulbs in parallel.
c) The bulbs in parallel are brighter than the bulbs in series.
d) The bulbs in parallel use up less energy per second than the bulbs in series.

15.



In which of the circuits above does a current exist to light the bulb?

16. When two charged rods are moved three times as far apart the force of interaction *decreases* by a factor of
a) 1
b) 3
c) 9
d) None of the above.

17. The pretty colors that you see in soap films are caused by interference effects between light reflected from the two surfaces of the film.
(Choose from a - d below.)
a) diffraction.
b) interference.
c) refraction.
d) dispersion.

18. Circle the correct statements. **(There may be more than one correct answer for this question.)**
a) Unlike charges repel.
b) Unlike charges attract.
c) Like poles repel.
d) Unlike poles attract.

19. In an optical fiber, the propagation of light (see the schematic drawing below) is aided by the phenomenon of total internal reflection. (Choose from the list below.)
a) total internal reflection
b) diffraction
c) interference
d) dispersion

20. A rainbow in the sky is caused by
a) the reflection of light in water droplets.
b) the diffusion of light in water droplets.
c) the dispersion of light in water droplets.
d) the total internal reflection of light in water droplets.

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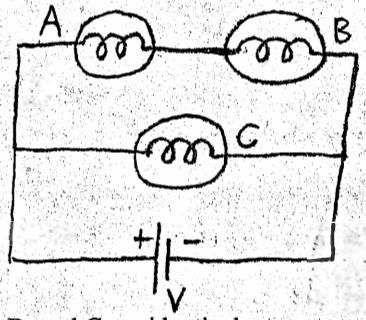
Four longer questions. Each question is worth 5 points. (Total points = 20.)
FOR THESE LONG ANSWER QUESTIONS SHOW ALL EQUATIONS AND CALCULATIONS.
MARKS WILL BE ASSIGNED BASED UPON THE CALCULATIONS THAT YOU SHOW.

21.



In the diagram above, bulbs A, B, and C are identical.

a) How does the brightness of bulb A compare with bulb B?

Same brightness

b) How does the brightness of bulb A compare with bulb C?

A is less bright than C

c) Which bulb draws the most current?

C

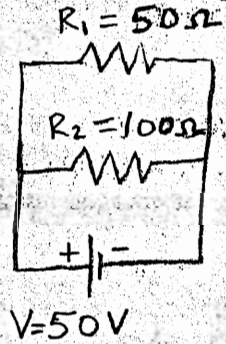
d) What will happen if bulb A is unscrewed?

B will go out, C will be unchanged.

e) What will happen if bulb C is unscrewed?

A & B will stay on & be same brightness.

22. a) In the diagram we show a 50 Ω and 100 Ω resistance which are connected up in parallel. Determine the current that must be supplied by the battery.

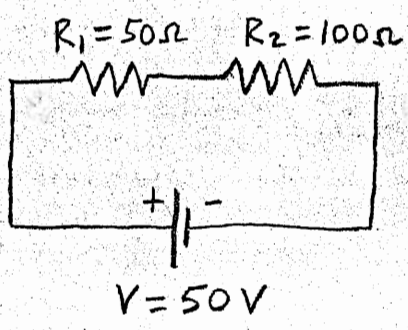


$I_1 = \frac{V}{R_1} = \frac{50}{50} = 1\ A$

$I_2 = \frac{V}{R_2} = \frac{50}{100} = \frac{1}{2}\ A$

$I_{TOT} = I_1 + I_2 = 1 + \frac{1}{2} = 1\frac{1}{2}\ A$

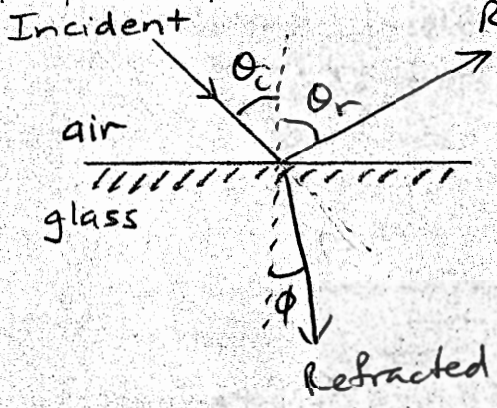
b) We now show the 50 Ω and 100 Ω resistance connected in series. For this new configuration determine the current that must be supplied by the battery.



$I = \frac{V}{R} = \frac{V}{R_1 + R_2} = \frac{50}{50 + 100}$

$= \frac{1}{3}\ A$

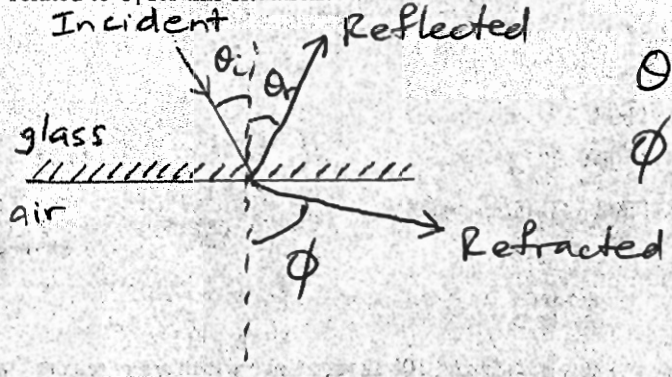
23. a) In the diagram below we show light incident upon an air/glass surface at an angle of incidence θ_i. **Carefully** draw in the reflected and refracted beams together with the reflected (θ_r) and refracted (ϕ) angles. How are θ_r and ϕ related to θ_i for this situation?



$\theta_i = \theta_r$

$\phi < \theta_i$

b) In the diagram below we show light incident upon an glass/air surface at an angle of incidence θ_i. (Note: in this case, the light is incident from the glass medium rather than from the air medium, as in (a).) **Carefully** draw in the reflected and refracted beams together with the reflected (θ_r) and refracted (ϕ) angles. How are θ_r and ϕ related to θ_i for this situation?



$\theta_i = \theta_r$

$\phi > \theta_i$

c) For which of the two situations above, (a) or (b), will one find total internal reflection.

(b)

24. a) A current of 0.07 A can kill you. If you accidentally touch a 120 V outlet, what would the resistance of your body need to be in order that you received a fatal electric shock?

$$R = \frac{V}{I} = \frac{120}{0.07} = 1714\ \Omega$$

b) How much electrical energy would be delivered to your body in a 10s time period?

$$EPE = VIt = 120 \times 0.07 \times 10$$

$$= 84\ J$$