8B Sample Midterm

You MUST Bring

8.5” x 11”

BLUE BOOK!!!!!!!!!!

PHYSICS 8B - Buehler
Summer 2011
Final - Part 2 (a.k.a. "Final")
Thur., Aug. 11, 2011, 6:10-8:00 pm

NAME : _____ SID # :_____

Disc #:_____ Disc Day & Time:_____

- A formula sheets are provided as the last pages of the exam.

- Don't spend all your time on one problem at the expense of not trying the others.

- No Partial credit

Total	/44

<u> ALL ANSWERS MUST BE DONE ON THE ANSWER SHEETS PROVIDED **</u>**

Part 1 - True or False (circle correct answer) (1pts each)

1.	T	F		6.	T F
2.	T	F		7.	T F
3.	T	F		8.	T F
4.	T	F		9.	T F
5.	T	F		10.	T F

Part 2 – Multiple Choice (circle correct answer) (1pts each)

11.	a	b	c	d			37.	a	b	c	d
12.	a	b	c	d			38.	a	b	c	d
13.	a	b	c				39.	a	b	c	d
14.	a	b	c	d			40.	a	b	c	d
15.	a	b	c	d			41.	a	b	c	d
16.	a	b	c	d			42.	a	b	c	d
17.	a	b	c				43.	a	b	c	d
18.	a	b	c	d			44.	a	b	c	d
19.	a	b	c	d			45.	a	b	c	d
20.	a	b	c	d							
21.	a	b	c								
22.	a	b	c								
23.	---										
24.	a	b	c	d							
25.	a	b	c	d	e	f					
26.	a	b	c	d							
27.	a	b	c	d	e						
28.	a	b	c								
29.	a	b	c	d							
30.	a	b	c	d	e						
31.	a	b	c								
32.	a	b	c	d	e						
33.	a	b	c	d	e	f					
34.	a	b	c	d							
35.	a	b	c								
36.	a	b	c	d							

Part 1 - True or False (1pt each)

1. Oppositely charged point charges attract each other due to an electric force, but oppositely charged lines of charge repel each other due to a magnetic force.

2. A proton placed at the midpoint between two positive point charges. If the proton is given a small push toward one point charge, it will tend to return toward its original position.

3. Two capacitors in series attached to a battery always store less energy than the same two capacitors attached to the same battery in parallel.

4. For a solenoid carrying a current I, there is a non-zero magnetic field inside the solenoid and an electron with initial velocity along the axis of the solenoid will travel in a straight line.

5. An inductor opposes current flowing through it, so we treat it like a resistor in circuits.

6. For a mirror, if the image of a candle is smaller than the original candle, the image must be closer to the mirror than the original candle, regardless of the focal length of the mirror.

7. High energy ultraviolet photons from the Sun travel faster and do more damage to our bodies than visible light photons.

8. Diffraction occurs when light passes through an opening (single slit, etc), but not when it shines on a solid object (screw, pin, etc).

9. In a lab, there is no way to tell the difference between hydrogen atoms making a transition from n = 4 → 2 and hydrogen atoms making a transition from n = 4 → 3 and then n = 3 → 2 because they both emit the same total amount of energy.

10. Because of the Pauli exclusion principle, the ground state of an oxygen atom is not necessarily when the electrons are all in the n=1 energy level.

Part 2 – Multiple Choice (1pt each)

Questions 11-13 all concern the following scenario.
You are looking at an approaching car with your eye.

11. When the car is 30 m away, which is true
    a) The image formed is real and upright.
    b) The image formed is real and inverted.
    c) The image formed is virtual and upright.
    d) The image formed is virtual and inverted.

12. When the car is 10 m closer, you must
    a) Increase the focal length of your eye.
    b) Keep the focal length of your eye constant, but increase the image distance to your retina.
    c) Decrease the focal length of your eye.
    d) None of the above.

13. The pupils in your eyes get larger in the dark to let more light in. Can you resolve the car's headlights at a further distance during the day or the night?
    a) Day
    b) Night
    c) Your ability to resolve the headlights is the same during the day and the night.

Questions 14 - 16 all concern the following scenario.
Two very large parallel plates are separated by a distance, d. The left plate is attached to the positive terminal of a 12V battery and the right is attached to the negative terminal. Electrons are released from the right plate and protons are released from the left plate.

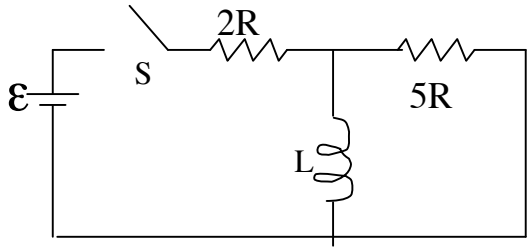
14. Which is true?
    a) The force on each electron is smaller than the force on each proton due to the electron's smaller mass.
    b) The electrons hit the opposite plate with the same speed as the protons (hitting the other plate) since the force on each is F=eE.
    c) The electrons hit the opposite plate with the same kinetic energy as the protons (hitting the other plate).
    d) The magnitude of the force on the electrons decreases as they move away from the right plate, is smallest at the midpoint, and then increases as it approaches the right plate.

15. If the plates are moved closer together, the velocity with which the electrons hit the opposite plate
    a) Increases
    b) Stays the same
    c) Decreases
    d) Can't tell from information given

16. The current associated with the electrons moving is to the _____ and the current associated with the protons moving is to the _____.
    a) Left, Left
    b) Left, Right
    c) Right, Left
    d) Right, Right

Questions 17 - 19 all concern the following scenario.

Initially the switch is in the open position. The switch is now CLOSED.

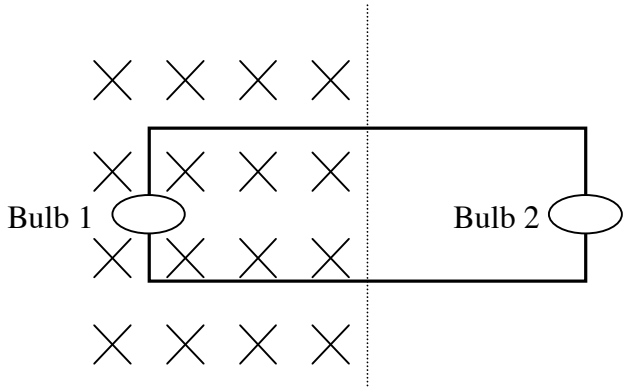


17. After the switch is closed, which is true?
    a) The current through 2R starts at zero and builds gradually over time.
    b) The current through 5R starts at zero and builds gradually over time.
    c) The current through L starts at zero and builds gradually over time.

18. After the switch is closed, initially V_{2R} is _____ V_{5R}, and after a long time V_{2R} is ____ V_{5R}.
    a) Less than , greater than
    b) Greater than , less than
    c) Equal to , equal to
    d) Equal to , greater than

19. After a long time, the switch is opened. Which is true?
    a) The voltage across the inductor immediately drops to zero since it no longer has to oppose the current from the battery.
    b) You see a spark at the switch because the current through the inductor can't change instantly.
    c) The energy stored in the inductor will all be dissipated as heat in only one of the resistors.
    d) None of the above.

Questions 20 - 23 all concern the following scenario.



A rectangular metal loop is sitting in a divided region of space. The left half is in a region of magnetic field $B(t) = 4t^2$ Tesla directed into the page. The loop has two light bulbs in it as shown.

20. Which bulb will light up?
    a) Bulb 1 b) Bulb 2 c) Both d) Neither

21. For your answer to 20, as time passes it/they
    a) get brighter b) get dimmer c) don't change

22. Which direction does current flow through Bulb 1?
    a) Up b) Down c) No current flows

23. ----------There is no #23 ----------

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24. America uses AC voltages of 110V. Europe uses AC voltages of 220 V. If I want to plug in my American laptop while on vacation in Paris, I need a transformer with _____ primary turns (wall outlet side) and _____ secondary turns (laptop side).
    a) 400 , 200
    b) 16 , 4
    c) 20 , 40
    d) 400 , 1600

25. In Compton scattering, an x-ray photon hits an electron at rest. The electron recoils with some KE and a scattered photon is given off. The scattered photon always has _____ energy, _____ wavelength, and _____ speed compared to the incident photon. (Assume ϕ is not zero.)
    a) greater, shorter, same
    b) less, shorter, greater
    c) same, larger, less
    d) less, same, same
    e) greater, larger, less
    f) none of the above

Questions 26 - 28 all concern the following scenario.

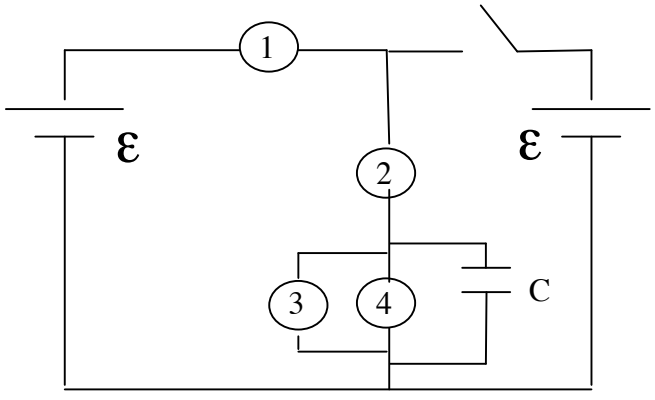
A uranium nucleus, $^{238}_{92}U$, mass 238.05079 u, decays into a thorium nucleus, and ejects a high energy alpha particle, $^{4}_{2}He$, mass 4.00260 u.

26. Which is the mass of the Thorium nucleus?
    a) 234.07458 u b) 234.06021 u c) 234.04819 u d) 234.04363 u

27. The thorium nucleus has _____ neutrons
    a) 238 b) 234 c) 92 d) 90 e) none of the above

28. Classically, the alpha particle does not have enough energy to escape the potential energy barrier of the nucleus. Which is true?
    a) The fact that sometimes the alpha particle is found outside the nucleus is an example of tunneling.
    b) The idea of half-life allows you to know when the uranium nucleus will decay.
    c) If a 100g rock contains uranium, after 2 half-lives, 75g have been converted entirely to energy.

Questions 29 - 31 all concern the following scenario.



All bulbs have same resistance, R.

29. With the switch open a long time, which is true?
    a) $V_1 = V_4$
    b) $I_2 = 2I_3$
    c) $V_C = \varepsilon$
    d) $I_4 = 3I_1$

30. With the switch closed a long time, rank the bulbs in order of brightness from dimmest to brightest.
    a) $1 < 3 < (2=4)$
    b) $(3=4) < 2 < 1$
    c) $1 < (3=4) < 2$
    d) $(3=4) < (1=2)$
    e) $3 < (2=4) < 1$

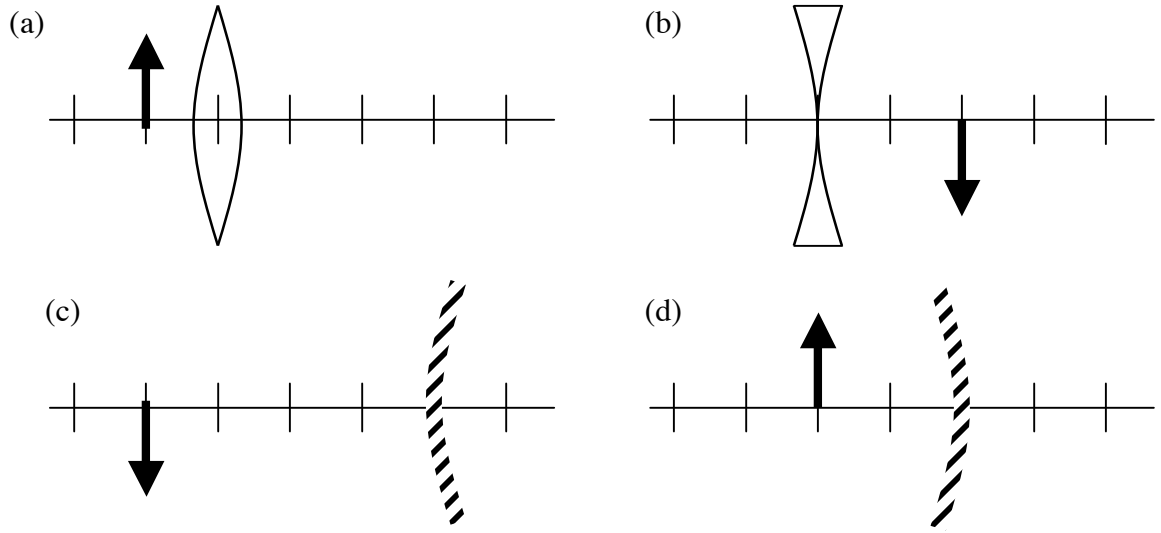
31. Closing the switch causes the energy stored in the capacitor to
    a) Increase over time
    b) Stay the same for all times
    c) Decrease over time

32. Suppose I (Terry) wear glasses that are diverging lenses with a focal length of –25 cm. The lenses in my eyes have a focal length of 1.85 cm. I hold a 3 cm candle 1 m in front of a full length plane mirror. My glasses are 1.5 m from the mirror. The final image of the candle I see formed by the mirror, then the glasses, then my eyes is

a) virtual and smaller than the original candle
b) virtual and bigger than the original candle
c) real and smaller than the original candle
d) real and bigger than the original candle
e) Can't tell from the information given.

Questions 33 - 34 all concern the following scenario.

Each tick mark is 5 cm. Cases (a) & (b) are lenses. Cases (c) & (d) are mirrors. All have focal lengths of magnitude |f| = 20 cm. An identical sized object is placed as shown.



33. Which produces a real image?

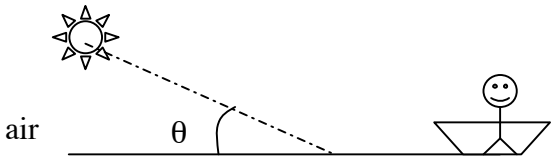
a) The mirrors.
b) The lenses.
c) The converging cases.
d) The diverging cases.
e) All of them.
f) None of them

34. To detect the image formed by (c) you should

a) Place a screen to the left of the mirror.
b) Position your head left of the mirror looking right.
c) Place a screen to the right of the mirror.
d) Position your head right of the mirror looking left.

Questions 35 - 36 all concern the following scenario.

Light from the sun is shining on a lake at $\theta = 30°$ above the horizon. There is a fish swimming in the lake (not shown). You are fishing in a boat.



35. As photons of light enter the water from the air, they
    a) speed up since their wavelength decreases.
    b) travel at the same speed since Einstein said so.
    c) slow down since $n_{water} > n_{air}$.

36. If the fish could talk, it would say the sun appears
    a) more than 30° above the horizon.
    b) exactly 30° above the horizon.
    c) less than 30° above the horizon.
    d) missing since it is beyond the critical angle for total internal reflection off the water.

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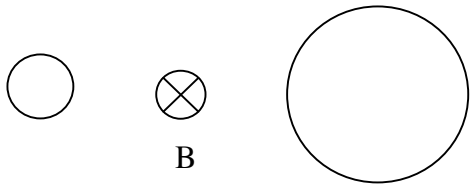
37. The main difference between the magnetic field of a small bar magnet and that of a short (i.e. finite) solenoid is
    a) The bar magnet only has magnetic field on the outside, while the short solenoid only has magnetic field on the inside.
    b) The bar magnet has magnet field lines that start at the north pole and end at the south pole, while the short solenoid has field lines that are closed loops.
    c) The solenoid would try to line its field up with an external magnetic field (like a coil in a motor), while the bar magnet would try to line its field up opposite to an external field (like a compass needle)
    d) None of the above

38. A proton and an electron travel with the same speed in circles in the same uniform magnetic field as shown. (NOT drawn to scale) The magnetic field is directed into the page.



    a) The electron travels clockwise around the smaller circle and the proton travels counterclockwise around the larger circle.
    b) The electron travels clockwise around the larger circle and the proton travels counterclockwise around the smaller circle.
    c) The electron travels counterclockwise around the smaller circle and the proton travels clockwise around the larger circle.
    d) The electron travels counterclockwise around the larger circle and the proton travels clockwise around the smaller circle.

Questions 39 - 41 concern the following scenario.

A hydrogen atom is in an excited state (n=4). The atom makes a transition or series of transitions returning to the ground state.

39. Of the photons emitted in the following transitions, which has the longest wavelength?
    a) 4→1 b) 4→2 c) 3→1 d) 3→2

40. Of the photons emitted in the following transitions, which has the largest momentum?
    a) 4→1 b) 4→2 c) 4→3 d) All photons have the same speed and thus the same momentum.

41. Recalling the hydrogen spectra you learned about in the lab; fill in the blanks about the transitions listed
    4→1 emitted _____, 4→2 emitted _____, 4→3 emitted _____

    a) Infrared, turquoise, ultraviolet
    b) Ultraviolet, turquoise, infrared
    c) Ultraviolet, yellow, red
    d) Yellow, turquoise, red

Questions 42 – 44 concern the following scenario.

An electron is in an infinite potential well of width L.

42. If the electron is in the n=4 state, where are you most likely to find the electron in a small interval of width dx = L/100?
    a) x = .25L
    b) x = .375 L
    c) x = .5 L
    d) All points are equally likely since quantum mechanics says the electron is wave and thus at all points at the same time.
43. Which is not an allowed deBroglie wavelength for the electron to have
    a) $\lambda = 3L$
    b) $\lambda = 2L$
    c) $\lambda = L/2$
    d) $\lambda = L/3$
44. For an electron in the ground state, decreasing the width of the infinite potential well increases
    a) The electron's momentum, p
    b) The uncertainty in the electron's momentum, Δp
    c) Both of these
    d) Neither of these

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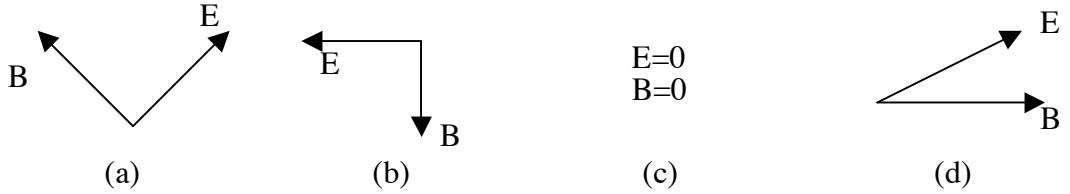
45. Which of the following can NOT be the instantaneous electric and magnetic fields of an EM wave coming out of the paper toward you.



(a) (b) (c) (d)