Conceptual Physics NAME:

Homework 5b Current: Homeworks are due usually a day after the corresponding textbook part/lecture is completed. Due dates will be announced in class. Multiple-choice problems will all be marked. **USE** the answer table for these problems. The rest of the homeworks will be marked for apparent completeness and some full-answer problems will/may be marked in detail. Make the full-answer solutions sufficiently detailed that the grader can follow your reasoning. Solutions will be posted eventually after the due dates. The solutions are intended to be (but not necessarily are) super-perfect and often go beyond full answers. For an argument or discussion problem, there really is no single right answer. The instructor's answer reflects his long experience in physics, but there could be objections to his arguments, assumptions, nuances, style, facts, etc.

NAME:

Answer Table for the Multiple-Choice Questions

	a	b	c	d	e		a	b	c	d	e
1.	O	O	O	O	O	26.	O	O	O	O	O
2.	O	O	O	O	O	27.	O	O	O	O	O
3.	O	O	O	O	O	28.	O	O	O	O	O
4.	O	O	O	O	O	29.	O	O	O	O	O
5.	O	O	O	O	O	30.	O	O	O	O	O
6.	O	O	O	O	O	31.	O	O	O	O	O
7.	O	O	O	O	O	32.	O	O	O	O	O
8.	O	O	O	O	O	33.	O	O	O	O	O
9.	O	O	O	O	O	34.	O	O	O	O	O
10.	O	O	O	O	O	35.	O	O	O	O	O
11.	O	O	O	O	O	36.	O	O	O	O	O
12.	O	O	O	O	O	37.	O	O	O	O	O
13.	O	O	O	O	O	38.	O	O	O	O	O
14.	O	O	O	O	O	39.	O	O	O	O	O
15.	O	O	O	O	O	40.	O	O	O	O	O
16.	O	O	O	O	O	41.	O	O	O	O	O
17.	O	O	O	O	O	42.	O	O	O	O	O
18.	O	O	O	O	O	43.	O	O	O	O	O
19.	O	O	O	O	O	44.	O	O	O	O	O
20.	O	O	O	O	O	45.	O	O	O	O	O
21.	O	O	O	O	O	46.	O	O	O	O	O
22.	O	O	O	O	O	47.	O	O	O	O	O
23.	O	O	O	O	O	48.	O	O	O	O	O
24.	O	O	O	O	O	49.	O	O	O	O	O
25.	O	O	O	O	O	50.	O	O	O	O	O

1. Current is the:

   a) flow of negative charge. b) flow of positive charge. c) flow of net charge.
   d) oscillation of charge. e) reflection of charge.

2. "Let's play *Jeopardy*! For \$100, the answer is: It is the rate of charge per unit time passing or flowing through a specified surface in a specified sense and we'll call this quantity flow for the nonce (i.e., for the rest of this answer). By 'charge' without qualification, one means the net charge (i.e., positive plus negative charge or positive charge minus the absolute value of negative charge). By 'specified sense', one means that one defines one side of the surface as the positive side where all charge flows to that side are added and all charge flows to the other side are subtracted. This means that added positive charge or subtracted negative charge both increase flow and added negative charge and positive subtracted charge both decrease flow. The above specifications for adding up the contributions to the flow make perfect sense if one considers the net charge in a box into which charge is flowing. For example, positive inflows and negative outflows increase charge in the box and positive outflows and negative inflows decrease charge in the box. Integrated flow as we have defined it gives the change in the box charge.

   Positive and negative flows can occur. Usually one chooses one's conventions so that the flows are positive, but obviously in cases where the flow can reverse or where you don't know the direction of flow initially, negative flows can arise."

   What is electrical _____, Alex?

   a) swarm b) tide c) flux d) tirade e) current

3. The SI unit of current is the:

   a) ampère: $1\,\mathrm{A} = 1\,\mathrm{C\,s}$. b) ampere: $1\,\mathrm{A} = 1\,\mathrm{C/s}$. c) ampere: $1\,\mathrm{A} = 1\,\mathrm{C/s^2}$.
   d) ampére: $1\,\mathrm{A} = 1\,\mathrm{C/s^2}$. e) volt: $1\,\mathrm{V} = 1\,\mathrm{C/s}$.

4. In common parlance, the current unit ampere is often abbreviated to:

   a) ant. b) amp. c) aunt. d) aump. e) ahmp.

5. One thousandth of an amp is a:

   a) kiloamp. b) hectoamp. c) deciamp. d) milliamp. e) microamp.

6. In general, the current charge carriers can be:

   a) positive or negative. b) positive only. c) negative only.
   d) neither positive nor negative. e) neutral.

7. In metals, the charge carriers are:

   a) electrons. b) protons. c) positrons. d) positive ions. e) negative ions.

8. "Let's play *Jeopardy*! For \$100, the answer is: This person is to blame for naming positive positive and negative negative in the 18th century. If he/she had just done it the other way around, the most common charge carriers in technological application, electrons, would flow from 'positive' to 'negative'. This would have made our mental picture of conduction in metals simpler although it makes no difference in principle or practice as long as one sticks to the proper definition of current. Of course, there was not way in the 18th for him/her to have known the sign of the carriers. Still he/she could have been luckier."

   Who is _____, Alex?

   a) Ben Franklin (1706–1790) b) Benedict Arnold (1741–1801)
   c) Abigail Adams (1744–1818) d) John Paul Jones (1747–1792) e) Betsy Ross (1752–1836)

9. A current of 2 A flows past a point in a wire. How many electrons flow past per second? (More exactly what is the net flow of electrons per second?)

   a) 3.2×10^{-19} electrons/s. b) 2 electrons/s. c) 1.25×10^{19} electrons/s.
   d) 2×10^{19} electrons/s. e) none.

10. Current is caused:

    a) only by the electric field. b) only in force-free cases. c) in any number of ways.
    d) conveyor belts. e) by pressure.

11. In many current cases, the current is conceptualized as being ultimately caused by a/an _____ which is actually a work per unit charge. The _____ causes a potential difference which drives a current. The potential difference, of course, can be considered just a measure of the electric field effect that drives the current.

    a) enf b) emf c) epf d) epa e) tva

12. The voltage difference between the terminals of a battery ideal equals the battery emf no matter what current flows through the battery. In reality, the voltage usually:

    a) increases slowly with increasing current. b) decreases slowly with increasing current.
    c) drops to zero with any current. d) doubles with any current.
    e) oscillates with any current

13. The electricity term circuit can be defined in somewhat different ways. But a common way is that it is closed loop or network of closed loops of:

    a) wires. b) capacitors. c) magnets. d) resistors. e) conducting elements.

14. "Let's play *Jeopardy*! For $100, the answer is: They are conventionalized schematic diagrams of circuits. Common circuit elements are represented by conventionalized symbols. There are infinitely many ways of constructing a circuit represented by one of these diagrams—'do I put this wire here or there and do I lay it flat or do I make a cute curlicue of it or ...'—but electrically the realizations should all behave the same to within some tolerance anyway."

    What are _____, Alex?

    a) circuit diagrams b) current diagrams c) wire diagrams d) circuit images
    e) wire images

15. The ratio of voltage drop across a device (caused by the electrical resistance of the device) to current flow through it is its resistance

$$R = \frac{V}{I} \ .$$

    The SI unit of resistance is the ohm with symbol Ω:

$$1\,\Omega = \frac{1\,\mathrm{V}}{1\,\mathrm{A}} \ .$$

    If R is independent of V or I (which is the same thing as being independent of V), then _____ is obeyed for the device. This law is usually written

$$V = IR \ .$$

    a) Kirchhoff's voltage law b) Kirchhoff's current law c) Faraday's law d) Joe's law
    e) Ohm's law

16. What is the current in a toaster of $12\,\Omega$ with a DC potential (or voltage) drop across it of 120 V?

    a) 0 A. b) 1440 A. c) 120 A. d) 10 A. e) 12 A.

17. A single loop circuit has emf $\mathcal{E}$ and resistor R. It's current is:

    a) $I = \mathcal{E}R$. b) $I = R/\mathcal{E}$. c) $I = \mathcal{E}/R$. d) $I = \mathcal{E}/R^2$. e) $I = \mathcal{E}R^2$.

18. "Let's play *Jeopardy*! For $100, the answer is: In physics, it is energy transferred per unit time."

    What is _____, Alex?

    a) power b) work c) force d) momentum e) density

19. The SI unit of power is the joule per second with special name:

    a) woo (W). b) wenn (W). c) watt (W). d) wye (W). e) woe (W).

20. The world commercial power usage is about:

    a) 10 kW. b) 15 MW. c) 15 GW. d) 15 TW. e) 10 PW.

21. For a DC electrical element, the power input (voltage rises in current direction) or output (voltage drops in current direction) is given by the formula:

    a) $P = I/V$. b) $P = IV$. c) $P = V/I$. d) $P = IV^2$. e) $P = I^2V$.

22. The electrical energy lost in a resistance is converted into:

    a) electric field energy. b) heat energy. c) magnetic field energy.
    d) macroscopic mechanical energy. e) gravitational potential energy.

23. The electrical power extracted in a resistance R with a potential drop V and a current I is:

    a) $P = VIR = V/R = I/R$. b) $P = VIR = VR^2 = I^2R$. c) $P = VI = VR^2 = I^2/R$.
    d) $P = VI = V^2/R = I^2R$. e) $P = VI = V/R = IR$.

24. A current of 10 A (an ampere is a coulomb per second) goes through a device with voltage difference of 10 V (a volt is joule per coulomb). What is the power (energy per unit time with MKS units of watts [symbol W]: i.e., joules per second) delivered to the device?

    HINT: Do the units come out right from the math?

    a) 100 W. b) 100 J. c) 10 W. d) 10 J. e) 1 W.

25. An X-ray tube operates at a current of 7.0 **mA** and a potential difference of 80 **kV** (note kilovolts). The energy is going out of electrical potential energy into electron kinetic energy and then into X-ray energy. What is the X-ray tube's power in watts?

    a) 0.56 W. b) 5.6×10^5 W. c) 560 W. d) 11.4 W. e) 1.14×10^7 W.

26. "Let's play *Jeopardy*! For $100, the answer is: It is an arrangement of circuit elements such that a single current flows consecutively through all of them."

    What is _____, Alex?

    a) in rough b) in sequence c) in perpendicular d) in parallel e) in series

27. DC (direct current) has a current flow in a single direction. AC has current that alternates its direction in a periodic manner. The usual AC current function with time is a:

    a) sawtooth wave. b) square wave. c) catenary. d) sinusoid. e) cycloid.