Biology 211
Study Questions Exam 4

Chapter 26: Fluid, Electrolyte & Acid-Base Balance

1. Distinguish between plasma & interstitial fluid. What fluids are included in interstitial fluid?
2. Define electrolytes & nonelectrolytes & give 2 examples of each.
3. List the major ions in extracellular fluid & intracellular fluid.
4. What are the primary sources of water intake & water output? What is meant by sensible & insensible water loss (where does each occur)?
5. Where is the primary thirst regulatory center located in the body?
6. Describe the movement of water that accompanies dehydration, hypotonic hydration & edema. What are 2 factors that can cause edema?
7. What percent of sodium in filtrate is generally reabsorbed in the absence of aldosterone? Where in the kidney tubules is the remaining sodium reabsorbed when aldosterone is present. Briefly describe the renin-angiotensin mechanism for release of aldosterone.
8. What are baroreceptors & where are they located? What is the primary effect of baroreceptor activation?
9. What is the effect of ADH release? Where is ADH produced & released?
10. What is the effect of each of the following on blood pressure: aldosterone, ADH, atrial natriuretic peptide?
11. What are the major functions of potassium ions in the body? What is the effect of aldosterone on potassium ions?
12. Which hormones regulate calcium ion content in the blood & what are their effects?
13. What is the normal range for blood pH?
14. Define acidosis & alkalosis.
15. What is the function of the blood buffer system? What are its primary components? What other molecules can act as buffers in blood?
16. What is the effect of increasing levels of carbon dioxide in the blood on blood pH?
17. How do the kidneys respond to acidosis & alkalosis with respect to hydrogen ions & bicarbonate ions during filtration?

Chapter 27: The Reproductive System

18. What are the male & female gametes & where are they produced?
19. What is the primary function of the dartos & cremaster muscles of the scrotum?
20. Where are sperm produced in the testes?
21. Where are interstitial cells (Leydig cells) located & what is their function?
22. What are the names of the erectile tissues in the penis? What material do they fill with that causes their erectile behavior?
23. Briefly describe the pathway of sperm from the testes to the penile urethra.

24. Describe the function of the secretions from: seminal vesicles, prostate gland, bulbourethral gland.
25. Describe the function of the following components of semen: fructose, prostaglandins, seminalplasmin.
26. What is the name given to meiosis in males? In females?
27. What are the normal diploid & haploid numbers of chromosomes in humans?
28. Which meiotic division is the reduction division, reducing the chromosome number from 2n to n?
29. Definitions: synapsis (crossing over), tetrads, independent assortment. During what stage of meiosis does each occur/form (I or II)?
30. Give a brief description of each of the following cells seen during spermatogenesis: spermatogonium, primary spermatocyte, secondary spermatocyte, spermatid, sperm cell.
31. What is spermiogenesis? What is the function of the acrosome & flagellum of the mature sperm cell?
32. Briefly describe the role of the sustentacular cells (Sertoli cells).
33. Give the site of release & basic function in the male reproductive system of the following hormones: GnRH, FSH, LH, testosterone, inhibin.
34. What is the primary function of the ovaries?
35. Where are ovarian follicles located. Briefly define the following: primordial follicle, primary follicle, secondary follicle, Graafian follicle, ovulation, corpus luteum.
36. What are the 3 regions of the uterine (fallopian) tubes? Where does fertilization generally occur? Where are the fimbriae located & what is their function?
37. What are the 3 regions of the uterus? Which region communicates with the vagina?
38. What are the 3 layers of the uterine wall & what is the tissue composition of each? What is the function of the stratum basalis & stratum functionalis? Which layer is built up & shed during the uterine cycle?
39. What is the function of the ovarian ligament & round ligament?
40. What is the tissue composition of the vaginal mucosa? Is the pH of vaginal secretions generally acidic, basic or neutral? Why?
41. Which region of the female external genitalia contains erectile tissue?
42. What type of glands are the mammary glands? What product do they secrete & where within the glands is it produced?
43. Give a brief description of each of the following cells seen during oogenesis: oogonium, primary oocyte, secondary oocyte, ovum (egg cell), polar body.
44. During spermatogenesis, meiotic divisions proceed continuously from prophase to telophase, without external signals. Are meiosis I & meiosis II divisions completed in the same way during oogenesis? If not, at what stage do they arrest, & what signals are required to proceed?
45. Describe the cells resulting from complete spermatogenesis in males & oogenesis in females.
46. List the days & major events defining the phases of the ovarian cycle.
47. Give the site of release & basic function in the female reproductive system of the following hormones: GnRH, FSH, LH, estrogen, progesterone, inhibin.

48. List the days & major events defining the phases of the uterine cycle.
49. What is the causative agent (viral or bacterial) for: gonorrhea, syphilis, Chlamydia, genital warts, genital herpes?

Chapter 28: Pregnancy & Human Development

50. Briefly define: conceptus, gestation period, preembryo, embryo, fetus, zygote.
51. How long are sperm & egg cells viable after release?
52. What is the acrosomal reaction & why is it necessary?
53. Briefly describe the 2 blocks to polyspermy after fertilization.
54. Following sperm entry, what events lead to formation of the zygote?
55. Define: cleavage, blastomeres, morula, blastocyst, gastrula.
56. What is the function of the trophoblast cells & inner cell mass in the blastocyst?
57. What is implantation & where does it occur?
58. What 2 tissue types form the placenta & are these fetal or maternal tissues?
59. What is the function of the following in the embryo: amnion, yolk sac, allantois?
60. What are the 3 primary germ layers & what types of tissue in the embryo is each involved in forming?
61. What structures are formed during neurulation?
62. What germ layer forms somites? What are the 3 components of a somite & what does each form?
63. What tissues are formed by: intermediate mesoderm, somatic mesoderm, splanchnic mesoderm?
64. What is the function of the 3 fetal shunts (ductus venosus, ductus arteriosus & foramen ovale) & why are they necessary?
65. Briefly describe: fetal ultrasonography, amniocentesis, chorionic villi sampling, maternal alpha-fetoprotein test.
66. What is the source of estrogen & progesterone during the first 3 months of pregnancy? During months 3 through the end of pregnancy?
67. What is the function of human chorionic gonadotropin (hCG)?
68. What is the function of oxytocin & prostaglandins during childbirth?
69. Define: crowning, vertex presentation, breech presentation, Caesarian (C) section.
70. What are the hormones involved in the onset of lactation & where are they produced/released?

Chapter 29: Heredity

71. Definitions: alleles, genotype, phenotype, homozygous, heterozygous, carrier.
72. Briefly define & give an example of: incomplete dominance, multiple-allele inheritance, codominance.

Biology 211
Study Notes Exam 4

Chapter 26: Fluid, Electrolyte & Acid-Base Balance

1. ***Plasma***: fluid component of blood; ***Interstitial fluid (IF)***: fluid in spaces between tissue cells - includes lymph, CSF, synovial fluid, serous fluid, etc...
2. **electrolytes**: molecules that do dissociate in water into charged particles (e.g.: inorganic salts, organic & inorganic acids & bases, some proteins); **nonelectrolytes**: molecules that have no electrical charge; do not dissociate in water (e.g.: organic molecules such as glucose, lipids, creatinine & urea)
3. **extracellular fluid**: chief ions are ***sodium*** cations (positive ions) & ***chloride*** anions (negative ions)**; intracellular fluid**: chief ions are ***potassium*** cations & ***phosphate*** anions
4. ***water intake***: 60% fluids, 30% water in foods, 10% from metabolism; ***water output***: 60% excreted in urine (sensible water loss), 28% vaporizes out of lungs of is lost by diffusion through skin (insensible water loss), 8% lost through perspiration & 4% in fecal waste
5. thirst center: hypothalamus
6. **dehydration**: water moves from cells to ECF to equalize osmolality; **hypotonic hydration (water intoxication)**: water flows into cells by osmosis; **edema**: fluid movement from blood to interstitial space
7. 85-90% sodium is reabsorbed in the proximal tubules & loop of Henle without aldosterone; when ***aldosterone*** levels are high, nearly all the remaining sodium is actively reabsorbed from the *distal tubules & collecting ducts*; renin released by JG cells converts angiotensinogen to angiotensin I, & angiotensin I is converted to angiotensin II by angiotensin converting enzyme (ACE) – angiotensin II activates release of aldosterone from adrenal cortex
8. ***baroreceptors*** are pressure receptors in the heart & large vessels (aorta & carotid arteries); activation of baroreceptors results in constriction of afferent arterioles, decreased glomerular filtration rate & decreased sodium & water output -> increased blood pressure
9. **ADH** is produced in the hypothalamus & stored & released from the posterior pituitary; *ADH* increases water reabsorption from the collecting ducts
10. **aldosterone** increases blood pressure; **ADH** increases blood pressure; **atrial natriuretic peptide (ANP)** decreases blood pressure
11. ***potassium*** ions are important for *electrical conduction* in neurons & muscle cells; in the presence of ***aldosterone***, f*or each sodium reabsorbed, a potassium ion is secreted* to maintain electrolyte balance
12. ***parathyroid hormone*** increases blood calcium levels; ***calcitonin*** decreases blood calcium levels
13. ***blood pH*** is normally maintained between pH **7.35-7.45**
14. ***acidosis***: blood pH < 7.35; ***alkalosis***: blood pH > 7.45

15. **bicarbonate buffer system**: mixture of carbonic acid & its salt sodium bicarbonate in the same solution; stabilizes blood pH; *phosphates & proteins* can also act as buffers in blood
16. ***carbon dioxide*** from metabolism enters blood & combines with water to form carbonic acid -> ***lowers pH***
17. *during acidosis*: bicarbonate ions generated while excreting hydrogen ions; *during alkalosis*: bicarbonate ion secretion while reabsorbing hydrogen ions

Chapter 27: The Reproductive System

18. male gamete is ***sperm*** produced in testes; female gamete is ***ovum (egg cell)*** produced in ovaries
19. temperature of testes is maintained by contraction & relaxation of dartos & cremaster muscles
20. sperm are produced within seminiferous tubules of testes
21. **interstitial cells (*Leydig cells*)**: located in areas surrounding seminiferous tubules; produce *androgens* (***testosterone***)
22. erectile tissue in penis: ***corpus spongiosum*** & ***corpora cavernosa***; become filled with blood during sexual excitement
23. seminiferous tubule -> straight tubule -> rete testis -> efferent duct -> epididymis -> ductus deferens -> ejaculatory duct -> (prostatic) urethra
24. **seminal vesicles**: secrete seminal fluid – contains nutrient for sperm (fructose), prostaglandins that aid in sperm motility & its alkaline nature helps to neutralize penile urethra; **prostate gland:** secretes a slightly acidic fluid containing citrate (can also be used in energy pathways by sperm), enzymes & prostate-specific antigen (PSA) to break down clotting proteins in semen; **bulbourethral glands (Cowper's glands)**: produce thick clear mucus prior to ejaculation that neutralizes acidic urine in urethra
25. ***fructose*** for ATP production by sperm; ***prostaglandins*** aid in sperm motility & may stimulate uterine contractions to propel sperm through female tract; ***seminalplasmin*** is an antibiotic (destroys bacteria)
26. meiosis in males is ***spermatogenesis***; meiosis in females is ***oogenesis***
27. normal diploid chromosome number (2n) in humans is **46**; normal haploid chromosome number (n) in humans is **23**
28. **meiosis I**: reduction division (2n to n)
29. ***synapsis***: homologous chromosomes pair & exchange genetic information***; tetrads*** or *bivalents*: chromosomes in the act of "crossing over"; ***independent assortment***: either maternal or paternal chromosome of each homologous pair can be on a given side of metaphase plate; each occurs during **meiosis I**
30. ***spermatogonium***: 2n stem cell -> divides to form ***primary spermatocyte*** (2n) -> divides in meiosis I to form ***secondary spermatocytes*** (n) -> divide in meiosis II to form ***spermatids*** (n) -> differentiate to form ***sperm cells***
31. **spermiogenesis:** spermatids undergo changes to form sperm cells; ***flagellum*** is for locomotion; ***acrosome*** contains hydrolytic enzymes for penetration of egg cell

32. ***sustentacular cells (Sertoli cells)*** surround cells of seminiferous tubules & connect to one another by tight junctions which form blood-testis barrier that prevents immune cell targeting of sperm
33. *Gonadotropin-releasing hormone* ***(GnRH)*** release from hypothalamus controls release of *follicle-stimulating hormone* ***(FSH)*** *&* *luteinizing hormone* ***(LH)*** from anterior pituitary; **FSH** stimulates sustentacular cells to release androgen-binding protein (ABP), which causes spermatogenic cells to bind testosterone & begin spermatogenesis; **LH** binds to interstitial cells & stimulates them to secrete testosterone; **testosterone** feeds back (negative feedback) to hypothalamus & anterior pituitary, inhibiting release of GnRH & tropic hormones; **inhibin** released by sustentacular cells inhibits release of FSH from anterior pituitary & GnRH from hypothalamus
34. **ovaries**: female gonads; produce oocytes & female sex hormones (estrogens & progesterone)
35. **ovarian follicles**: in cortex; contain immature egg (oocyte) encased by one or more cell layers (1 layer = follicle cells; more than 1 layer = granulosa cells)***; primordial follicle***: one layer of squamous cells enclose oocyte; ***primary follicle***: 2 or more layers of cuboidal or columnar cells surround oocyte; ***secondary follicle***: has central fluid-filled cavity (antrum); ***vesicular (Graafian) follicle***: follicle bulges from ovary surface; oocyte sits on stalk of granulosa cells at one side of antrum
36. ***uterine tube:*** *infundibulum, ampulla & isthmus*; ***fertilization*** normally occurs *within uterine tube* (generally ampulla, although sometimes fertilization occurs within infundibulum or even pelvic cavity); **fimbriae** located at end of infundibulum, & have cilia that sweep oocyte into uterine tube
37. **uterus**: consists of fundus, body & cervix; ***cervical canal*** communicates with vagina
38. ***perimetrium***: serous membrane, ***myometrium***: smooth muscle, ***endometrium***: mucosa with simple columnar epithelium; ***stratum basalis (basal layer)***: forms new functional layer after menstruation***, stratum functionalis (functional layer)***: undergoes cyclic changes in response to ovarian hormones; ***functional layer*** shed during menstruation
39. ***ovarian ligament*** anchors ovary to uterus; ***round ligament:*** anchors uterus to anterior abdominal wall
40. wall of ***vagina*** consists of outer fibroelastic adventitia, smooth muscle muscularis & mucosa of stratified squamous epithelium with ridges (rugae); pH of vagina is normally acidic due to metabolism of sugars by resident bacteria
41. ***clitoris*** contains erectile tissue (corpora cavernosa)
42. ***mammary glands*** are composed of modified sweat glands; lobules within lobes contain ***alveoli*** that produce milk
43. ***oogonium***: stem cell in ovary that differentiate into a primary oocyte; ***primary oocyte***: cell formed from oogonium that is committed to producing gamete (egg); ***secondary oocyte***: cell resulting from meiosis I in the ovary; ***ovum (egg cell)***: functional gamete resulting from meiosis II in ovary; ***polar body***: nonfunctional cell produced by meiosis I & meiosis II in ovary
44. *primary oocytes* <u>*arrest*</u> *in prophase of meiosis I*, each month after puberty, several primary oocytes complete meiosis II in response to <u>FSH & LH</u> from anterior

pituitary; *secondary oocytes arrest in metaphase of meiosis II*, sperm penetration of secondary oocyte is the signal to complete meiosis II

45. ***spermatogenesis***: 4 gametes (sperm cells); ***oogenesis***: 1 gamete (ovum) & 2 or 3 polar bodies
46. **follicular phase**: primordial follicle→primary follicle→secondary follicle→vesicular (Graafian) follicle (days 1-14); **ovulation**: bulging ovary wall ruptures & releases secondary oocyte into peritoneal cavity; (~ day 14); **luteal phase**: period of corpus luteum activity, corpus luteum secretes *progesterone & estrogen* for ~ 10 days & degenerates if fertilization does not occur (days 14-28)
47. **GnRH** released from hypothalamus stimulates FSH & LH release from anterior pituitary; **FSH & LH** released from anterior pituitary & stimulate follicle growth & *estrogen* secretion; **estrogen** secreted by follicle cells & corpus luteum (& placenta), feeds back to anterior pituitary inhibiting release (while stimulating production) of FSH & LH, prepares embryo for implantation & peak levels stimulate burst of LH from anterior pituitary that signals ovulation; **progesterone** released by corpus luteum (& placenta) works with estrogens to prepare endometrium for embryo implantation, prepares mammary glands for milk production, inhibits GnRH & LH release
48. **menstrual phase** (days 1-5): uterus sheds all but deepest layer of endometrium, passes out through vagina as menstrual flow; **proliferative phase** (days 6-14): rising estrogen levels stimulate endometrium to rebuild itself, ovulation at ~ day 14; **secretory phase** (days 15-28): increasing progesterone levels prepare endometrium for embryo implantation
49. ***gonorrhea***: caused by bacterium *Neisseria gonorrheae;* ***syphilis***: caused by bacterium *Treponema pallidum*; ***chlamydia***: caused by parasitic bacterium *Chlamydia trachomatis*; ***genital warts***: caused by human papillomavirus (HPV) (certain types also cause invasive cervical cancer); ***genital Herpes***: caused by human herpesviruses (herpes simplex virus, Epstein-Barr virus)

Chapter 28: Pregnancy & Human Development

50. **conceptus**: developing offspring; ***gestation period***: time of development; from last menstrual period until birth; ***preembryo***: first 2 weeks of development; ***embryo***: third through eighth weeks (embryonic period); ***fetus***: ninth week through birth (fetal period); **zygote:** fertilized ovum
51. ***sperm*** viable from 24 hours up to 72 hours; ***egg*** viable for 12-24 hours after ovulation
52. **acrosomal reaction**: release of acrosomal enzymes from sperm that break down protective covering of oocyte; corona radiata & zona pellucida of oocyte must be broken down for sperm to gain entry into oocyte
53. *fast block to polyspermy*: membrane depolarizes due to sodium ion entry through open sodium channels; *cortical reaction*: cortical granules within oocyte release enzymes that destroy sperm receptors
54. ***sperm nucleus*** enters oocyte (tail & midpiece are lost); *oocyte completes meiosis II* to form the ***ovum nucleus*** (and second polar body, which is ejected); ovum & sperm nuclei become ***female & male pronuclei***… their nuclear membranes rupture & release their chromosomes, which combine to form the **zygote**

55. **cleavage**: in embryonic development, a period of rapid mitotic divisions of the zygote following fertilization, resulting in doubled numbers of increasing smaller cells called blastomeres; **blastomeres**: cells resulting from cleavage (up until blastocyst stage); **morula**: berry-shaped cluster of 16 or more cells; ***blastocyst***: fluid-filled hollow sphere of cells composed of *trophoblast*, *blastocele*, & *inner cell mass*; **gastrula**: embryonic structure consisting of embryonic disc with 3 primary germ layers (endoderm, mesoderm & ectoderm)
56. ***trophoblast cells*** secrete hCG & enzymes to help in implantation, & give rise to the **chorion,** which begins formation of placenta; ***inner cell mass*** becomes the ***embryonic disc***, which forms the *embryo*
57. **implantation**: attachment of embryo to ***endometrium*** of uterus, ~ 6 days after fertilization
58. ***placenta*** arises from trophoblast of embryo & endometrial tissue of mother
59. **amnion**: sac containing ***amniotic fluid*** (from maternal blood & fetal urine) that cushions & protects embryo against trauma & maintains temperature; **yolk sac**: produces earliest *blood cells & vessels* and is the source of ***primordial germ cells*** that form *gonads*; **allantois:** the structural base for umbilical cord formation & forms part of urinary bladder
60. ***ectoderm, mesoderm & endoderm***; **ectoderm**: forms nervous system (brain, spinal cord, cranial & spinal nerves), epidermis of skin (also forms: accessory structures of skin (hair follicles, nails, glandular epithelium), outer & inner ear, lens, cornea, & epithelium of several glands); **mesoderm**: forms all connective tissues, dermis of skin, skeletal, cardiac & most smooth muscle, blood, bone marrow & lymphatic tissue (also forms: endothelium of vessels, sclera & choroid of eye, middle ear, mesothelium & epithelium of several organs); **endoderm**: forms: epithelium of respiratory & GI tracts, epithelium of bladder, gallbladder & liver & epithelium of several glands
61. **neurulation**: differentiation of ectoderm (in response to signals from notochord) to form neural tube, which develops into brain & spinal cord
62. **somites**: formed from mesoderm; ***sclerotome***: produces vertebra & rib***; dermatome***: helps form dermis of skin; ***myotome***: forms skeletal muscles
63. **intermediate mesoderm**: forms gonads & kidneys***; somatic mesoderm***: helps form dermis, parietal serosa & bones, ligaments & dermis of limbs; ***splanchnic mesoderm***: forms heart, blood vessels & most connective tissue
64. ***ductus venosus***: liver bypass***; foramen ovale***: pulmonary circuit bypass from right atrium to left atrium; ***ductus arteriosus***: pulmonary circuit bypass from pulmonary trunk to aorta
65. **Fetal Ultrasonography**: sound waves passed over the abdomen & reflected by the fetus are converted to an on-screen sonogram image; **Amniocentesis**: amniotic fluid is withdrawn with a hypodermic needle inserted through the mother's abdominal wall & into the amniotic cavity within the uterus; **Chorionic Villi Sampling**: a catheter is guided through the vagina & uterine cervix to chorionic villi, & tissue is suctioned out for chromosomal analysis; ***maternal alpha-fetoprotein (AFP) test****:* serum levels of AFP in maternal circulation tested to check for potential fetal nervous system defects

66. **corpus luteum** secretes progesterone & estrogens during first 3-4 months; **placenta** secretes progesterone & estrogens from third month through end of pregnancy
67. ***human chorionic gonadotropin (hCG)*** from chorion stimulates hormone release from corpus luteum & prevents menstruation
68. **oxytocin**: causes placenta to release *prostaglandins*, both are uterine muscle stimulants that initiate contractions; ***oxytocin*** also causes *milk ejection* from mammary gland ducts; **prolactin** stimulates milk production from mammary glands
69. **crowning**: when largest dimension of baby's head distends vulva; ***vertex (head-first) presentation***: skull of baby dilates cervix; ***breech (buttock-first) presentation***: fetal buttocks or lower limbs enter birth canal first; ***Caesarian (C) section***: delivery of infant through abdominal & uterine walls
70. ***prolactin-releasing hormone (PRH)*** from ***hypothalamus*** stimulates ***anterior pituitary*** to release **prolactin**

Chapter 29: Heredity

71. ***alleles***: alternative forms of a gene that code for the same trait at the same location on homologous chromosomes; ***genotype***: genetic makeup for a trait or traits; ***phenotype***: physical or outward expression of a gene (appearance for a trait); ***homozygous***: an individual with the same alleles on homologous chromosomes***; heterozygous***: an individual with different alleles on homologous chromosomes; ***carrier***: heterozygous individuals that carry a recessive gene but do not express it, and can pass the gene on to their offspring
72. **incomplete dominance**: neither member of an allelic pair is dominant over the other, & the heterozygote has an intermediate phenotype between dominant & recessive phenotypes (example**: si*ckle-cell disease (SCD)***); **multiple-allele inheritance:** inherited traits with more than 2 alleles (example: ***ABO blood groups***); **codominance**: more than 2 alleles fully expressed (example: ***ABO blood groups***)