BIOLOGY TOPICAL:

Endocrine System
Test 1

Time: 21 Minutes*
Number of Questions: 16

* The timing restrictions for the science topical tests are optional. If you are using this test for the sole purpose of content reinforcement, you may want to disregard the time limit.

DIRECTIONS: Most of the questions in the following test are organized into groups, with a descriptive passage preceding each group of questions. Study the passage, then select the single best answer to each question in the group. Some of the questions are not based on a descriptive passage; you must also select the best answer to these questions. If you are unsure of the best answer, eliminate the choices that you know are incorrect, then select an answer from the choices that remain. Indicate your selection by blackening the corresponding circle on your answer sheet. A periodic table is provided below for your use with the questions.

PERIODIC TABLE OF THE ELEMENTS

1 **H** 1.0																	2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 39.9
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.8	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.5	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 **La *** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.0	89 **Ac †** 227.0	104 **Unq** (261)	105 **Unp** (262)	106 **Unh** (263)	107 **Uns** (262)	108 **Uno** (265)	109 **Une** (267)									

	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
*														
	90 **Th** 232.0	91 **Pa** (231)	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)
†														

GO ON TO THE NEXT PAGE.

Passage I (Questions 1–6)

The *corpus luteum* is the yellowish mass of cells formed from an ovarian follicle following ovulation. In the absence of fertilization, the corpus luteum normally disintegrates approximately two weeks after ovulation. If fertilization does occur, the developing embryo begins to secrete the peptide hormone *human chorionic gonadotropin* (*hCG*), which prevents regression of the corpus luteum. hCG also ensures that the corpus luteum continues to secrete progesterone until the second trimester of pregnancy, when the placenta becomes the primary source of progesterone secretion.

Both progesterone and estrogen are secreted at steadily increasing levels throughout pregnancy. The presence of high levels of estrogen and progesterone maintains the physiologic conditions required for pregnancy, and prevents ovulation by inhibiting the secretion of the pituitary hormones LH and FSH.

Home pregnancy tests are designed to detect hCG excreted in the urine. These tests typically contain two reagents, a suspension of latex particles covalently bound to hCG and a solution of hCG antibodies. To test for hCG, a drop of urine is mixed with a drop of the antibody-containing solution on a black slide. One drop of hCG-bound latex particles is then added. Agglutination (an antibody-antigen reaction) of the latex particles can easily be observed when a light source is illuminated against the dark background of the glass slide.

1. Removal of the ovaries in the fifth month of gestation would:

A. terminate pregnancy, because progesterone secreted from the ovaries is required for pregnancy in the fifth month of gestation.
B. terminate pregnancy, because LH secreted from the ovaries is required for pregnancy in the fifth month of gestation.
C. have no effect on pregnancy, because progesterone secreted from the ovaries is not required for pregnancy in the fifth month of gestation.
D. have no effect on pregnancy, because LH secreted from the ovaries is not required for pregnancy in the fifth month of gestation.

2. It can be inferred from the passage that very low levels of circulating estrogen and progesterone will:

A. not inhibit the secretion of LH and FSH, and consequently, not inhibit ovulation.
B. not inhibit the secretion of LH and FSH, and consequently, inhibit ovulation.
C. inhibit the secretion of LH and FSH, and consequently, not inhibit ovulation.
D. inhibit the secretion of LH and FSH, and consequently, inhibit ovulation.

3. Would the use of anti-estrogen monoclonal antibodies in an early-detection pregnancy test be appropriate?

A. Yes, because estrogen is not secreted at high levels in the absence of pregnancy.
B. No, because estrogen levels also rise to high levels prior to ovulation.
C. No, because steroid hormones are not excreted in the urine.
D. No, because antibodies only recognize protein ligands.

4. A woman suspects she is two months pregnant and her doctor therefore orders a blood test to screen for the presence of certain hormones. The presence of which of the following hormones at elevated levels would be consistent with pregnancy?

I. Estrogen and progesterone
II. LH and FSH
III. hCG

A. I only
B. III only
C. I and III only
D. I, II, and III

5. In theory, which of the following could NOT be used as a method of female birth control?

A. Prior to ovulation, inject monoclonal antibodies for estrogen and progesterone.
B. Prior to ovulation, inject compounds that mimic the activities of FSH and LH.
C. Prior to ovulation, ingest compounds that mimic the activities of estrogen and progesterone.
D. Prior to ovulation, inject inhibitors of FSH and LH.

GO ON TO THE NEXT PAGE.

6. Based on information in the passage, it can be inferred that agglutination in the pregnancy test indicates:

A. a positive test, because the hCG in the urine binds to the antibody, thereby preventing the hCG antibody from binding to the hCG-bound latex.
B. a positive test, because the hCG in the urine binds to the hCG-bound latex.
C. a negative test, because in the absence of hCG in the urine, the hCG antibody binds to the hCG-bound latex.
D. a negative test, because in the absence of hCG in the urine, the hCG antibody cannot bind to the hCG-bound latex.

GO ON TO THE NEXT PAGE.

Passage II (Questions 7–12)

Parathyroid hormone (*PTH*) regulates the extracellular concentration of both calcium (Ca^{2+}) and phosphate (PO_4^{3-}) via its action on bone, the gastrointestinal tract, and the kidney. PTH production is regulated by the Ca^{2+} concentration of the extracellular fluid bathing the cells of the parathyroid glands. When the concentration of Ca^{2+} is low, PTH is synthesized and released. When plasma concentration of Ca^{2+} is high, Ca^{2+} binds to receptors on the parathyroid glands, inhibiting PTH production.

There are four distinct effects of PTH production and release. First, it stimulates activity of bone cells known as *osteoclasts*. These cells stimulate the movement of Ca^{2+} from bone into extracellular fluid. Second, PTH increases renal tubular Ca^{2+} reabsorption. Third, it promotes the activation of vitamin D_3. Vitamin D_3 increases intestinal absorption of Ca^{2+} and PO_4^{3-}. Finally, PTH reduces renal tubular reabsorption of PO_4^{3-}. These effects are significant because, in humans, Ca^{2+} and PO_4^{3-} concentrations are held constant by the solubility characteristics of undissociated $Ca_3(PO_4)_2$. Thus, if there is an increase in the extracellular concentration of PO_4^{3-}, extracellular Ca^{2+} will deposit on bone, resulting in lower plasma Ca^{2+} concentrations.

Abnormal regulation of PTH production and secretion can lead to several disease states. *Hypoparathyroidism*, in which the parathyroid glands do not secrete sufficient PTH, can cause laryngeal spasms, which obstruct respiration and can lead to death.

7. A patient has undergone a *parathyroidectomy* (an operation in which the parathyroid glands are surgically removed). In comparison to a normal individual, the patient will have a(n):

A. lower plasma Ca^{2+}concentration.
B. lower plasma PO_4^{3-} concentration.
C. reduced secretion of thyroid hormone.
D. increased secretion of thyroid hormone.

8. A disease that causes dysfunction of the parathyroid glands results in an elevated extracellular Ca^{2+} concentration. This disease would most likely weaken the:

A. kidney.
B. gastrointestinal tract.
C. thyroid gland.
D. bones.

9. According to the passage, a low Ca^{2+} concentration stimulates the production and release of PTH. This is an example of:

A. negative feedback regulation.
B. positive feedback regulation.
C. cascade regulation.
D. second messenger regulation.

10. What would be the result of artificially reducing the extracellular concentration of PO_4^{3-}?

A. Osteoclast activity will decrease and then plasma Ca^{2+} concentration will increase.
B. Osteoclast activity will increase and then PTH production will decrease.
C. Extracellular Ca^{2+} will deposit on bone and then urinary Ca^{2+} concentration will decrease.
D. Extracellular Ca^{2+} will deposit on bone and then renal tubular reabsorption of Ca^{2+} will decrease.

11. One of the tide effects of an experimental drug is that the Ca^{2+} receptors located on the parathyroid glands are blocked. Which of the following would most likely occur after administration of this drug?

A. decreased plasma concentration of PTH
B. A decreased intestinal absorption of Ca^{2+} and PO_4^{3-}
C. An increased urinary concentration of Ca^{2+}
D. An increased urinary concentration of PO_4^{3-}

12. Administration of which of the following compounds would NOT help relieve the symptoms of hypoparathyroidism ?

A. 1,25-dihydroxycholecalciferol, the active form of vitamin D_3
B. Calcitonin
C. Ca^{2+}
D. PTH

GO ON TO THE NEXT PAGE.

Questions 13 through 16 are **NOT** based on a descriptive passage.

13. A patient who has gained 40 lbs in the past 3 months goes to her physician with complaints of fatigue. She is found to have a goiter and a decreased metabolic rate. Based on this information, the patient most likely has a deficiency of:

A. thyroxine.
B. aldosterone.
C. estrogen.
D. cortisol.

14. A radio-labeled hormone is added to a culture of liver cells. After a 4-hour incubation, the cells were separated, and the radioactivity was found to be primarily located in the nucleus. Which of the following conclusions about this hormone is most consistent with this observation?

A. It is a peptide hormone, because peptide hormones contain hydrophilic amino acids, which allow it to cross the nuclear membrane.
B. It is a peptide hormone, because peptide hormones function as transcriptional activators by binding to DNA.
C. It is a steroid hormone, because steroid hormones contain hydrophilic regions, which allow it to cross the nuclear membrane.
D. It is a steroid hormone, because steroid hormones function as transcriptional activators by binding to DNA.

15. The drug mevinolin is a potent inhibitor of *HMG CoA reductase*, the key enzyme in cholesterol biosynthesis. Patients taking this medication would most likely exhibit decreased production of all of the following hormones EXCEPT:

A. testosterone.
B. aldosterone.
C. insulin.
D. cortisol.

16. Following the ingestion of a glucose-rich meal:

A. glucagon secretion would increase, thereby lowering blood glucose concentration.
B. glycogen degradation in liver cells would increase, thereby lowering blood glucose concentration.
C. insulin secretion would increase, thereby lowering blood glucose concentration.
D. epinephrine secretion would increase, thereby lowering blood glucose concentration.

END OF TEST

THE ANSWER KEY IS ON THE NEXT PAGE

ANSWER KEY:

1.	**C**	6.	**C**	11.	**D**	16.	**C**
2.	**A**	7.	**A**	12.	**B**		
3.	**B**	8.	**D**	13.	**A**		
4.	**C**	9.	**A**	14.	**D**		
5.	**B**	10.	**B**	15.	**C**		

ENDOCRINE SYSTEM TEST 1 TRANSCRIPT

Passage I (Questions 1-6)

1. The correct answer is choice C. From introductory biology you should know that the ovaries are female endocrine organs that secrete estrogen and progesterone and produce the female gametes, the eggs, or ova. The other endocrine organs that secrete hormones that regulate the activities of the female reproductive system are the hypothalamus, which secretes gonadotropin releasing hormone, GnRH, and the anterior pituitary gland, which secretes luteinizing hormone, LG, and follicle-stimulating hormone, FSH. GnRH is the releasing hormone that stimulates the anterior pituitary gland to secrete FSH and LH. LH and FSH are involved in the regulation of gametogenesis and the menstrual cycle. So choices B and D can be immediately eliminated, since LG is secreted by the anterior pituitary, NOT by the ovaries. Now all you have to do is decide between choices A and C. The normal period of human gestation is nine months; the second trimester of pregnancy begins after the third month of pregnancy, and the third trimester of pregnancy begins after six months. So we know that the question is referring to the second trimester. And from the passage you know that the corpus luteum secretes progesterone until the second trimester, at which point the placenta takes over, continuing to secrete the progesterone necessary for the remainder of the pregnancy. So, obviously choice A is incorrect and choice C is the correct answer.

2. The correct answer is choice A. This is simply a verbal reasoning type question and everything you need to know to answer it is found in the passage. The passage states that the high levels of circulating estrogen and progesterone present during pregnancy PREVENT ovulation by inhibiting the secretion of the pituitary hormones FSH and LH. This is how birth control pills work. So from this information you can infer that LOW levels of estrogen and progesterone would NOT inhibit the secretion of FSH and LH, and consequently, ovulation WOULD occur. Thus, we can see that choice A is correct, and that choices B, C and D are incorrect. In fact you might recall that after menstruation, estrogen and progesterone levels are very low, and because of these low levels, the inhibition of FSH and LH secretion is removed. The subsequent rise in FSH and LH levels marks the start of a new menstrual cycle. Again choice A is the correct answer.

3. The correct answer is choice B. In order to answer this question correctly you needed to know how estrogen levels fluctuate during the menstrual cycle. Estrogen reaches high levels just PRIOR to ovulation, because secretion of estrogen by the ovarian follicle cells peak at this time. And maximal levels of circulating estrogen, in the absence of progesterone, actually causes maximal secretion of FSH and LH via a positive feedback mechanism. Don't panic if you are suddenly feeling confused. Yes, AFTER ovulation and during pregnancy, high levels of estrogen and progesterone--IN COMBINATION--cause a negative feedback inhibition of FSH and LG. But PRIOR TO ovulation, progesterone is not present at significant levels in the bloodstream. So prior to ovulation, we have a different situation in terms of LH and FSH regulation. Prior to ovulation, low levels of estrogen INHIBIT FSH and LH secretion, but high levels of estrogen STIMULATE FSH and LH secretion.

If you were able to follow this last discussion, you are well on your way to understanding how the menstrual cycle is regulated by the endocrine system. So now that this brief overview is over, let's get back to the question. As we just discussed, estrogen DOES reach high levels prior to ovulation. Therefore, you could not use estrogen detection as your basis for testing pregnancy, since both a pregnant woman and a non-pregnant woman could have high estrogen levels, depending at what stage of the menstrual cycle the non-pregnant woman was in. Therefore, choice A can be eliminated and choice B must be correct. Let's look at the other two choices. Steroids ARE excreted in the urine, but if you did not know this you could have figured it out by thinking about a medical practice that has been given a lot of attention in the media--namely, drug testing. Many athletes use anabolic steroids in order to give them an advantage in competition. And urine tests are used as a means of detecting these protein ligands. The antibody itself is composed of protein, but the ligand, which is what the antibody binds to, is not necessarily a protein. Again choice B is the correct answer.

4. The answer to this question is choice C. This is a Roman numeral type question so we should remember to use the appropriate strategy in choosing the correct answer. After we have read the question stem and all of the Roman numeral statements, we should eliminate all of the answers that are incorrect. All of the information you need to answer this question is contained in the passage. The passage tells you that hCG levels rise after fertilization and that the presence of hCG in the urine is the basis of some pregnancy tests. The passage also tells you that hCG is secreted until the second trimester of pregnancy, or the third month of pregnancy. Therefore we can conclude that between the first and third months of pregnancy, an hCG test COULD be used to indicate pregnancy, and therefore Roman numeral III is correct. So from this one piece of information we can eliminate choice A. The passage also tells you that high levels of estrogen and progesterone are present throughout the pregnancy. Estrogen and progesterone levels also rise during the menstrual cycle. Therefore high levels of these two hormones alone do not indicate pregnancy. However, in conjunction with the presence of hCG, high levels of estrogen and progesterone are consistent with pregnancy. Therefore Roman numeral I is also correct. Now we can eliminate choice B. Finally, the passage states that FSH and LH secretion is inhibited during pregnancy to prevent ovulation; thus, Roman numeral II must be incorrect. Therefore, the correct answer must be Roman numerals I and III only, so choice C is the correct answer.

5. The correct answer is choice B. From the question stem you know that you need to identify the answer choice that could NOT be used as a female contraceptive. With this in mind, let's look at the answer choices. Choice A suggests injecting monoclonal antibodies for estrogen and progesterone prior to ovulation. Well, what effect will this have? When antibodies bind to a ligand, which is the moiety that the antibody specifically recognizes and binds, the ligand is usually removed from solution or inactivated. In this case the ligands are estrogen and bound to large antibody molecules. So choice A is really addressing the effect of inactivating estrogen and progesterone with monoclonal antibodies. If estrogen and progesterone were inactivated, ovulation and pregnancy could not occur, because activity of these hormones is required for female reproductive function, as discussed in the passage. Thus choice A is incorrect because it COULD theoretically be used as a method of female birth control. As for choice B: If compounds were injected into the body that mimicked the activity of FSH and LH, pregnancy would NOT be prevented. Why? Because both of these hormones are required for ovulation, and neither hormone has negative feedback effects on estrogen and progesterone, which as discussed in the passage, are required for pregnancy. So, in theory, if FSH and LH analogs were injected, no conditions would be present that would prevent pregnancy. Therefore, choice B is the correct answer. Using similar reasoning we can also conclude that choice D is incorrect, because if FSH and LH activities are inhibited, then ovulation will not occur, and hence fertilization would be impossible. So choice D should make an effective female contraceptive. Choice C is also incorrect. In fact, choice C describes birth control pills. The reason that estrogen and progesterone can be used to prevent pregnancy is that these hormones have a negative feedback effect on LH and FSH and thereby prevent ovulation, as discussed in the passage. In fact, the estrogen and progesterone activities of the birth control pill trick the body into thinking that it is already pregnant, because ingestion of this pill leads to the high levels of circulating estrogen and progesterone that are characteristic of pregnancy. Again choice B is the correct answer.

6. The correct answer is choice C. This question is testing your understanding of the pregnancy test described in the passage. From the passage you should have inferred that if hCG is present in the urine, the pregnancy test will be positive, and if there is no hCG present in the urine, the test will be negative. You're told that in this test, a drop of urine is combined with a drop of hCG antibody solution. If hCG is NOT present in the urine tested, the hCG will remain available to bind with the hCG-bound latex particles, which are added subsequently. If hCG IS present in the urine, it will bind to the hCG antibody, and thus prevent the hCG antibody from binding to the hCG-bound latex particles added subsequently. Okay, but how does agglutination with the latex particles relate to all of this? Well, you're told in the passage that agglutination refers to the binding of the hCG antibody with the hCG-bound latex particles. And as we just discussed, hCG antibody can only bind to the hCG-bound latex particles if hCG is ABSENT from the urine. And if hCG is NOT present in the urine tested, then the test is said to be negative. Therefore, choice C is the right answer. The pregnancy test is said to be positive when agglutination does NOT occur. So choices A and B are wrong. And based on our discussion choice D is obviously incorrect and choice C is the correct answer.

Passage II (Questions 7-12)

7. The correct answer is choice A. To get this one right, you need to understand the basic function of parathyroid hormone, or PTH. The passage gives you all the information you need. PTH is produced by the parathyroid glands and one of its effects is the activation of osteoclasts. This increased osteoclast activity causes calcium to be released from bones, thus increasing plasma calcium concentration. In the question, however, you are told that the parathyroid glands were surgically removed. For this reason, the body will no longer be able to produce PTH. Our bodies are constantly using calcium, thereby depleting the available supply in our blood. If we do not replenish this supply, in time, plasma calcium concentration will decrease. If PTH production is halted, this calcium deficit cannot be erased and the patient will have a lower plasma calcium concentration, hence choice A is correct.

Now let's take a look at the other choices. Choice B is incorrect. Since phosphate concentration is inversely proportional to calcium concentration, decreasing calcium levels in the absence of PTH will cause a subsequent rise in phosphate concentration. Choices C and D are incorrect because PTH has nothing to do with thyroid hormone secretions. It affects parathyroid hormone levels. Thyroid hormone and parathyroid hormone are entirely different hormones with different actions and should not be confused. Once again, choice A is the correct answer.

8. The correct answer to this question is choice D. In order to answer this question correctly, you needed to infer from the passage that bone is the tissue primarily responsible for the storage and release of calcium ions. Even if you didn't infer this information from the passage you should have been able to figure it out. As a child you were probably told to drink your milk so you would have strong bones. And what does milk contain? Calcium and vitamin D_3, which is key to calcium absorption from the gut. Anyway, back to the question. So, if a disease causes an elevated plasma calcium concentration, calcium must be moving from the bones into the plasma. Although other conditions, such as renal failure or secondary hyperparathyroidism, lead to high plasma calcium, they do so through bone degradation. This means that osteoclast activity must be high. And from the passage you know that PTH stimulates osteoclast activity. Therefore patients with this disease most likely have elevated levels of PTH. And if there is excessive osteoclast activity due to excessive PTH, too much calcium is released from the bone into the plasma, thus degrading and weakening bone structure. For this reason, choice D is correct.

Choice A is incorrect because the kidney is not weakened by excessive plasma PTH levels. You're told that PTH increases renal tubular calcium reabsorption, and decreases renal tubular phosphate reabsorption. This causes increased urinary excretion of phosphate ions, and has the effect of lowering plasma phosphate ion concentration and raising plasma calcium ion concentration. However, these are normal functions of the kidney and although the kidney will work harder in the presence of extra PTH, the organ itself will not be degraded or debilitated in any way. Choice B is also incorrect. The intestinal tract is only involved in the absorption of both ions and, as with the kidney, it will simply be required to work harder. It will not be weakened in any way. As for choice C: The thyroid gland would increase its secretion of calcitonin, the hormone that decreases plasma calcium. Calcitonin and PTH are an example of antagonistic hormones. Once again, the correct answer is choice D.

9. The correct answer to this question is choice A. From the passage you know that a decrease in calcium concentration causes an increase in PTH. Conversely, an increase in calcium causes a decrease in PTH. And as you know from the passage, PTH will stimulate osteoclast activity, thereby increasing plasma calcium concentration. So you have a situation where the end product of a pathway, calcium, inhibits the starting point, PTH. So all you have to do is decide what type of regulation this is an example of. Here's where your outside knowledge comes into play. Negative feedback is a control mechanism whereby an increase in some substance INHIBITS the process leading to its increase. This sounds exactly like what we've just described. An increase in calcium inhibits PTH, which if released, would lead to a further increase in plasma calcium. Thus, choice A is correct. As its name implies, positive feedback is just the opposite--an increase in some substance STIMULATES the process leading to its increase. Since this is the opposite situation, choice B is incorrect. Choice C is incorrect, because cascade regulation involves a series of enzymes or hormones with each compound stimulating the production of the next. For example, if compound A increases, then compound A would stimulate the production of compound B, which would then stimulate the production of compound C and so forth. Choice D is also wrong. Second messenger regulation involves the binding of a hormone to a cell surface receptor. This binding typically leads to the activation of adenylate cyclase. The increased activity of adenylate cyclase increases the level of cyclic AMP in the cytosol. cAMP then acts inside the cell to alter the rate of one or more processes. Obviously PTH regulation by calcium does not involve a second messenger. Again, choice A is the correct answer.

10. The correct answer is choice B. From the question stem you know that the extracellular concentration of phosphate is artificially decreased. And from the passage you know that there is an inverse relationship between calcium and phosphate plasma levels due to a solubility equilibrium that exists between the two. This means that as plasma phosphate is reduced, plasma calcium will increase. Now that we know this, you know that in order for plasma calcium to increase, without ingesting a calcium-rich meal, calcium must move from bone into the plasma. Therefore you can eliminate choice A, because osteoclast activity will INCREASE, not decrease. And choices C and D can also be ruled out, since these choices suggest that calcium is moving from the extracellular fluid to the bone. So by the process of elimination, choice B must be the right answer. Let's just go over what will happen as a result of the increased plasma calcium due to increased osteoclast activity. Well, you know that a high plasma calcium concentration will block PTH production due to a negative feedback mechanism. Thus PTH production will decrease, inhibiting the very activities that raise plasma calcium in the first place. This reconfirms choice B as the correct answer.

11. The correct answer is choice D. Answering this question requires thinking of the sequence of events that would occur if calcium receptors on the parathyroid glands were blocked. It may be most useful for you to write out a simple chronology of the steps that would occur so that you may refer back to our own notes without getting confused. The reasoning behind this question is as follows: the drug binds to the calcium receptors on the parathyroid glands, thereby preventing calcium from binding. With no calcium bound, excess PTH is produced and secreted because the body is fooled into thinking that plasma calcium is low. Therefore, choice A is incorrect; there will be an INCREASED, not decreased, plasma concentration of PTH. Increasing PTH causes increased osteoclast activity, in addition to INCREASED intestinal absorption of calcium and phosphate. Therefore, choice B is incorrect. Also, tubular reabsorption of calcium will increase. Thus, extracellular plasma calcium will increase and urinary calcium concentrations will DECREASE. Therefore, choice C is incorrect. As noted in the passage, increased PTH production will also decrease tubular reabsorption of phosphate. This causes a decrease in plasma concentration of phosphate and an INCREASE in urinary concentration of phosphate. Thus, choice D is correct.

12. The correct answer is choice B. From the passage you know that hypoparathyroidism is a deficiency in PTH production and secretion. Since low amounts of PTH are produced, there is an abnormally low amount of plasma calcium and decreased renal tubular calcium reabsorption. Furthermore, there is decreased activation of vitamin D_3, and hence decreased intestinal absorption of calcium and phosphate, and increased renal tubular reabsorption of phosphate. Proper treatment of this condition may involve any means by which you can alleviate these symptoms. This question, however, wants you to choose the treatment that will NOT help this condition. With this in mind let's look at the answer choices. Choice D is obviously incorrect, because this is a direct infusion of PTH, the hormone that is under-secreted in hypoparathyroidism. Choice C is also incorrect. As we just mentioned, one of the problems of hypoparathyroidism is a decreased plasma calcium concentration. So supplementing a patent with calcium WILL help alleviate this symptom. Choice A is wrong because

adding active vitamin D_3 will increase intestinal absorption of phosphate and calcium. So by the process of elimination, choice B must be the only choice that will NOT help alleviate the symptoms of hypoparathyroidism. Calcitonin, you should remember, is a hormone produced by the body to counteract the effects of PTH. Calcitonin stimulates osteoblast activity, instead of osteoclast activity. Osteoblasts promote the deposition of calcium onto bones. This causes the build-up of bones, taking calcium out of the plasma. So administration of calcitonin to a patent with hypoparathyroidism would only lower plasma calcium concentration further. Thus, calcitonin WORSENS this condition; it does not help alleviate the symptoms. Therefore choice B is the correct answer.

Discretes (Questions 13-16)

13. The correct answer is choice A. Thyroxine is one of the thyroid hormones secreted by the thyroid gland and plays an important role in regulating metabolism. In adults, thyroid deficiency, or hypothyroidism, results in a decreased rate of metabolism, which in turn produces symptoms such as weight gain, fatigue, an intolerance to cold, and a swelling of the thyroid known as goiter. Because a decreased metabolic rate means that the body is using less energy per day, fewer calories are required in the diet. Thus, unless a hypothyroid patient changes her diet such that she decreases her daily caloric intake, she will gain weight. Why? Because these excess calories will be converted into fat. In response to the low thyroid hormone levels, the pituitary gland secretes thyroid-stimulating hormone, which triggers an increase in thyroid hormone production. However, if the thyroid is unable to increase its hormone synthesis, it will simply hypertrophy, or increase in mass, resulting in the goiter. Deficiencies in aldosterone, estrogen, or cortisol, choices B, C, and D, respectively, would not count for the symptoms experienced by the patient, and therefore should have been ruled out as possibilities. Again, the correct answer is choice A.

14. The correct answer is choice D. From the question stem you learned that the radio-labeled hormone winds up in the nucleus of the liver cells. Well, what type of hormones enter the nucleus? To figure this out let's briefly review the mechanisms of action for both steroid hormones and peptide hormones. Steroid hormones freely enter their target cells, where, after combining with an intracellular receptor, they exert a direct influence on the transcription of mRNA. Peptide hormones, on the other hand, combine with receptor molecules on the surface of their target cells' membranes. The hormone-receptor complex may be carried into the cytoplasm by receptor-mediated endocytosis, or the complex may trigger the release of a second messenger, such as cAMP. The second messenger, in turn, sets off a series of events within the cell that is responsible for the end results of hormone activity. Thus, peptide hormones do NOT influence the transcription of mRNA directly. In other words, peptide hormones do not enter the nucleus of their target cells and activate transcription. Therefore, choice B can be eliminated. On the other hand, steroid hormones DO directly influence transcription by binding to the DNA of their target cells and promoting transcription of specific genes. Therefore choice D is the correct answer. Choice A is incorrect because HYDROPHOBIC amino acids, not hydrophilic ones, are needed to cross a hydrophobic lipid bilayer such as the nuclear membrane. Remember, like dissolves like. And choice C is incorrect because steroid hormones are commonly derivatives of cholesterol, which are hydrophobic, not hydrophilic. Again choice D is the correct answer.

15. The correct answer is choice C. Mevinolin is a drug that competitively inhibits the enzyme HMG CoA reductase. This enzyme catalyzes the committed step in cholesterol biosynthesis. And if the committed step is blocked, cholesterol cannot be made. So what does cholesterol have to do with hormones? Cholesterol is the precursor of the five major classes of steroid hormones: progestagens, glucocorticoids, mineralocorticoids, androgens, and estrogens. So without cholesterol the steroid hormones cannot be synthesized. Therefore, all you have to do to answer this question is determine which one of the answer choices is NOT a steroid hormone. Testosterone, aldosterone, and cortisol are all steroid hormones. Therefore choices A, B and D are incorrect. Insulin is a peptide hormone, and therefore choice C is the correct answer. To arrive at this answer you had to know which hormones are peptide hormones and which ones are steroid hormones. There was one trick you could have used to at least help you make an educated guess. Testosterone and aldosterone both have the same suffix. So it would be pretty safe to guess that they are the same type of hormone. And since you need to find the one choice that doesn't belong, you should have been able to eliminate these two, raising your chances of getting this question right to 50%. Again, choice C is the correct answer.

16. Choice C is the correct answer. Following the ingestion of a lot of glucose, there will be an excess of blood glucose. Therefore the body will want to lower the blood glucose concentration. Thus, you can eliminate choice B because glycogen degradation will INCREASE blood glucose concentration, not decrease it, since glycogen is the storage form of glucose. Glucagon, which is secreted by the pancreas, stimulates glycogen breakdown and inhibits glycogen synthesis. In addition, glucagon stimulates gluconeogenesis (the synthesis of glucose) and inhibits glycolysis (the breakdown of glucose). Obviously, all of these actions serve to raise blood glucose levels, not lower them. Therefore, choice A can be eliminated. Insulin, which is also secreted by the pancreas, stimulates glycogen synthesis and suppresses gluconeogenesis, in addition to accelerating glycolysis. All of these processes LOWER blood glucose concentration. Therefore, choice C is correct. Epinephrine, which is secreted by the adrenal gland, stimulates the breakdown of glycogen, stimulates the secretion of glucagon, and inhibits the secretion of insulin. Epinephrine supplies the energy for the fight-or-flight sympathetic response.

So epinephrine secretion will increase blood glucose levels, not lower them. Thus choice D is incorrect. Again, choice C is the correct answer.