NTNU

Faculty of medicine
Department of Circulation and Medical Imaging

Exam MFEL3010
Medicine for students of natural sciences and technology

Friday May 31st 2013. 0900-1200

ECTS credits: 7.5
Examination support: None handwritten or printed except English dictionary (non-medical).

Simple calculator allowed

Answer on separate sheets (Only the answer sheets must be turned in)

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Examination results: June 21st 2013
Results are announced on http://studweb.ntnu.no/

There is only one answer per question. Each correct answer gives 2.5 points. There are no minus points for wrong or omitted answer. Limit for passing is ≥ 65 points.

1: The lungs have a state and size of equilibrium where there is a balance between elastic forces pulling the thorax wall outwards and the lungs inwards. Thus, we don't need to use respiratory muscle activity to maintain this state. The different volumes of the lungs can be described by dynamic and static lung volumes. What is the name of the total gas volume we have in this equilibrium state?

A Recidual volume (RV)
B Expiratory reserve volume (ERV)
C Functional recidual kapacity (FRC)
D Inspiratory reserve volume (IRV)

2: What is the function of the sodium-potassium pump?

A Transporting potassium and Sodium across the cell membrane from low to high concentration by utilizing the membrane potential
B Transporting potassium and Sodium across the cell membrane from low to high concentration by use of energy in the form of ATP
C Transporting of sodium and potassium from high to low concentration by facilitated diffusion.
D Equalize extracellular and intracellular concentration of Sodium and Potassium.

3: And what is the result of this process?

A Utilizing the concentration gradient of sodium and potassium for synthesis of ATP.
B The concentration gradient of potassium lead to a diffusion of potassium that is not followed by anionic diffusion, and this builds up a membrane potential
C As the concentration differences of potassium and sodium across the cell membrane are removed (equalized), the differences in protein anions will create a membrane potential.
D As the intracellular concentrations of sodium and potassium becomes equal, the membrane potential is determined by the concentration of calcium.

4: The kidney produces urine to get rid of waste products. What is the mechanism best describing how the "pre-urine" is produced in the glomerulus?

A Osmosis
B Filtration
C Electrostatic pressure
D Active transport

5: And how much pre urine is produced in all nephrons of both kidneys during 24 hours?

A Ca 1,6 litres
B Ca 3 litres
C Ca 20 litres
D Ca 180 litres

6: What is the effect of antidiuretic hormone?

A Facilitates active transport of water from pre urine
B Induces active transport of sodium from pre urine, and thus water follows passively
C Increases the permeability of water in the collecting ducts
D Inhibits emptying of the urinary bladder

7: The method called restriction fragment length polymorphism (RFLP) is used to:

A Increase the amount of DNA found in a small sample
B Increase the amount of DNA found in a degraded samples
C Break up the DNA-strand into smaller pieces to compare DNA from different sources
D To sequence the DNA on a base to base manner

8: Which characteristics of the hippocampus can be studied with MRI?

A 3D shape
B memory-related activation
C blood flow
D all of the above

9: The structural and functional organization of the human body can be described on several different levels. Cells are the basic unit of life, yet cells can differ fundamentally when it comes to form, protein and organelle content, and function. How can such differences between cell types be explained?

A Different cell types have different DNA
B Different cell types use different genetic codes
C Different cell types have different gene expression
D Different cell types use different alternative splicing after transcription

10: Where in thorax is the pressure lowest during inspiration?

A Trachea
B The bronchii
C The alveoli
D Pleura

11: Hypertension (high blood pressure) is an important risk factor for cardiovascular diseases like heart attack, stroke, etc. Which of the following is the most important <u>cause</u> of hypertension?

A Obesity (overweight, body mass index >30)
B Diabetes
C Smoking
D Hypercholesterolemia (high cholesterol level in the blood)

12: The blood pressure is usually measured by inflating a cuff around the upper arm, and then reducing the pressure gradually. Which of the statements below are correct in relation to this procedure?

A When the cuff pressure falls below the systolic artery pressure, the artery will just start to open.
B When the cuff pressure falls below the diastolic artery pressure, the artery will just start to open.
C When the cuff pressure falls below the systolic artery pressure, the artery is open during the whole heart cycle
D When the cuff pressure is zero, the blood flow in the artery starts.

13: The blood pressure is among other things regulated by peripheral resistance. Which vessels are responsible for most of this resistance?

A Arteries
B Arterioles
C Capillaries
D Venules

14: The ejection fraction is used a measure of ventricular function. However, this has some limitations. Endurance training increases left ventricular volume and reduces heart rate. A certain (male) endurance runner has an end diastolic left ventricular volume of 220 ml. During rest, he has a normal cardiac output of 4.7 litres /min with a heart rate of 45 beats / min. What is the resting ejection fraction?

A 89%
B 53%
C 47%
D 35%

15: During exercise, the runner in Q 14 has the ability to increase the ejection fraction to 82%. End diastolic volume does not increase during exercise in the healthy. His maximal heart rate is 185 beats / min. What is his maximal cardiac output?

A 7 l/min
B 16 l/min
C 33 l/min
D 39 l/min

16: Endurance training increases the maximal oxygen uptake. What is the factor that is increased by training, and thus responsible for increased fitness?

A The Hemoglobin
B The Arterial oxygen saturation (meaning more efficient oxygenation by the lungs)
C The maximal heart rate
D The maximal stroke volume

17: Maximum oxygen uptake (VO_{2max}) is a measure of aerobic fitness. Oxygen uptake is related to cardiac output by the formula: CO = VO_2 x O_2 extraction. During maximal exercise, the oxygen extraction (= arteriovenous O_2 difference) may be as high as 90% (i.e. arterial oxygen saturation of 100%, venous saturation of 10%). One gram of hemoglobin binds 1.4 ml O_2. Given a body weight of 85 kg and hemoglobin of 15.4 g/dl, and maximal cardiac output as given in Q 15, what is then his VO_{2max}?

A 99 ml/kg/min
B 89 ml/kg/min
C 75 ml/kg/min
D 68 ml/kg/min

18: A certain clinical study shows treatment 1 to be better to reduce the mortality (number of deaths) than treatment 2 for a certain disease with a p value (significance) of 5%. What does this mean?

A The probability of dying of the disease with treatment 1 is 5% lower than with treatment 2
B The number needed to treat the disease with treatment 1 instead of treatment 2, in order to reduce the number of deaths by one patient, is 5
C The difference may be real, with a probability of 95%
D The difference may be real, but only with a probability of 5%

19: For a treatment result to be significant, what is the customary limit for the p value?

A 2.5%
B 5%
C 10%
D 20%

20: The study power was calculated, and was found to be only 70% for the patient number and significance level of 5%. What does that mean?

A That only 70% of the patients would profit from treatment 1 over treatment 2
B That 70% of the patients would survive with treatment 1, as opposed to only 30% with treatment 2
C That there was only 70% probability of achieving a p value of 5%, even if the difference was real
D The difference may be real, but only with a probability of 70%

21: A recent study of different measures of left ventricular function gave the following results for mean values in the (healthy) study group: Mean ejection fraction 59%, mean systolic shortening of the left ventricle: 17 mm, mean systolic tissue velocity: 9.1 cm/s and mean systolic strain rate (shortening velocity per length unit) – 1.1 s^{-1}

To compare the usefulness of the different measures, we look at the reproducibility of the results, doing repeated measurements. Which measure of repeatability would be best here for comparison of the accuracy of the different measures?

A Limits of agreement
B Correlation
C Mean error
D kappa coefficient

22: Ultrasound Doppler can measure blood velocity. We are interested in measuring the blood velocity at a certain depth. This is done by pulsed Doppler. How is the depth selectivity achieved?

A By varying the frequency in the transmitted signal
B By varying the total energy in the transmitted signal
C By selecting the reflected signal at a certain time after the pulse is sent out (time gating)
D By selecting a certain frequency in the reflected signal (frequency gating)

23: Which of these factors are important for the resolution in an ultrasound image?

A The wavelength
B The frequency
C The probe aperture size
D All of the above

24: What are the main biological effects of MR?

A Chemical, due to ionization
B Chemical, due to free radical formation
C Thermal (i.e. tissue heating)
D Cellular, due to mechanical cell disruption

25: What is the principle of PET (positron emission tomography) scan?

A Gamma rays are emitted directly by a radioisotope injected into the body, and are detected by a ring of detectors around the patient. The concentration of the isotope is mapped by the intensity of radiation in the cross section.
B Positrons are emitted by a radioisotope injected into the body, and are detected by a ring of detectors around the patient. The concentration of the isotope is mapped by the intensity of radiation in the cross section.
C Positrons are emitted by a radioisotope injected into the body, travels only a micro distance before being annihilated by collision with an electron. This produces two gamma photons in opposite directions that are detected by a ring of detectors around the patient. The concentration of the isotope is mapped by the intensity of radiation in the cross section.
D Positive alpha particles are emitted directly by a radioisotope injected into the body, and are detected by a ring of detectors around the patient. The concentration of the isotope is mapped by the intensity of radiation in the cross section.

26: A researcher has performed a radioimmunoassay. The setup includes standards, a negative control, a positive control and 50 samples from an experiment. Upon evaluating the results, she finds that the negative control is higher than the predefined limit. What is the best conclusion she can draw?

A The setup is reliable if the positive control is OK
B The setup is OK if the sample results seem reasonable
C The negative control should be repeated before the conclusion is drawn
D The entire setup should be discarded and repeated

27: What is an oncogene?

A A gene that codes for enzymes that repair damaged DNA
B A gene that regulates cell growth and death
C A mutated growth regulator gene
D A gene giving the cancer cells ability to break down connective tissue to facilitate metastasis.

28: You happen to be admitted to the cardiology department for chest pain and palpitations (a noticeably rapid, strong, or irregular heartbeat due to agitation, exertion, or illness) and is being examined by Dr. Asbjørn Heart, a consultant in cardiology. Upon completion of the examination, he uses an Electronic health record system to prepare a clinical note. You suffer from atrial fibrillation. You are put on a anticoagulant (a substance having the effect of retarding or inhibiting the coagulation of the blood), discharged from the hospital the next day, and scheduled for a follow-up with Dr. Heart within three weeks.

Five days later, you develop a nose bleeding (that might be related to the use of the anticoagulant). You rush to visit your primary care physician (fastlege). He queries his primary care EHR-system, but cannot find any discharge letter from the hospital, and is not aware that you are using an anticoagulant. He seeks to find out by making a phone call to Dr. Heart.

Which of the following clinical purposes of Electronic health record (EHR) systems applies to the situation of your primary care physician?

A EHR systems shall facilitate the clinical care of individual patients by making information available to others with access to the record system who are involved in the care of the same patients.
B EHR systems shall facilitate the clinical care of individual patients by providing information for inclusion in other documents (e.g. laboratory requests referrals and medical reports).
C EHR systems shall facilitate the clinical care of individual patients by providing information to patients about their health and health care.
D EHR systems shall facilitate the clinical care of individual patients by storing information received from other parties or organizations (e.g. laboratory results and letters from specialists).

29: Which hardware component in an MR system enables spatial encoding of the signal?

A The main superconducting magnet.
B The radiofrequency antennas/coils.
C The gradient coils.
D The computer.

30: The stomach epithelium secretes hydrochloric acid into the lumen, making the contents very acidic. What is the function of this low pH?

A It stimulates the secretion of gastrin, in order to facilitate digestion by increasing the secretions in the duodenum.
B It activates and optimizes the Pepsin action of digesting proteins in the stomach
C It acts by emulsifying fat in the watery solution
D It is necessary to neutralize the bicarbonate that is secreted in the duodenum by the pancreas

31: 7 – 9l water per day enters the digestive system from food, drink and from local secretion. Only 1 – 2 dl is excreted in the feces. Where is the main part absorbed?

A The Esophagus
B The stomach
C The small intestine
D The large intestine

32: In diabetes glucose is found in the urine as a sign of elevated blood sugar. What is the mechanism for this?

A Glucose is normally not filtrated in the urine, only in elevated blood sugar.
B In elevated blood sugar, the renal capacity for reabsorption is exceeded by the urine concentration of glucose
C In elevated blood sugar the excess amount of sugar is actively secreted in the urine
D In elevated blood sugar the epithelium becomes permeable for glucose

33: And what will happen if there are large amounts of glucose in the urine?

A The amount of urine (water) will increase due to the osmotic effect of the glucose
B The amount of urine will decrease, as the active reabsorption of glucose going at maximal capacity will reabsorb a larger volume of water through osmosis
C The amount of urine (water) will decrease as the tubuli are filled with glucose replacing the water
D The amount of urine is unchanged.

34: A blood vessel has a narrowing in a short segment. What will always happen to the blood dynamics in this narrow segment? (Velocity: meters/sec, Flow: litres/min)

A The blood velocity increases
B The blood velocity decreases
C The blood flow increases
D The blood flow decreases

35: Mean incidence of influenza in Norway in week 8 in 2012 was 3%. We may consider that the duration of influenza to be on the average 5 days for that epidemic. What was the mean prevalence of influenza during that week?
A) 2.1%
B) 3%
C) 6%
D) 14%

36: A 50 year old man with no symptoms want a checkup to be sure he doesn't have coronary heart disease, for safety's sake. He went to a private specialist centre in order to have a test, and had a stress echocardiography. The risk of having significant coronary disease in men without symtoms at that age may be assumed to be 4%. Stress echo has a sensitivity of about 80%, and a specificity of 90%. This may be expressed in the following 4x4 table:

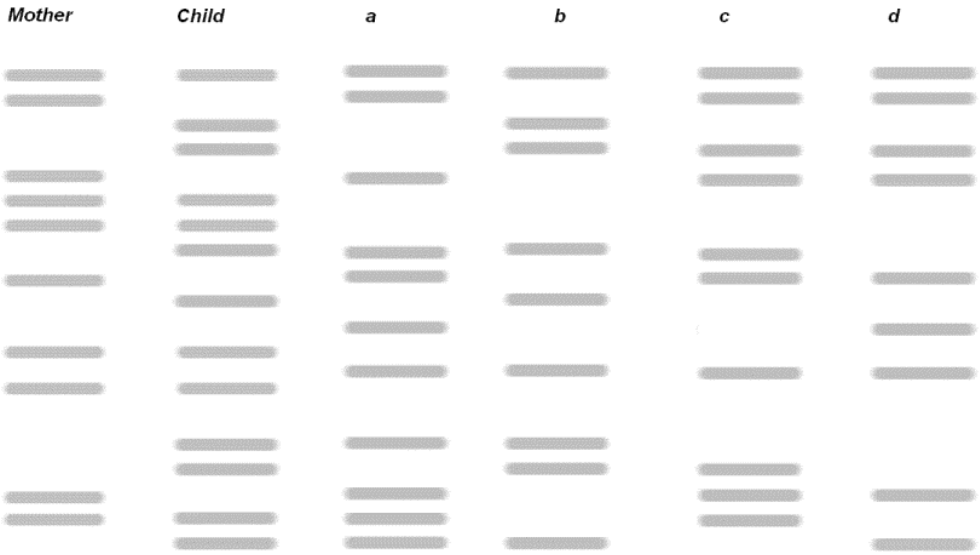
Probability of	Positive test	Negative test	Total
healthy	9.6%	86.4%	96%
ill	0.8%	3.2%	4%
Total	10.4%	89.6%	100%

If the test shows a positive result (meaning it indicates coronary disease), what is the positive predictive value of this test (the probability that he really is ill)?
A) 1.3%
B) 6.2 %
C) 7.7%
D) 9.4%

37: If the test shows a negative result (meaning it doesn't indicate coronary heart disease), what is the negative predictive value of the test (the probability that he really is healthy)?
A) 99.8%
B) 96.4%
C) 90.0%
D) 85.6%

38: Anemia is a state of reduced hemoglobin content of the blood. What dietary requirement is essential for normal hemoglobin?
A Calcium
B Magnesium
C Iron
D Iodine

39: In a paternity case, there are four possible fathers (a, b, c and d). A DNA test is done, which of the four candidates is the most probable father?



A) a
B) b
C) c
D) d

40: The main part of the DNA in the cell is found in the nucleus. What other organelles do also contain DNA?
A) The Golgi apparatus
B) The endoplasmic reticulum
C) The centrosomes
D) The mitochondria

Answers:

1C	2B	3B	4B	5D	6C	7C	8D	9C	10C
11A	12A	13B	14C	15C	16D	17C	18C	19B	20C
21C	22C	23D	24C	25C	26D	27C	28D	29C	30B
31C	32B	33A	34A	35A	36C	37B	38C	39B	40D