NTNU – Trondheim
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Department of Circulation and Medical Imaging

Examination paper for MFEL3010 (Medicine for students of natural sciences and technology)

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Permitted examination support material: Simple calculator

Other information: Only the enclosed answer sheets is to be delivered, the question sheets is to be kept for the student's own reference.

Language: English

Number of pages (question sheets) including front page: **9**

Number of pages (answer sheets) enclosed: **3**

Checked by:

Date Signature

1. In a case-control study of the association between an exposure and a disease;

A the controls should not be exposed

B 10% of the controls should be exposed

C the controls should represent the distribution of the exposure in the population that the cases come from

D the controls should be matched to the cases so that the exposure is similar between cases and controls

2. How can confounding change the effect estimate (e.g. a relative risk) of a cohort study? The effect estimate

A can become either too large or too small

B can only become too large

C will not change

D will not change if the study is large enough

3. 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. Proteins in the urine give a high osmotic pressure gradient that "drags" fluid Into the urinary space

B. High hydrostatic pressure in the blood "push" fluid into the urinary space

C. The high concentration of albumin, which is negatively charged, "push" waste product with a negative charge into the urinary space.

D. Waste products in the blood are actively transported from the blood into the urinary space with active pumps at the glomerulus basal membrane.

4. 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

5. Each of our cells is like a tiny factory where thousands of chemical reactions take place every day in separate and specialized organelles, of which the ribosomes are one type. - What is the major function of this particular organelle?

A. Protein synthesis

B. Protein modification

C. Protein collection

D. Protein package

6. 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-1To 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

7. The meshwork that forms the fabric of a blood clot is:

A. chymotrypsin.
B. fibrin.
C. thrombin.
D. collagen.

8. Antihistamine treatment reduces:

A. blood vessel dilation.
B. phagocytosis of antigens.
C. MHC presentation by macrophages.
D. the secondary immune response.

9. What is the origin of the signal in clinical magnetic resonance imaging?

A. Iron ions.
B. Hydrogen nuclei (protons).
C. Water molecules.
D. Injected magnetic particles.

10. What do we mean by T1-relaxation in MRI?

A. The regrowth of longitudinal magnetization towards the thermal equilibrium value.
B. The loss in phase coherence after application of an rf-pulse.
C. The loss in transverse magnetization.
D. The loss of longitudinal magnetization when applying an rf-pulse.

11. 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.

12. The most important single factor for regulation of the ventilation is:
A. Low oxygen saturation of the blood
B. Low pH in the blood
C. High CO_2 content of the blood
D. Low oxygen content in the alveolar air

13. Kidney transplantation is over all the best treatment of serious terminal renal failure, although not without side effects.. Which of the following statements are **NOT** correct?
A. Transplantation is cheaper than dialysis in the long term
B. Transplantation gives better quality of life than dialysis
C. Transplantation gives more problems with hypertension, as the patients must use many medicines that may increase blood pressure
D. Transplantation gives better survival

14. It is possible to open the bile ducts down to the intestine and remove stones from the duct with an endoscope. To open the bile duct one uses:
A. A thin knife through the endoscope
B. A thin metal tread with electrical current through the scope
C. An inflatable balloon through the scope
D. Injection of a medicine through the scope

15. One of these factors is of central importance in the development of *all* cancer tumours.
A. Changed cellular metabolism
B. Changed cellular glucose uptake
C. Accumulation of mutations
D. Accumulation of waste products

16. Compared to cohort studies, what is a major limitation of the case-control design in the study of a causal relation between a factor (= exposure) and a disease (= outcome)?
A. A case-control study is more expensive and takes longer time
B. There may be bias (= systematic error) in the measured presence or absence of the suspected factor (exposure)
C. There may be bias (= systematic error) in the measured presence or absence of the resulting outcome (disease)
D. It is difficult to identify (ascertain/skaffe) appropriate controls

17. The Polymerase chain reaction (PCR) is a method that:
A. Uses restriction enzymes to split the DNA into smaller pieces
B. Amplifies small amounts of DNA into several thousand copies
C. Separates DNA fragments based on size
D. Visualise DNA fragments in a gel by a fluorescence dye

18. The cell (division) cycle is the series of events in a cell between one cell division and the next, leading to its division and replication. The cycle consists of several distinct phases, where one of the phases is called S (synthesis) phase. - What is the most important event that happens in this phase of the cell cycle?

A. DNA replication
B. Cytokinesis
C. Mitosis
D. DNA repair

19. 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.

20. 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 f 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.

21. As muscle relaxes, the relaxation itself is an energy demanding process, meaning that a contracted muscle will not relax if the cell is depleted of energy. What is the energy demanding process in the cell responsible for relaxation?

A The active elongation of the cell, as the actin – myosin cross bridges turns the other way, pushing action and myosin from each other.
B The uncoupling of actin-myosin cross bridges
C The restoration of the normal resting membrane potential.
D The active removal of calcium from the cytoplasm

22. Where is the regulatory centre for respiration situated in the nervous system?

A The sympathetic ganglia
B The brain stem
C The cerebellum
D The basal ganglia

23 Which of these factors are important for the resolution in an ultrasound image?
A Only the wavelength
B Only the frequency
C Only the probe aperture size
D All of the above

24 What are the main biological effects of diagnostic ultrasound?
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 Diagnostic ultrasound used in the heart has a frequency around 2 MHz. What approximate wavelength does this frequency correspond to?
A 0.17 mm
B 0.77 mm
C 7.7 mm
D 17 mm

26 What is the reason Technetium can be used for imaging of so many different organs?
A Because technetium is so reactive, it will react with molecules in most cells when injected
B Because Technetium emits so many different wavelengths, depending on the tissue composition, making it possible to select the wavelengths from different tissues with adjustment of the gamma camera
C Because technetium has different isotopes with affinity for different tissues
D Because technetium is so reactive, it can be bound to many different chemical compounds that have affinity for different tissues

27 The aortic valve may be calcified and narrow due to disease. What happens to the blood dynamics through that valve during systole? (Remember: 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

28 And what <u>imaging</u> modality would be most useful in showing this effect?
A Pet scan
B CT
C Ultrasound M-mode
D Ultrasound Doppler

29 The ejection fraction is used a measure of ventricular function. An endurance athlete has an end diastolic left ventricular volume of 250 ml. During rest, he has a normal cardiac output of 5.5 litres /min with a heart rate of 42 beats / min. What is the resting ejection fraction?

A 66%
B 59%
C 52%
D 48%

30 We do a heart catheterization at rest (cardiac output is the same as in 29), and measure a hemoglobin of 16.5 g/dl, an arterial oxygen saturation of 100%, and a mixed venous saturation of 70%. One gram of hemoglobin binds 1.4 ml of oxygen. The patient weighs 82 kg. What is his oxygen uptake during the procedure?

A 3,5 ml/kg/min
B 4,6 ml/kg/min
C 10,8 ml/kg/min
D 15,5 ml/kg/min

31 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 20%. What does this mean?

A The probability of dying of the disease with treatment 1 is 80% lower than with treatment 2
B The numbers needed to treat the disease, in order to reduce the number of deaths by one, is 80% higher with treatment 1 instead of treatment 2.
C The difference may be real, with a probability of 80%
D The difference may be real, with a probability of 20%

32 The study power was calculated, and was found to be only 60% for the actual patient number and the desired significance level of 5%. What does that mean?

A That only 60% of the patients would profit from treatment 1 over treatment 2
B That 60% of the patients would survive with treatment 1, as opposed to only 40% with treatment 2
C That there was only 60% probability of achieving a p value of 5%, even if the difference was real
D That there was only 40% probability that the difference was real

33 Mean incidence of a virus epidemic in Trondheim in in a certain week was 10%. On the average 3.3% of the people were ill each day. What was the average duration of the disease?

A one day
B two days
C three days
D Four days

34 Ejection fraction measured by ultrasound has a high variability. Limits of agreement are ± 10% points. A patient who has had a small infarct had an ejection fraction of 53% (near normal) when he left the hospital. Two months later, he was admitted because of dyspnea, but had no new infarction. During the second stay, a new echocardiography was made, and they now found an EF of 41%. The diagnosis of worsening heart failure (HF) was made, and medical treatment for heart failure was started. The conclusion that the patient had worsening heart failure was:

A Correct because the EF was below 45%
B Correct because the EF had dropped by 12% points
C Incorrect because a change of 12% points is not a significant change with this method
D Incorrect because an EF of 41% is not compatible with heart failure.

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

36 Hypertension is a risk factor for stroke and heart infarction. What's the limit between high normal blood pressure (prehypertension) and manifest hypertension (stage 1)?

A 120/80
B 140/90
C 160/100
D 180/110

37 What is the sensitivity of a certain diagnostic test?

A The probability of having a positive test if you are ill
B The probability of having a negative test if you are healthy
C The probability of being ill if you have a positive test
D The probability of being healthy if you have a negative test

38 Anaerobic respiration is a process where glucose is metabolised to lactic acid, producing a small amount of ATP. Where in the cell does this process take place?

A The cytoplasm
B Smooth endoplasmatic reticulum
C The Golgi apparatus
D The mitochondria

39 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

40: A marathon runner wants to increase his oxygen uptake by increasing his hemoglobin as much as possible. How can he achieve this in an efficient manner?

A Only by taking iron injections s
B Only by taking vitamin B12
C Only by erythropoietin injections
D All of the above

Answers:

1C 2A 3B 4C 5A 6A 7B 8A 9B 10A 11B 12C 13C
14B 15C 16B 17B 18A 19B 20B 21D 22B 23D 24C 25B 26D
27A 28D 29C 30B 31C 32C 33C: This question was wrongly formulated in the original exam paper, and was omitted from the evaluation, here is given the correct question and answer. 34B 35A 36B 37A 38A 39C 40C