



NTNU – Trondheim
Norwegian University of
Science and Technology

Department of Circulation and Medical Imaging

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

Academic contact during examination: Asbjørn Støylen

Phone: 48108880

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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. Where is DNA located in the cell?

- A In the cell nucleus
- B In the cell nucleus and the ribosomes
- C In the cell nucleus and the sarcoplasmic reticulum
- D In the cell nucleus and the mitochondria

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. “The central dogma of molecular biology” says something about the flow of genetic information in living organisms. - What is the direction of this flow?

- A. The flow is unidirectional; RNA – DNA – protein
- B. The flow is reversible; RNA – DNA – protein
- C. The flow is reversible; DNA – RNA – protein
- D. The flow is unidirectional; DNA – RNA – protein

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. The hemoglobin molecule is the body's most important carrier of oxygen in the circulation. Which of the following factors affects the hemoglobin's *capacity* for binding oxygen?
- A. The alveolo capillary membrane
 - B. The arterio venous O₂ difference
 - C. The pH of the blood
 - D. The cardiac output

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 CO₂ 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 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** The wavelength
 - B** The frequency
 - C** 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 imaging modality would be most useful in showing this?

- A** Pet scan
- B** CT
- C** Ultrasound B-mode
- D** Ultrasound Doppler

29 The ejection fraction is used a measure of ventricular function. A patient with heart failure has an end diastolic left ventricular volume of 250 ml. During rest, she has a normal cardiac output of 4.5 litres /min with a heart rate of 92 beats / min. What is the resting ejection fraction?

- A** 49%
- B** 36%
- C** 24%
- D** 20%

30 We do a heart catheterization at rest, and measure a hemoglobin of 13.5 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 67 kg. What is her oxygen uptake during the procedure?

- A** 3,5 ml/kg/min
- B** 3,8 ml/kg/min
- C** 8,9 ml/kg/min
- D** 12,7 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 15%. What does this mean?

- A** The probability of dying of the disease with treatment 1 is 15% 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 15
- C** The difference may be real, with a probability of 85%
- D** The difference may be real, with a probability of 15%

32 The result were a little disappointing, as we like the significance level of a clinical study to be below 5% for the result to be useful. So the study power was calculated, and was found to be only 60% for the patient number and 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 6%. On the average 1.7% 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 $\pm 10\%$ points. A patient who has had an infarct had an ejection fraction of 45% (slightly reduced) 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 38%. 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 40%
- B** Correct because the EF had dropped by 7% points
- C** Incorrect because a change of 7% points is not a significant change with this method
- D** Incorrect because an EF of 38% 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?

- A By taking iron supplies as pills
- B By taking iron injections
- C By taking vitamin B12
- D By taking erythropoietin injections

Answers

1C 2A 3D 4C 5A 6D (The whole chain must be taken into consideration)
7B 8A 9B 10A 11C 12C 13C 14B 15C 16B 17B
18A 19B 20B 21D 22B 23D 24C 25B (In diagnostic ultrasound, it is the tissue velocity that matters) 26D 27A 28D 29D 30B 31C 32C 33B 34C
35A 36B 37A 38A 39C 40D: This question was incorrectly formulated in the original exam, and thus omitted from the score). Here a correct formulation with answer is given.