

Obafemi Awolowo University, Ile-Ife
Department of Microbiology
2010/2011 Rain Semester Examinations

Analytical Microbiology and Quality Control (MCB 404)

December , 2011

Answer all Sections in separate booklets provided

Time Allowed: 3 h

Important Notice

ACADEMIC INTEGRITY: Requires you to uphold a high standard of honesty in this examination and eschew cheating in whatever form. Some examples of violations of this requirement are: using notes, handouts or books; looking at another person's answer booklet; knowingly allowing another student to look at your answer booklet; and, verbally exchanging information with another student etc. You are strongly advised to simply put in your best and leave the rest!

SECTION A

Shade the most correct option (a-e) on the answer sheet provided

1. What is the attribute of a microscope whose function is the ability to distinctly show two separate parts that are close together?
a. Numerical aperture b. Brightness c. Lens resolution d. object definition e. Magnification
2. Condenser assembly is an essential part of a light microscope. Which of the following does not explain its relevance?
a. it comprises of carefully arranged lens b. it comprises of iris diaphragm and filter
c. the intensity of light is regulated d. rays of the same wavelength are selected
e. transmitted rays are concentrated
3. How would you define numerical aperture?
a. diameter of objective lens b. ratio of tube length of the eye piece to upper length of the objective
c. focal length of the objective d. ratio of the diameter of the lens to the focal length e. ratio $\sin \theta_2$ to θ_1
4. Why are lenses made of components cemented together with interfaces rarely being exactly spherical?
a. to relax dependence on paraxial rays for brightness and improvement of image quality.
b. so that rays may not be paraxial c. to enhance production of paraxial rays
d. to take the wave nature of light into account
e. to compensate for imperfections in the design of high-quality equipment
5. Simple microscopes are fitted with plane mirrors so that
a. refractions can be used to analyse light into its component wavelengths
b. the index of refraction of one medium with another can vary with wavelengths
c. images can be made virtual, erect and of the same size as the object
d. the left and right are inter-changed in image with respect to the object
e. images can be real but inverted because light passes through them
6. In addition to the lens construction, a factor that affects numerical aperture is
a. the medium through which the light passes b. the wavelength of the light used
c. the light intensity d. the thickness of the specimen e. the diameter of the specimen

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7. In real-life optical devices where image replica and scaling up/down are desired, which of the following does not explain the imperfections referred to as aberrations?
a. object is not usually a plane but we want to record image on a plain photographic film
b. a pair of objects produces a power image only approximately
c. refracting properties of the lens material vary with wavelength
d. none of the listed e. geometric optics assures the light travels in a straight line and which does not
8. In a typical microscope, the lens cannot be considered as "thin" because
a. lenses are made of several components cemented together b. it holds only as an approximation
c. the rays produced may not be paraxial d. it greatly relaxes the dependence on paraxial rays
e. the thin lens formula applies for simplicity of illustration only
9. The numerical aperture cannot be greater than one if the objective lens is separated from the object by air. How can it be raised?
a. immerse in a liquid of higher refractive index than that of air b. select and use oil immersion lens
c. choose appropriate ocular lens d. increase field depth e. decrease field depth
10. The pH meter consists essentially of three major sections namely
a. reference, indicator and glass electrodes b. internal reference electrode, power supply and pH indicator
c. electrodes, amplifier, and pH indicator/recorder
d. glass electrode, a potentiometric device and pH assembly e. amplifier, power supply and the electrode
11. The pH electrode that is best described as consisting of an internal reference electrode, internal solution of AgCl covering electrode and stem-filling solution of HCl or KCl is the electrode
a. reference b. indicator/glass c. combined d. glass e. mercury
12. The electrical path between the glass/indicator and reference electrodes is completed when both are immersed in the test solution which acts as a/an
a. voltage drop in the feedback resistor b. current c. H^+ activity d. electrical cell e. variable resistor
13. Which of the following standard solutions are required to calibrate a pH meter?
a. pH 4.0, 7.0 and 9.2 b. pH 7.0 only c. pH 4.0 and 9.2 only d. pH 9.2 only e. pH 4.0 only
14. The principal requirements for standardization of pH of samples/solutions are
a. 1N HCl, 1M NaOH b. 0.1N HCl, 0.1M NaOH c. 0.1M HCl, 0.1M NaOH
d. conc. HCl and NaOH e. 1M HCl, 1M NaOH
15. Two main types of balances are
a. electromagnetic, analytical b. single pan, twin pan c. micro, analytical
d. mechanical, electronic e. top-loading, micro
16. Using the balance, the weight of samples are determined by means of a mechanical system which usually involves the displacement of external and internal standard weights?
a. electronic b. micro c. analytical d. spring e. mechanical
17. Two main types of mechanical balance are
a. electronic, analytical b. single pan, twin pan c. micro, analytical
d. mechanical, electronic e. top-loading, micro
18. A cooling system consists in series of major components namely
a. compressor, refrigerant, condenser b. condenser, refrigerant, compressor
c. evaporator, condenser, compressor d. compressor, condenser, refrigerant control
e. refrigerant control, evaporator, condenser
19. A substance which disperses in the air in a fuming divided form is a/an
a. gas b. oxidizing agent c. dust d. reducing agent e. explosive

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20. What class of fire hazard could arise from high tension, wrong general installations, over-loading and earth electrical connections?
a. class A b. class B c. class C d. class D e. class E
21. What hazard could result from drowning, poisoning, suffocation and electric shock?
a. nausea b. upset of the nervous system c. inflamed lips and throat d. asphyxia e. convulsion
22. Injuries caused by flames, hot objects/electricity, acids, alkalis and corrosive chemicals are generally referred to as
a. shocks b. burns c. asphyxia d. cuts/wounds e. poisoning
23. encountered in the laboratory can be treated by Silvester and direct insufflation methods.
a, poisoning b. electric shock c. nausea d. convulsion e. asphyxia
24. What would you do to correct for a mixture of air and steam which yields a lower temperature at a given pressure in an autoclave?
a. close the air valve immediately the lid was tighten up
b. open the air valve immediately the lid was tighten up to expel air
c. open the air valve after the heating cycle has been completed to expel air
d. leave the air valve closed after the heating cycle for the pressure to come down to zero
e. leave the air valve open to admit steam to the pressure level
25. Which of the health and safety in the laboratory Acts stresses the use of standard colours and signs?
a. Factories Act, 1961 b. British Act, 1974 c. Fire precaution Act, 1971
d. British Standards, 5378 e. Pharmacy and Poisons Act, 1933

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For questions 26 – 30, match the statements with the correct options listed below:
a, warning signs b. rectangular signs c. circular signs d. red e. blue

26. Prohibitory and obligations are expressed as
27. are rectangular
28. Supplementary and emergency information are given in
29. is for prohibition and fire fighting
30. Mandatory instructions are given by
31. During pH measurement using the pH meter, the reference electrode should always be placed on
a. pH range permanently and the pH verified b. suspension in the air
c. pH range intermittently and the pH verified d. stand-by permanently
e. stand-by intermittently and the pH verified
32. The prime concern of coded labels in science laboratories is
a. protection of persons b. protection of scientific and structural facilities/assets c. prevention of fire
d. substitution of written information e. observance of warnings, rules and guidance
33. The health, safety and welfare Act of 1974 in Britain was about
a. of scientific and structural facilities b. the use of warning symbols
c. provision of protection for laboratory users d. the use of standard colours and signs
e. responsibilities of employers/employees
34. Safety in the laboratory is achieved through

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- a. alertness b. appropriate safety precautions c. knowledge, fore-thought and care
 d. obeying rules and regulations e. paying adequate attention to the job in hand

For questions 35-40, match the following with the appropriate warning signs.

- a. biohazard b. toxic c. corrosive d. irritant/harmful e. radioactive f. highly inflammable



35



36



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40

SECTION B.

1. You have been employed as a scientific officer in a biotechnology outfit with the mandate to understand the molecular mechanism of a virulence gene in an unnamed bacterium. The following materials were given to you as stock: Buffer (10X); MgCl₂ (25mM); dNTPs (5mM); Primer (forward) 10μM; Primer (reverse) 10μM and DNA concentration (60ng/μl). If the final volume for Taq polymerase per reaction is 0.25 μl, set up a PCR (10 strains of the unnamed bacterium – total volume: 50μl) with the following as final concentration: buffer (1X); MgCl₂ (1.5mM); dNTPs (0.2mM); Primers (forward) 0.8μM; Primers (reverse) 0.8μM and DNA concentration (10ng/μl). State your calculations clearly.
2. (a) Mention the steps in the determination of the identity of a bacterial strain using 16S rRNA sequencing method.
 (b) Mention two tracking dyes in electrophoresis and outline how you would resolve the following:
 - (i) Poor resolution of DNA fragments
 - (ii) Band smearing.

SECTION C

- a) In a simple tabular form, give the physicochemical properties of proteins or other biomolecules and the corresponding purification techniques being used.
- b) What are the two key factors considered during purification process?
- c) Mention the various column materials packed within the glass cylinder.
- d) Explain the following terms: (i) stationary phase (ii) mobile phase (iii) eluant (iv) fraction and (v) pooled.

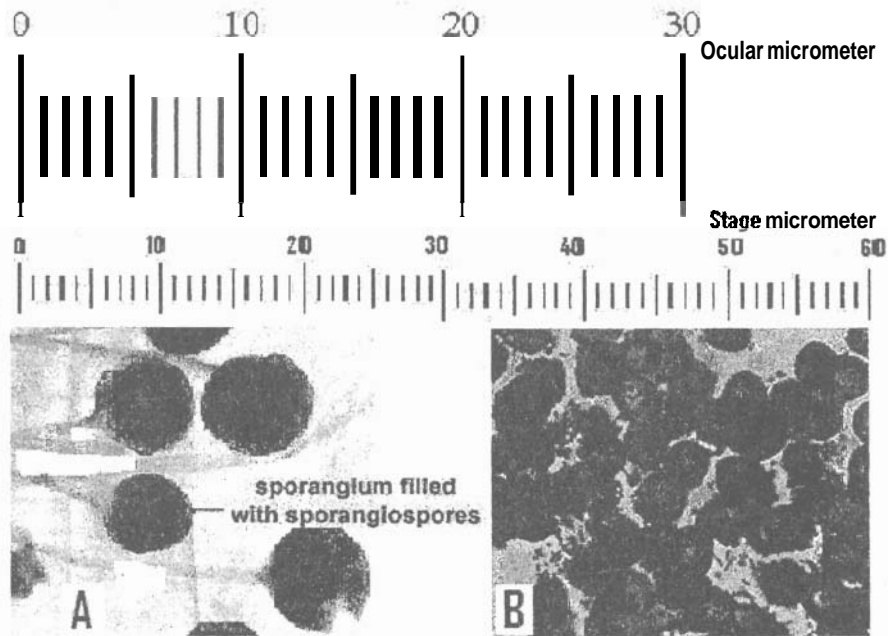
SECTION D

THEORY OF PRACTICAL

1. (a) In microbiology, colorimetric methods are used to measure the concentrations of biological compounds that do not absorb light in the visible range.
 - i. Write and briefly explain the mathematical model for the principle of absorptiometry and list the equipment manufactured based on the concept.
 - ii. Write a short note on the principle of Bradford spectrophotometric method for

the estimation of protein.

2. Assuming the figurative representation of the alignment of the ocular micrometer, stage micrometer, and prepared slides of the sporangia of a fungus (A) and the cells of a bacterium (B) viewed under the microscope is given in the figure below.
 - a. Calibrate the ocular microscope if the given length of the stage micrometer is $1000\ \mu\text{m}$. Show all calculations.
 - b. Estimate the diameter of the fungal sporangium and the bacterial cell. Show all calculations.
 - c. What precautions must you observe when applying this method of measuring microbial cells?



G.O.B

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