



MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ANALYTICAL CHEMISTRY)

BACHELOR OF SCIENCE IN (APPLIED PHYSICS AND TECHNOLOGY)

SAN 308/SPH 305: RESEARCH METHODOLOGY

DATE: _____

TIME: _____

INSTRUCTIONS:

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks).
- Answer any **two** questions from section **B** (each 20 marks).

SECTION A (COMPULSORY)

QUESTION ONE (30 MARKS)

a) Define the following terms as used in research (5 marks)

- Research
- Dependent variable
- Independent variable
- Research design
- Research ethics

b) Differentiate between the following

- Review of literature and literature review (2 marks)
- Research methods and research methodology (2 marks)

- iii. True experimental and quasi-experimental research (2 marks)
- iv. A sample and a population (2 marks)
- c) Discuss in detail the different types of research. (14 marks)
- d) Explain what is meant by the term cause and effect and how a scientist can ensure their research is able to establish cause and effect. (3 marks)

SECTION B: ANSWER ANY OTHER TWO QUESTIONS

QUESTION TWO (20 MARKS)

- a) Discuss the seven main steps involved in a research process. (14 marks)
- b) Briefly outline what is meant by peer review in scientific writing (3 marks)
- c) Discuss the characteristics of a scientific literature and explain why newspapers do not fall within scientific literature. (3 marks)

QUESTION THREE (20 MARKS)

- a) Discuss the following terms as applied in research ethics. (6 marks)
 - i. Falsification
 - ii. Fabrication
 - iii. Plagiarism
- b) Discuss the purpose of literature review in research (5 marks)
- c) Scientists play a very key role in the society. As a scientist, explain how you would address the COVID-19 problem that has paralyzed most activities since 2020. (5 marks)
- f) A group of medical students conducted a research on the awareness of diabetic diet in medical clinic participants. Their research was recognized as the best undergraduate research and later they submitted the same research paper to two different journals to see which journal publishes it first. Provide two reasons why this is considered unethical. (4 marks)

QUESTION FOUR (20 MARKS)

- a) Think about a research problem you would like to address and write a brief problem statement. (4 marks)
- b) Examine the following quantitative research question: “Do fifth grade students who participate in a supplemental daily calendar math program learn more math content as demonstrated on the Virginia SOLs than those who do not receive this supplementary math program?” Identify the independent and dependent and explain your answer. (4 marks)
- c) Identify the weakness of correlational research that can be overcome using experimental research. (2 marks)
- d) Define and identify the key differences between probability and non-probability sampling (3 marks)
- e) A staff nurse is interested in the infection rates for patients who have indwelling Foley catheters. Considering the research process, what would be the next step for the nurse and why is the step important? (3 marks)
- f) Using relevant examples, define and show the difference between integral and non-integral citation. (4 marks)

QUESTION FIVE (20 MARKS)

- a) Outline the steps that are involved in defining a research problem. (7 marks)
- b) Discuss the importance of referencing in any write up. (6 marks)
- c) Provide three ways in which scientific results can be disseminated. (3 marks)
- d) Using the snapshot provided below. Identify the following: (4 marks)
 - i. Authors
 - ii. Name of the journal
 - iii. Journal volume
 - iv. DOI

Cite this: *Anal. Methods*, 2015, 7, 8034

Multi-walled carbon nanotubes: innovative sorbents for pre-concentration of polychlorinated biphenyls in aqueous environments

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Carbon nanotubes (CNTs) have demonstrated outstanding chemical and mechanical stability, electrical properties, and strong interactions with aromatic compounds owing to the π -electron system on the graphene sheets. Taking advantage of these unique properties, we have developed a fully validated sample pre-concentration technique for determination of polychlorinated biphenyls (PCBs) in aqueous environments using gas chromatography combined with a micro-cell electron capture detector (GC- μ ECD). The optimized method using pristine MWCNTs gave recoveries in the range of 46.0–92.5%, 51.4–91.5%, 48.7–77.8% for tap water, river water, and lake water, respectively. Compared to conventional C18 adsorbent and oxidized MWCNTs (oMWCNTs), pristine MWCNTs provided the best recoveries, thereby confirming that MWCNTs are excellent alternatives for C18, with the ability to achieve high performance. The developed protocol achieved method detection limits in the range of 0.002–0.011 $\mu\text{g L}^{-1}$ and relative standard deviation (RSD) < 15.5%.

Received 10th June 2015
Accepted 20th July 2015DOI: 10.1039/c5ay01496d
www.rsc.org/methods