

# **UNIVERSITY OF SWAZILAND**

## **FACULTY OF HEALTH SCIENCES**

### **MAIN EXAMINATION PAPER – DECEMBER, 2012**

TITLE OF PAPER	:	FUNDAMENTALS OF EPIDEMIOLOGY
COURSE CODE	:	EHM 203
TIME	:	2 HOURS
MARKS	:	100
INSTRUCTIONS	:	<b>ANSWER QUESTION 1 AND ANY FOUR QUESTIONS</b>
	:	<b>EACH QUESTION IS 20 MARKS</b>
	:	<b>NO FORM OF PAPER SHOULD BE BROUGHT INTO NOR TAKEN OUT OF THE EXAMINATION ROOM</b>
	:	<b>BEGIN THE ANSWER TO EACH QUESTION ON A SEPARATE SHEET OF PAPER</b>
	:	<b>CALCULATORS MAY BE USED BUT THEY MUST BE THE SILENT TYPE</b>
	:	<b>ALL CALCULATIONS/WORK-OUT DETAILS SHOULD BE SUBMITTED WITH YOUR ANSWER SHEET</b>

**QUESTION 1**      **MULTIPLE CHOICE [ALL STUDENTS MUST ANSWER THIS QUESTION]**

Indicate your response to the items in this question by writing down the letter corresponding to your chosen answer.

- i. One of the fundamental premises underlying the study of epidemiology is...
  - A. disease, illness and ill health are randomly distributed in a population.
  - B. disease, illness and ill health are not randomly distributed in a population.
  - C. disease, illness and ill health are only randomly distributed in large populations.
  - D. disease, illness and ill health are very rarely distributed in large populations
  
- ii. Fluoridation of water would be an example of
  - A. A primary prevention strategy
  - B. A secondary prevention strategy
  - C. A tertiary prevention strategy
  - D. It is not a prevention strategy
  
- iii. During the 19<sup>th</sup> century, John Snow...
  - A. Proved his miasmatic theory of disease using shoe leather epidemiology
  - B. Proved that cholera was spread through contaminated water by conducting natural experiments
  - C. Was the first anaesthesiologist to use chloroform on a woman in labour
  - D. Hypothesized that cholera was primarily due to overcrowded conditions and malnutrition
  
- iv. A researcher is interested in recording the number of individuals in a particular geographic region who have a common cold at some point during the month of February 2001. Which of the following measures of morbidity would be most appropriate in answering this question?
  - A. Point prevalence
  - B. Period prevalence
  - C. Cumulative incidence
  - D. Incidence density
  
- v. It is assumed that diseases can be transmitted directly or indirectly. A vector such as a mosquito is an example of....
  - A. direct disease transmission
  - B. indirect disease transmission
  - C. single exposure
  - D. common vehicle exposure
  
- vi. The resistance of a population to an attack by a disease to which to which a large proportion of the members of the group are immune is referred to as.....
  - A. group resistance
  - B. population immunogenesis
  - C. herd immunity
  - D. the Panum Effect

- vii. The property of a test to identify the proportion of truly ill persons in a population who are identified as ill by a screening test
- Sensitivity
  - Specificity
  - Positive predictive value
  - Negative predictive value
- viii. A study that measures the number of persons with influenza in a calendar year
- Cohort study
  - Case control
  - Cross sectional
  - Case report

**Questions ix and x are based on this article.**

During a study of 20 years five people are followed to measure the occurrence of upper respiratory tract infection. As this infection can occur more than once, all disease events are included in this study.

- 1 person is lost to follow-up after 1.5 years.
- 2 persons died respectively after 10 and 15 years from a different cause.
- 1 person got the first respiratory tract infection after seven years and the second infection after 12 years of follow-up. Both infections take half a year of recovery. This person is followed-up until the end of the study.
- One person is followed-up the whole period without occurrence of disease.

- ix. What is the incidence rate in this study?
- 0.06 per person-year
  - 0.03 per person year
  - 0.15 per person-year
  - 0.08 per person year
- x. What is the fraction of cases with the disease among the exposed that is attributable to the exposure?

	Unexposed	Exposed
Disease	9	17
No disease	7	5

- 0.27
- 0.60
- 0.30
- 0.77

**[20 marks]**

## QUESTION 2

- a. Infectious disease results from the interaction of the agent, host, and environment in a process which involves six components that includes host susceptibility. Discuss FIVE factors that affect host susceptibility and result in variation on infectivity between one host and the next. (10)
- b. A study from Malawi attempted to assess the sensitivity and specificity of direct observable clinical signs for the diagnosis of malaria and pneumonia in children. The study subjects were 1 469 children under 5 years of age who came to a children's outpatient department with fever and/or cough. The purely clinical definition of malaria was as follows:
- Fever or history of fever

and the definition of pneumonia was as follows:

- History of cough; or
- Difficulty in breathing and lower chest-wall in-drawing; or
- Increased respiratory rate

Blood films for microscopic examination for malaria parasites were taken from all of the children, but only those with evidence of pneumonia (or who had parasitaemia) had a chest x-ray. A total of 1 290 children fulfilled the clinical definition of malaria (i.e. fever or history of fever). Of these, 486 children had a positive blood film, while in 804 children no parasitaemia could be diagnosed. In total, 179 children did not meet the clinical case definition, but of these 22 individuals had a positive blood film.

- i. If we assume that 'positive blood film' is the gold standard for diagnosing malaria, what is the sensitivity of the clinical definition of malaria? (3)
- ii. Write a plausible interpretation for your sensitivity? (2)
- iii. What is the specificity of the clinical definition of malaria? (3)
- iv. Explain the meaning of the specificity? (2)

[20 marks]

## QUESTION 3

A total of 1 176 453 deaths (all cause in the whole population) were reported in country X in 2003. The mid-year population in 2003 was estimated to be 198 812 000. HIV-related deaths and mid-year population by age group are given in the table below.

HIV-related deaths and estimated population by age groups in Country X, 2003.

Age group (years)	HIV-related deaths	Mid-year population	Age-specific HIV related death rate (per 100 000 population)
0-4	110	11 217 000	.....i.....
5-14	30	28 146 000	.....ii.....
15-24	423	31 698 000	.....iii.....
25-34	4 238	37 315 000	.....iv.....
35-44	4 096	29 305 000	.....v.....
45-54	1 522	19 276 000	.....vi.....
55+	897	41 855 000	.....vii.....
<b>Total</b>	<b>11 406</b>	<b>198 812 000</b>	

- a. Explain why the population of country X is given as a 'mid-year population'. (2)
- b. Calculate the crude death rate (from all causes) in country X in 2003. (2)
- c. Would you say that this is an accurate estimation of the risk of dying (from all causes) for any resident of country X in 2003? Explain your answer. (3)
- d. Calculate the crude HIV-related death rate in country X in 2003 in the whole population. (3)
- e. Calculate the age-specific HIV-related death rate to complete the table by writing your answer against each roman numeral shown on the table. (7)
- f. How does the knowledge of age-specific HIV-related death rates for country X benefit control of the mortality rates. (3)

**[20 marks]**

#### **QUESTION 4**

The golden standard of all research is the placebo-controlled, randomised, double-blind clinical trial.

- a. Explain the meaning of:
  - i. placebo-controlled (4)
  - ii. randomised, and (2)
  - iii. double-blind (2)
- b. Explain why clinical trials are considered the 'golden standard of all research'. (4)
- c. Outline four limitations of randomised controlled trials. (4)
- d. Let us assume that we wish to study two groups of patients who will undergo different interventions, one of which is a new procedure. Suppose that we expect a 10% decrease in the morbidity rate with the new procedure. To be able to detect this difference with a probability (power) of 80%, we need 80 patients in each treatment arm.
  - i. What would be the number of patients required per an arm if the expected difference in effect was 20%. (2)
  - ii. What number of patients would be required per treatment arm if the difference expected was 1%. (2)

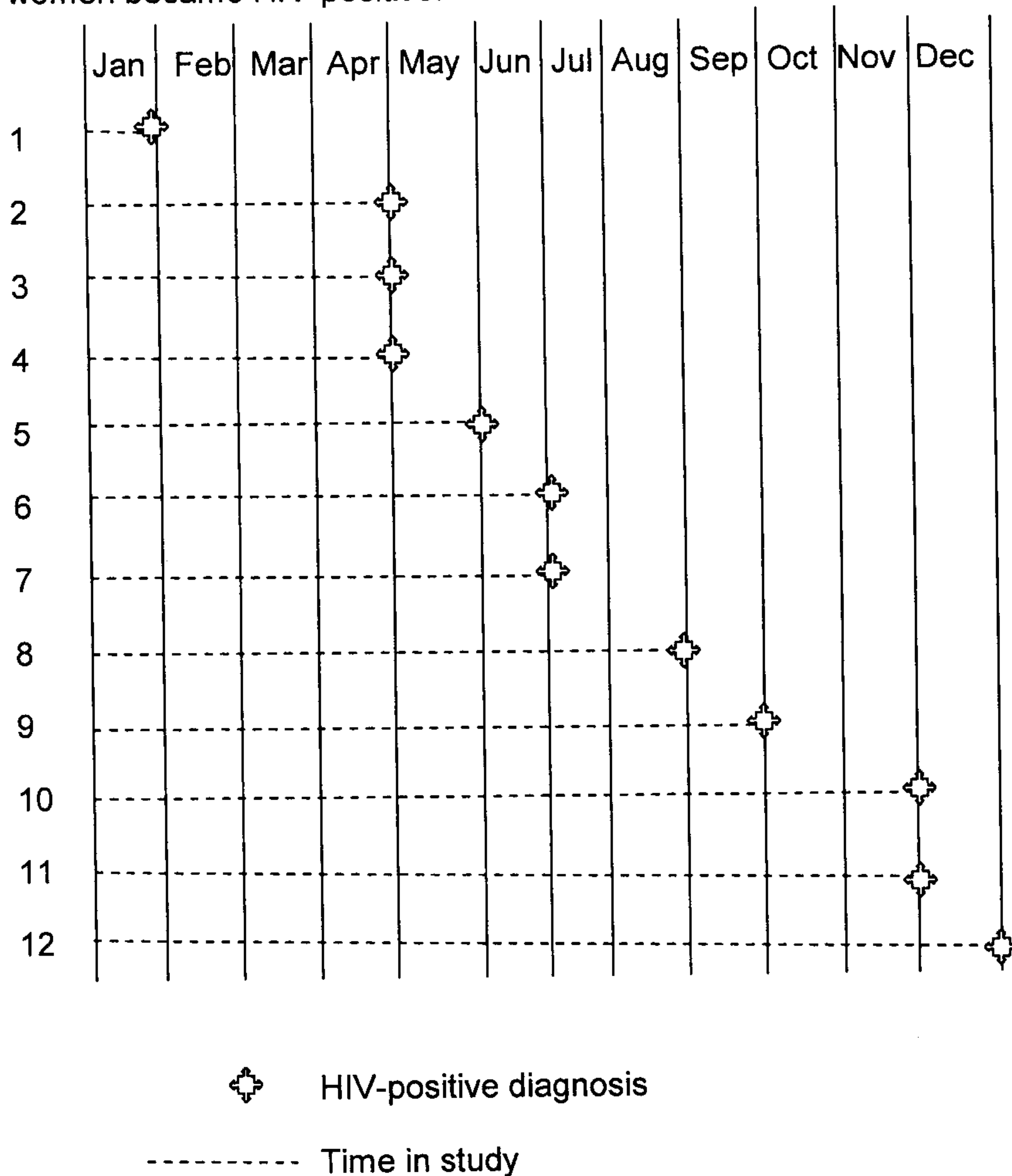
**[20 marks]**

**QUESTION 5**

One thousand women who were working at a Textile Factory A in Matsapha were screened for HIV on 1 January, 2010 and 155 of them were found to be positive for HIV antibodies. The screening was repeated in the same 1000 women on 1 January, 2011 and this time 192 women were positive, including the 155 women who were positive on the first screening (no one had died or was lost to follow-up).

- a. What was the prevalence of HIV in women working at Textile Factory A on 1 January, 2010, and on 1 January 2011? (4)
- b. What is the annual risk of developing HIV infection in women working in Textile Factory A in 2010? (3)

One thousand women from another Textile Factory B were screened on 1 January, 2010 and 140 were found to be HIV-positive. All the women were tested for HIV once a month until 31 December, 2010. Twelve women became positive during these 12 months. The remaining 848 women were still HIV-negative by 31 December, 2010. No one died or was lost to follow-up during this period. The diagram below shows when these twenty-four women became HIV-positive.



- c. Explain what happened to subjects number 5 and 12, respectively. (4)
- d. What were the odds of becoming infected with HIV in the first 6 months of 2010 in the 12 women who became HIV-positive that year? (3)
- e. What is the total number of person-months at risk of HIV infection observed in this study? (3)
- f. What was the incidence rate of HIV infection in women working in Textile Factory B? (3)

**[20 marks]**

### **QUESTION 6**

- a. Discuss the importance of host susceptibility in the infectious disease process. (6)
- b. Air may serve to spread particles of varying sizes from contaminated sources such as floors and clothing. Is this a direct or indirect method of transmission. Explain your answer. (3)
- c. The two major categories of human sources of infection are acute cases and careers.
  - i. Which of the two contributes more to disease transmission, acute cases or careers? Explain. (4)
  - ii. Explain what a convalescent career is and what causes one to become a convalescent career. (3)
- d. In hepatitis B, the blood of an infected person may be infectious as long as 3 months prior to the onset of jaundice. In dog rabies, the virus may be present in the saliva within 5 days prior to the onset of symptoms.
  - v. What type of career status is shown in the illustration of hepatitis B and rabies? (1)
  - vi. Which of the two transmissions are easier to control, hepatitis B or rabies. Explain your answer. (3)

**[20 marks]**

### **QUESTION 7**

- a. Define the following:
  - i. endemic (2)
  - ii. incubatory career (2)
  - iii. coalescent career (2)
- b. In a case-control study, coffee drinking was observed to be associated with the risk of cancer of the pancreas. The importance of this association was disputed because it was noted that coffee drinking was correlated with cigarette smoking and cigarette smoking was associated with cancer of the pancreas. So, cigarette smoking may have confounded the observed association between coffee drinking and cancer of the pancreas. The following data was obtained by the investigators:

Odds of exposure to coffee among all cases and controls

<i>Exposure</i>	<i>Cases</i>	<i>Controls</i>	<i>Total</i>
Coffee drinkers	450	600	1050
Non-coffee drinkers	300	750	1050
TOTAL	750	1 350	2 100

- i. Define what confounding variable is. (2)
- ii. What is the odds ratio of exposure to coffee in cases and in controls? (4)
- iii. Write an interpretation for your answer to the odds ratio. (2)

Because the researchers in this study believed that coffee drinking and cigarette smoking might be correlated, and also that cigarette smoking was associated with cancer of the pancreas, they calculated the odds ratio of exposure among smokers and non-smokers separately.

Odds of exposure to coffee in cases and controls stratified by exposure to smoking

<i>Exposure</i>	<i>Smokers</i>		<i>Non-Smokers</i>		<i>Total</i>
	<i>Cases</i>	<i>Controls</i>	<i>Cases</i>	<i>Controls</i>	
Coffee drinkers	400	300	50	300	1 050
Non-coffee drinkers	200	150	100	600	1 050
TOTAL	600	450	150	900	2 100

- iv. What is the odds of exposure to coffee among cases compared to controls among smokers and non-smokers? (4)
- v. What is your inference regarding the association between coffee drinking and cancer of the pancreas after stratifying by smoking? (2)

**[20 marks]**