POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

MD (CLINICAL ONCOLOGY) PART 1 EXAMINATION-AUGUST 2013

Date:- 19th August 2013 Time:-2.00 p.m.-4.15 p.m.

PAPER 1

If the examiners cannot read your writing they will be unable give you full credit for your knowledge.

PHYSICS

Each question carries 100 marks.
Each question to be answered in a separate book.
Question one is compulsory.
Answer five questions of the six questions from 2 to 7.

1.

1.1 Define the term "Equivalent Dose" and list the two units used to measure this quantity. (20 marks)

1.2 In radiation protection, it is taken that 1Roentgen is equal to1Rem. Explain why? (10 marks)

1.3 List Effective dose limits recommenced for radiation workers. (20 marks)

1.4 Briefly explain what is meant by external radiation hazards (15 marks)

1.5 List basic methods used to control the external radiation hazards. (15 marks)

1.6 Explain one method in 3-4 sentences giving practical examples. (20 marks)

Contd.....2-/

2.

2.1 Briefly explain the main interaction process of ionizing radiation with tissue
(a). For 50 kVp photons from a diagnostic X-ray machine (15 marks)

(b). For 6 MV photons from a Linear Accelerator machine (15 marks)

2.2 Suppose the site of irradiation is an adult arm, compare the relative proportion of radiation dose absorbed to bones with respect to surrounding normal tissue in above two situations and explain why? (20 marks)

2.3 How is the quality index specified for each radiation quality in 2.1 (20 marks)

2.4 Why do you check the beam quality for heterogeneous beams? (10 marks)

2.5 Explain briefly what is meant by the dose buildup region and give typical values for each radiation quality in 2.1 (20 marks)

3.

3.1 Define the following terms in relation to ICRU (International Commission on Radiological Units and Measurements) 50 and 62 reports
(a). Planning Target Volume (PTV) (20 marks)

(b). Organ at Risk (OAR) (20 marks)

3.2 What is meant by horns in the dose profile of a Linear Accelerator photon beam and why are they seen? (20 marks)

3.3 What is the main factor influencing the CTV to PTV expansion when delivering radiation to lung cancer? (15 marks)

3.4 State the best method to improve the accuracy of radiation field placement in (3.3) while reducing the exposure of healthy tissues? (15 marks)

3.5 How do you compensate practically for the above problem in (3.3) without (3.4) technology? (10 marks)

Contd.....3-/

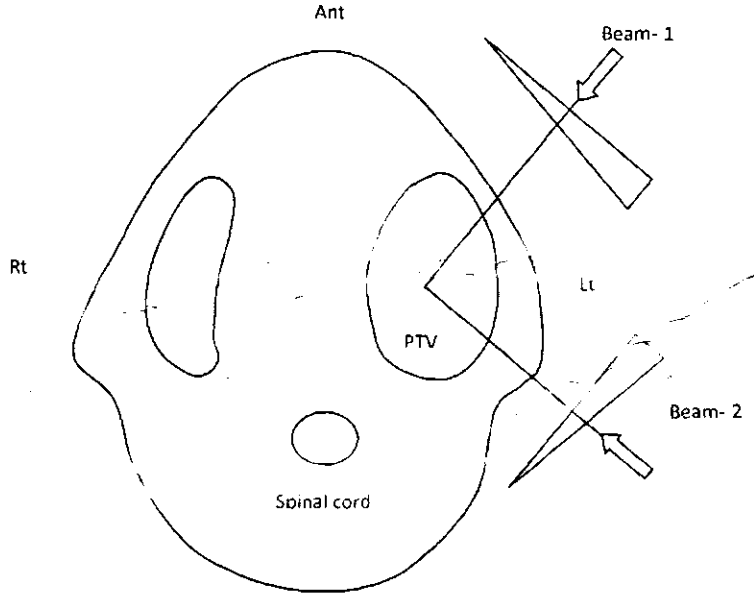
(2)

4.

4.1 Define with a diagram Tissue Maximum Ratio (TMR) in Radiotherapy. (20 marks)

4.2 Name the parameters that influence the TMR. (15 marks)

4.3 A patient with a left parotid carcinoma is to be treated using 6MV photon beam from a Linear Accelerator machine at 100 cm SAD (Source Axis Distance) as shown in figure. The prescribed dose to PTV is 60 Gy in 30 fractions over 6 weeks and the relevant beam data is given below.



Machine calibration conditions:

Source chamber distance = 100 cm
Calibration reference depth = d_{max} = 1.5 cm in water,
Field size = 10 x 10 cm^2
Calibration dose rate = 1 cGy/MU

Description	Beam 1	Beam 2
Tissue depth to beam isocenter (cm)	3.5	2.5
Gantry angle	40°	130°
Treatment field size (cm^2) *	7w x 8	7.5w x 8
Tissue maximum ratio	0.970	0.986
Wedge transmission factor (45°)	0.490	0.490
Collimator scatter factor	0.978	0.980
Phantom scatter factor	0.988	0.990

*w indicates wedged beam width

Contd.....4-/

(a) Using the above data, calculate the dose rate at d_{max} in water for open beams first and then obtain the dose rate at d_{max} for the wedge beams. (20 marks)

(b) Considering equal dose to the tumour center from both beams, calculate MUs per field per fraction. (20 marks)

Draw a typical cumulative dose volume histogram (DVH) for the above PTV with maximum and minimum dose of 57 Gy and 62 Gy respectively. Maximum dose to spinal cord is 45 Gy and total volume receives 30 Gy. (25 marks)

5.

5.1 Sketch a labelled diagram of a thimble ionization chamber which is used to calibrate photon beams. (20 marks)

5.2 Ionization current is measured while calibrating teletherapy machines. Why is it necessary to apply a temperature pressure correction factor to the meter reading? (20 marks)

5.3 What is meant by the calibration factor for an ionization chamber? (20 marks)

5.4 Briefly explain the static and dynamic MLC delivery systems in IMRT. (20 marks)

5.5 Give two advantages and two disadvantages of IMRT with compared to 3D CRT. (20 marks)

6.

6.1 What is therapeutic range of an electron beam therapy? (20 marks)

6.2 List the parameters which influence the therapeutic range. (20 marks)

6.3 A 6 MeV electron beam with a custom insert has measured output factor of 0.962 cGy/MU at d_{max}. If 200 cGy is prescribed to 90% isodose, calculate the MU setting. (20 marks)

Contd.....5-/

(3)

6.4 When 1 cm bolus is added to the above electron field and if above MUs are not changed, what changes are expected? (20 marks)

6.5 Explain why the field matching is more difficult for electron beams. (20 marks)

7.

7.1 List four physical properties of Ir-192 source? (20 marks)

7.2 What is the reference air Kerma rate for a Brachytherapy source? (20 marks)

7.3 Give three (03) reasons for doubly encapsulating Brachytherapy sources. (15 marks)

7.4 List five (05) checks performed daily an HDR Brachytherapy afterloader. (25 marks)

7.5 List four advantages of the use of HDR remote afterloading Brachytherapy systems compared to LDR Brachytherapy systems. (20 marks)

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MD (CLINICAL ONCOLOGY) PART 1 EXAMINATION- AUGUST 2013

Date: 19th August 2013 **Time:** 4.30 p.m.-5.15 p.m.

PAPER 1

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SECTION B – MEDICAL STATISTICS

Each question carries 100 marks.
Each question to be answered in a separate book.
Answer two questions of the three questions.

1. A randomized control trial was conducted to assess the efficacy of adjuvant radiotherapy on the lymph-node field control in patients who had undergone therapeutic lymphadenectomy for metastatic melanoma in regional lymph nodes. The primary and secondary endpoints were lymph-nodes field relapse and overall survival respectively. The trial was designed to have 80% power to detect a 20% difference of patients with lymph-nodes field relapse between the groups. Survival analysis was performed. For the interim analysis probability value was considered as 0.048. The study is registered at the Clinical Trials Registry of WHO.

   1.1 What is meant by 'primary outcome'? (15 marks)

   1.2 What is meant by '80% power'? (20 marks)

Contd..../2-

1.3 Why did the investigators decide to detect a 20% difference between patients with lymph-node field relapse between the groups? (15 marks)

1.4 Briefly explain the reason why the probability value for interim analysis is 0.048? (20 marks)

1.5 Briefly describe a statistical plan for the survival analysis. (20 marks)

1.6 State two (2) advantages of registering a trial on Clinical Trial Registry? (10 marks)

2. A study was conducted to assess the effect of major complications on health related quality of life in 5-year survivors of esophageal cancer surgery. Of 150 eligible patients, 140 gave consent to participate. Of these, 40 patients sustained major post-operative complications. Baseline characteristics of patients were compared by using the Mann-Whitney U test and Fisher's exact test. Mean difference of health related quality of life score was 15 (95% confidence interval 6 to 23) after 3 years of followed up. Adjustment was made for several potential confounders.

2.1 State the study design. (10 marks)

2.2 Calculate the non-response rate. (10 marks)

2.3 Define the study population. (10 marks)

2.4 List the baseline data (excluding socio-demographic data) which the investigators should have collected. (10 marks)

2.5 List possible reasons for application of the Mann-Whitney U test and Fisher's exact test. (20 marks)

2.6 Name a statistical test which was used for comparing quality of life. (10marks)

2.7 Interpret the mean difference of health related quality of life score and its 95% confidence interval. (20 marks)

2.8 State a method for adjusting of confounding factors of the above study. (10 marks)

Contd...../3-

5

3. Write notes on the following

3.1 Retrospective cohort studies (25 marks)

3.2 Informed consent (25 marks)

3.3 Incidence rate ratio (25 marks)

3.4 Uses of receiver operator characteristic curve (ROC) (25 marks)

(6)

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MD (CLINICAL ONCOLOGY) PART 1 EXAMINATION - AUGUST 2013

Date: 20th August 2013 **Time:** 9.00 a.m.-9.45a.m.

PAPER 2

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PATHOLOGY

Each question carries 100 marks.
Each question to be answered in a separate book.
Answer two questions of the three questions given below.

1. Mention four important histological prognostic factors for each of the following tumours.

1.1 Gastrointestinal stromal tumours. (20 marks)

1.2 Uterine Endometerial adenocarcinoma (20 marks)

1.3 Rhabdomyosarcoma (20 marks)

1.4 Adenocarcinoma of lung (20 marks)

1.5 Urothelial tumours of the bladder (20 marks)

2. What is the value of immunohistochemistry in tumour pathology considering

2.1 Diagnosis (30 marks)

2.2 Prognosis (40 marks)

2.3 Therapy (30 marks)

Contd...../2-

3. A 27 years old female is found to have an anterior mediastinal mass.

3.1 List six (06) neoplasms you would expect to see in this patient? (30 marks)

3.2 What biochemical investigations would help in arriving at a diagnosis? (20 marks)

3.3 Describe briefly the histological and immunohistochemical features of two common tumours mentioned on 3.1. (50 marks)

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Date:- 20th August 2013 Time:-10.00 a.m.-10.45a.m.

PAPER 2

If the examiners cannot read your writing they will be unable give you full credit for your knowledge.

RADIOBIOLOGY

Each question carries 100 marks.
Each question to be answered in a separate book.
Answer two questions of the three questions given below.

1.

1.1 An exponentially growing asynchronous population of cells is maintained under normal physiological conditions. Briefly comment (in a sentence or two) on the following with respect to reduced or increased cell killing by X rays. (50 marks)

1.1.1 Cell synchronization in S phase at the time of irradiation

1.1.2 Irradiation with the dose split into two fractions with a 24 hr interval between fractions rather than given as an acute exposure to the same total dose.

1.1.3 Irradiation under hypoxic conditions

1.1.4 Incorporation of bromodeoxyuridine into DNA prior to irradiation

1.1.5 Adding cysteine to the growth medium before irradiation

1.2 Comment on the following statements (50 marks)

1.2.1 Cell loss factor (φ) often decreases several weeks after the start of radiotherapy.

1.2.2 Growth fraction (GF) is the ratio of number of viable cells to the sum of viable and non viable cells

Contd...../2-

1.2.3 If volume doubling time (T_D) is 60 days and potential doubling time (T_{pot}) is 3 days wh is the cell loss factor?

1.2.4 T_{pot} has proven useful in predicting tumour response to accelerated radiotherapy

1.2.5 Typically, cell loss factor φ is of minor importance in determining a tumour's volum doubling time.

2.

2.1 Briefly explain which of the following fraction schedules would likely produce the highes incidence of late normal tissue toxicity?(Assume $\alpha/\beta = 2$ Gy for normal tissue injury) (50 marks)

2.1.1 20 Gy in 4 fractions over 1 week

2.1.2 24 Gy in 6 fractions over 2 weeks

2.1.3 45 Gy in 15 fractions over 3 weeks

2.1.4 50 Gy in 25 fractions over 5 weeks

2.1.5 60 Gy in 60 fractions over 6 weeks

2.2

2.2.1 What is the basis of conventional fractionation? (10 marks)

2.2.2 Draw survival curves for late responding and tumour and early responding tissues. Comment on the shape in terms of LQ relationship. (20 marks)

2.2.3 On what radiobiology theory was the schedule CHART based? (05 marks)

2.2.4 What are the conditions in CHART ? (10 marks)

2.2.5 Why is No allowance made for overall time for Late complications? (05 marks)..

Contd...../3-

(8)

3. Tolerance doses for kidney and lung are dependent on the volume of tissue irradiated. Both these normal tissues are very sensitive to irradiation of their entire volume. In contrast, small volumes can be irradiated to high doses without loss of function.

3.1 Mark the explanation **not** consistent with this observation. Briefly state your reasons. (50 marks)

3.1.1 Both organs have considerable reserve capacity

3.1.2 These organs have functional subunits arranged in series

3.1.3 A functional deficit is not observed in these organs until a critical number of functional subunits are inactivated by exposure to radiation

3.1.4 Above a certain threshold dose, radiation injury is usually expressed as a graded response rather than as an all or nothing response.

3.2 Why is it that a functional deficit is not observed until a critical number are inactivated? (25 marks)

3.3 In other normal tissues small volumes irradiated to high doses will lead to loss of function. State an example and briefly give reasons. (25 marks)

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MD (CLINICAL ONCOLOGY) PART 1 EXAMINATION-AUGUST 2013

Date:- 20th August 2013 Time:-11.00 a.m.-11.45a.m.

PAPER 2

If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

CHEMOTHERAPY (PHARMACOLOGY)

Each question carries 100 marks.
Each question to be answered in a separate book.
Answer two questions of the three questions given below.

1.

1.1 Classify the emetogenicity of cancer chemotherapeutic agents giving 2 examples of drugs in each group. (30 marks)

1.2

1.2.1 Explain what is meant by 'delayed emesis'. (10 marks)

1.2.2 Name 2 chaemotherapeutic agents known to cause delayed emesis. (10 marks)

1.2.3 List 2 drugs used for prevention of delayed emesis. (10 marks)

1.3

1.3.1 Explain what is meant by anticipatory nausea and vomiting. (05 marks)

1.3.2 List 5 factors associated with anticipatory nausea & vomiting. (15 marks)

1.3.3 Outline the management of anticipatory nausea & vomiting. (20 marks)

Contd.....2/-

2.

2.1 Mrs. Perera who has advanced breast cancer was treated using a combination of cyclophosphamide, methotrexate and 5 fluorouracil (CMF). The three drugs were used in several cycles with intervals of 3 weeks between each cycle.

2.1.1. Explain the mode of action of each chemotherapeutic agent in the CMF regime.

(30 marks)

2.1.2 List advantages of using combination chemotherapy for treatment of her cancer. (20 marks)

2.1.3 Explain the basis for using the three drugs in three week cycles.

(10 marks)

2.2 Explain the pharmacological basis for the use of following drugs in the treatment of breast cancer.

2.2.1 Anastrozole (20 marks)

2.2.2 Trastuzumab (20 marks)

3.

3.1 What is meant by carcinogenicity of a drug? Briefly explain how drugs are tested for carcinogenicity during drug development. (30 marks)

3.2 What is the main objective of phase II trials in oncology? Briefly explain how this objective is achieved in conducting a phase II trial in oncology

(30 marks)

3.3 Discuss the requirements you should fulfill to be an investigator in a clinical trial in oncology and indicate your obligations as an investigator when conducting a clinical trial. (40 marks)

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MD (CLINICAL ONCOLOGY) PART 1EXAMINATION- AUGUST 2013

Date:- 20th August 2013 Time:-12.00 p.m.-12.45 p.m.

PAPER 2

If the examiners cannot read your writing they will be unable give you full credit for your knowledge.

CANCER BIOLOGY

Each question carries 100 marks.
Each question to be answered in a separate book.
Answer two questions of the three questions given below.

1.1 Define apoptosis (15 marks)

1.2 Give four (4) examples of apoptosis (20 marks)

1.3 Describe the pathogenesis in each example that you mentioned in 1.2 (20 marks)

1.4 Briefly describe the molecular pathways involved in apoptosis. (45 marks)

Contd.....-2/

2

2.1 Describe the role of the K-RAS gene

a) in the control of cell growth. (15 marks)

b) as a target for pharmaceutical agents. (15 marks)

c) in inducing resistance to drugs. (15 marks)

2.2 Name two cancers in which K-RAS mutation testing is indicated.

(20 marks)

2.3 Why is it useful to test for mutations in the K-RAS gene clinically?

(15 marks)

2.4 Name two methods used for testing for mutations in the K-RAS gene.

(~~03~~ 20 marks)

3.

3.1 What is tumour immunotherapy? (10 marks)

3.2 List with examples, strategies used in tumour immunotherapy (including experimental). (45marks)

3.3 Briefly describe three (03) of the above strategies. (45 marks)