The Exam

The Radiation Protection course is assessable

Exam is on 15th October @ 10 am in Hunter Hall East
Resit exam (if required) is on 7th November @ 10 am in Randolph Hall

The exam paper is in two parts:

Part 1 – 10 multiple choice questions – total mark 40%
Part 2 – 3 written questions from a choice of 5 – total mark 60%

Pass mark is 50%

University of Glasgow

CANDIDATES ARE WARNED THAT MARKS MAY BE LOST THROUGH ILLEGIBLE WRITING.

Insert in the column below the numbers of the questions which you have answered in the order in which you have answered them.

Surname (IN BLOCK LETTERS) Becquerel

Other Names Henri

Matriculation Number x

Examination x

Date x

Subject x

Number of Table/Bench x

Number your answers to correspond with the number of the questions.

No.	
1-10	
11	
12	
13	

Write in ink what is to be read by the Examiners. ***All writing must be on right hand page.*** Leave the margin clear. Any writing not intended to be read by the Examiner must be clearly stroked out.

No other paper is to be brought into the room.

No writing is allowed on any other page whatever. No part of this book is to be torn out. ***It is to be given back to the Examiner entire.***

16 **Add address:** IBLS – Graduate School
e.g. Davidson Building
GBRC

Sample paper

University of Glasgow
Radiation Protection Course Examination

You are allowed a maximum of 2 hours for the paper. Attempt *all* the questions in Part 1 and *three* in Part 2. Where asked, try to be as concise as possible. Marks for each question are indicated in brackets and the pass mark is 50%. Please note that this is a closed book examination, programmable calculators and pocket computers are not allowed.

Part 1

1. *Thyroid monitoring for ^{125}I internal contamination can be done using a:*

a) Ion chamber

b) EP15 Geiger counter

c) Luxel optical luminescent dosimeter

d) Type 42 scintillation counter

2. *An unstable atom with too many protons can undergo which type of radioactive decay?*

a) beta minus

b) beta plus

c) alpha

d) photoelectric effect

3. *What type and thickness of shielding is generally used for Sulphur 35*
a) 1 mm lead
b) No shielding at all
c) 1 mm perspex
d) Concrete

4. *What is the preferred instrument for detecting ^{32}P contamination?*
a) Ion chamber
b) NaI scintillation probe
c) Geiger-Muller mini monitor
d) OSL dosimeter

5. *What is the radiation weighting factor for alpha radiation?*
a) 1
b) 5
c) 10
d) 20

6. *What is the unit of absorbed dose?*
a) Joule
b) Sievert
c) Gray
d) Becquerel

7. *Which of the following statements is not true for gamma radiation?*

a) Gamma radiation will be stopped by a sufficient thickness of lead absorber
b) Gamma radiation interacts with matter through the Compton effect
c) Gamma radiation is a form of electromagnetic radiation
d) Gamma radiation originates in an excited nucleus

8. *The half-life of ^{125}I is 60 days. Roughly, how long would you have to store ^{125}I waste for its activity to decay by a factor of 10?*

a) 4 months
b) 5 months
c) 6 months
d) 7 months

9. *A chronic dose of radiation over a long period of time can give rise to a 'stochastic' effect. What is meant by a stochastic effect?*

a) The probability of a health effect above a threshold limit
b) The probability of a health effect with no threshold limit
c) The certainty of a health effect with no threshold limit
d) A known effect

10. *A skin dose from a beta emitter is considered more hazardous than that from a gamma emitter. Which of the following best supports this statement?*

a) Betas are not significantly attenuated by skin and thus cause more damage
b) Gammas are significantly attenuated by skin and thus cause more damage
c) All the beta's energy is dissipated in the basal layers of the skin
d) All the gamma's energy is dissipated in the basal layers of the skin

Section 1 answers: D, B, C, C, D, C, A, D, B, C

PART 2
ANSWER THREE QUESTIONS ONLY - ***20 marks per question***

11 *Write short notes on each of the following:*
a) beta decay
b) electron capture
c) the Photoelectric effect
d) the Compton effect

12 *Describe how you would cope with a spillage of liquid radioactive material in the laboratory in order to control the potential hazard and clean up the area.*

13 *Write short notes on the following:*
a) absorbed dose
b) radiation weighting factor
c) equivalent dose
d) state the units of (a) and (c)
e) what are the current dose limits for a radiation worker?

14 What is meant by
a) 'controlled radiation area'
b) 'supervised radiation area'
c) 'system of work'
d) 'a permit to work'

15 *You are about to conduct an experiment in the laboratory for the first time using 32P. Write a risk assessment for the procedure detailing the five steps.*

END OF PAPER

Part 2:

- Each question is worth 20 marks
- Answer 3 questions only
- Short questions have 4/5 parts
- Long (essay) questions, 1 mark for each relevant point raised

e.g.

11 Write short notes on each of the following:

a) beta decay
b) electron capture
c) the Photoelectric effect
d) the Compton effect

A – There are 5 marks for each sub question i.e. 5 points per question

a) Beta decay

- 1 mark for noting there are two types
- 1 mark for noting beta minus has excess neutrons and beta plus excess protons
- 1 mark for noting neutron/proton is transformed into proton/neutron via WNF
- 1 mark for noting ejection of high speed electron/positron to satisfy charge conservation
- 1 mark for noting ejection of antineutrino/neutrino to satisfy conservation laws of e & am

b) Electron capture

- 1 mark for noting nucleus has excess protons
- 1 mark for noting inner electron is pulled into nucleus and combines with proton
- 1 mark for noting that only emitted particle is a neutrino
- 1 mark for noting space left in inner orbital is filled by an outer electron – emits characteristic X-ray
- 1 mark for noting the nucleus is left ‘excited’ and emits gamma ray(s)

A11 - continued

c) Photoelectric effect

• 1 mark for noting occurs for low energy em radiation – X-ray
• 1 mark for noting PE is an absorption process
• 1 mark for noting an inner shell electron is ejected and itself can cause further ionisations
• 1 mark for noting that vacany is filled with higher shell electron and emission of a photon
• 1 mark for correct diagram

d) Compton effect

• 1 mark for noting occurs for higher energy em radiation – gamma
• 1 mark for noting CE is an elastic collision process
• 1 mark for noting an outer shell electron is ejected and itself can cause further ionisations
• 1 mark for noting that the incoming gamma photon is scattered and has lower energy/different frequency
• 1 mark for a correct diagram

12 *Describe how you would cope with a spillage of liquid radioactive material in the laboratory in order to control the potential hazard and clean up the area.*

A – 20 marks = 20 points to note

- Don’t panic
- Inform nearby workers of any spill
- Treat yourself first
- Check yourself for any contamination (include clothing)
- Remove any contaminated clothing
- Any skin contamination go to nearest wash facility and wash with soap and water – not Decon
- If you have breathed in volatile isotopes (e.g. iodine) contact appropriate emergency services – local rules
- Cordon off contaminated area using warning tape and signs
- Use appropriate contamination monitor to detect the boundaries
- If the spillage is large inform your DRPS immediately – if not available contact RPS
- If the spillage is small try to contain using tissues soaked in Decon and working ‘out to in’
- If spillage is on the floor use benchkote (matt side down) as a walkway
- Work carefully to avoid spreading the contamination
- Monitor yourself and clothing regularly
- If isotope is short lived (e.g. Tc^{99m} - 6 hr half-life) can shut down area and let the isotope decay
- Wear suitable protective clothing
- When decontaminating put all waste into radioactive bin
- After decontamination recheck area again
- Inform DRPS if not already done so
- Fill in incident report
- Review incident to determine what went wrong and how to correct