NEWCASTLE UNIVERSITY

SEMESTER 2 ASSESSMENT PERIOD 2020/2021

Fundamentals of Pharmacy:
The Integration of Science and Practice

Time allowed - 24 hours

Your completed work must be submitted by [9:30am, UK time, on 25/05/2021]

You may submit your work at any point during the 24 hour period of the exam.

(IMPORTANT NOTE: Time in the UK is currently GMT+1hr, you may check what time it is in the UK at the following link. https://www.thetimezoneconverter.com/)

It expected that this paper will take 3 hours to complete.

You are not expected, and it is not advisable, to work on this assessment constantly for the 24-hour period. The assessment has been designed to be worked on for a much shorter period of time in line with the length of a standard examination sitting.

When answering the questions you should observe normal examination conditions and must not communicate or collude with others. The work that you submit must be your own work.

Your submission will be submitted to the Turnitin similarity checker to check for plagiarism.

Should you encounter IT difficulties that significantly affect your ability to complete this examination or when uploading your answer(s) you may submit a PEC detailing these for consideration.

Instructions to Candidates:

- The assessment consists of Section A-D. Each section is worth 25 marks and consists several questions. You should answer all the questions and type up your answers.
- Each section has a strict word limit of 1500. **You must accurately state the word count at the end of each section.** Where applicable, tables, figures, their captions, equations and calculations are excluded from the word count.
- Figures, chemical structures and tables may be created electronically or hand drawn then scanned or photographed and included as a clear image into the answer before you save the whole answer as a single PDF.
- Sources of information other than taught material should be referenced in the main body of text (e.g. “According to BNF...”), but it is not necessary to include a list of references or bibliography at the end of the document.
- A submission point has been created in the Final Exam section within your Canvas PHA1006 course. Your submission should be a single PDF file uploaded through this submission point. To avoid system overload please submit in good time within the 24-hour period. If you are unfamiliar with submitting your work, there is Canvas guidance available for submitting a Canvas Assignment.
- Further information on this assessment can be found in the Stage 1 Exam Guidelines and FAQs document. There is further student guidance on assignments available on the Digital Learning webpages and in the Canvas Student Orientation course.
- For academic queries regarding this assessment, please email mpharm.stage1leader@ncl.ac.uk during the first two hours of the 24-hour window. You must use your Newcastle University email address when contacting the above.
- University IT support is available 24/7. If you have any issues accessing your assessment or University IT systems, you can contact IT support on +44 (0)191 208 5999 at any time, or by email at it.servicedesk@ncl.ac.uk (monitored 08:00–17:00 BST, Monday to Friday).
- Any submissions received after the specified deadline will be marked as late* and a mark of ‘0’ will be applied. **unless a PEC is granted*.

SECTION A – Pharmacology

Section A consists of Questions 1 – 6 and is worth a total of 25 marks. The section has a maximum word limit of 1500 words.

Question 1

The neuromuscular junction is a chemical synapse between a motor neuron and a skeletal muscle fibre, critical for the communication between these two cell types. Describe the series of events in the neuromuscular junction that allow transmission of an action potential from the nerve fibre to the muscle cell. **[6 Marks]**

Question 2

Explain the difference in the signal transduction pathways between ionotropic and metabotropic receptors. **[2 Marks]**

Question 3

Describe the differences between innate and adaptive immunity, distinguishing cells that are solely part of the innate immunity response from those that are solely part of the adaptive immunity response. **[5 marks]**

Question 4

Granulocytes are sub-classified as either neutrophils, eosinophils or basophils. Describe the differences in morphology between these cell types and define their functions. **[3 Marks]**

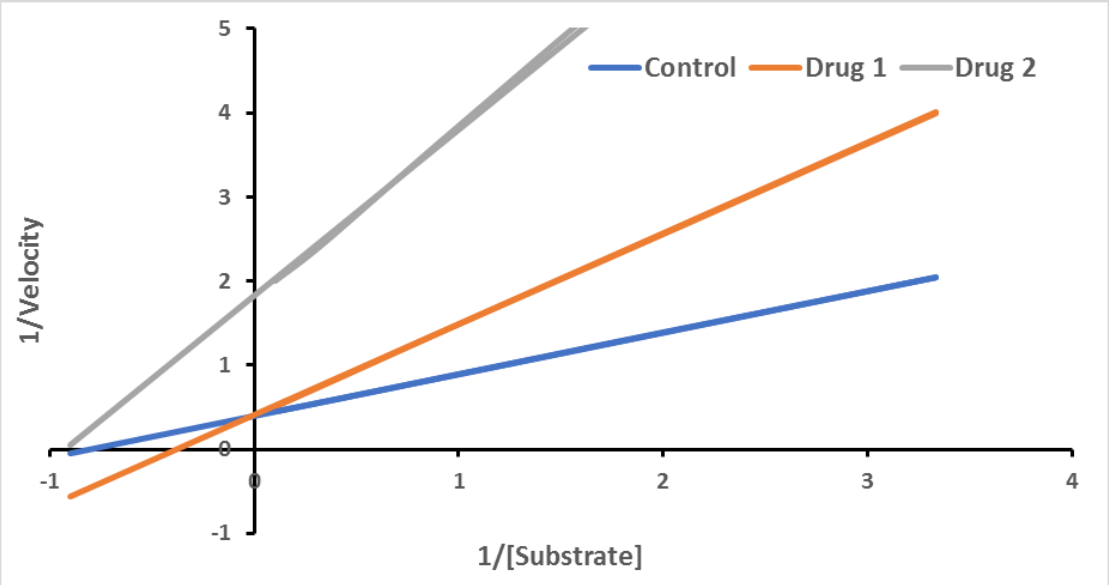
Question 5

a) Patient A reports they get very little pain relief when they take codeine. However, patient B reports a significant and rapid relief of pain with codeine and experiences some adverse effects. Explain the pharmacogenetic basis of these differences with reference to cytochrome P450. **[4 Marks]**

b) Patient C expresses the Arg144Cys genotype for cytochrome P450 2C9 (CYP2C9*2). From a pharmacogenetic perspective state whether it would be advised to give a high or low dose of warfarin for anticoagulation. Give a reason for your answer. **[2 Marks]**

Question 6

There are currently two small molecule drugs available for the management of a disease, both of which inhibit the activity of the same specific enzyme. In experimental enzyme inhibition studies, the following Michaelis-Menten graph was obtained for these drugs. The control in this graph indicates enzyme activity in the absence of either drug.



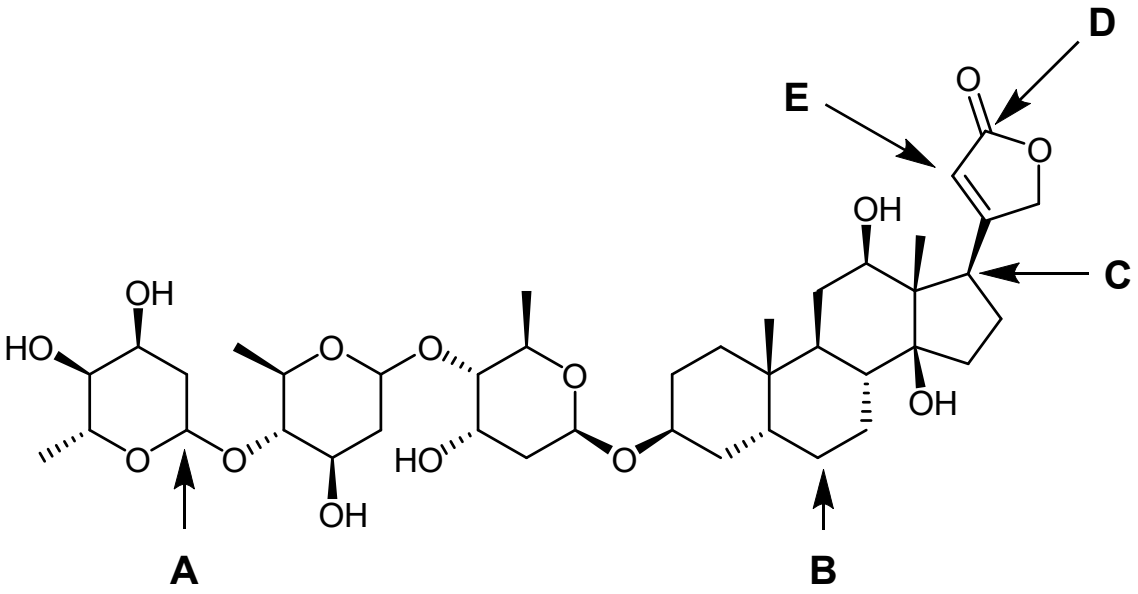
Identify with a rationale the type of enzyme inhibition demonstrated by each drug and state the effect of raising the levels of the natural enzyme substrate upon the effect of each drug. **[3 marks]**

SECTION B – Chemistry

Section B consists of Questions 7- 9 and is worth a total of 25 marks. The section has a maximum word limit of 1500 words.

Question 7

A patient with atrial fibrillation is taking digoxin.



digoxin

a) Identify the hybridisation state of the labelled carbon atoms A-E in the digoxin structure**.** **[2 marks]**

b) With reference to digoxin, draw and explain the term aglycone. Then indicate the functional group most prone to acid catalysed hydrolysis within the aglycone. **[3 marks]**

c) With reference to digoxin, explain what is meant by the term anomer and identify the anomeric centres within the glycone. **[5 marks]**

Question 8

Monoclonal antibodies (mAbs) are proteins that can be engineered to act like human antibodies. An important characteristic of these proteins is their isoelectric point (pI), this pI value being dependent on the charged amino acids making up the protein.

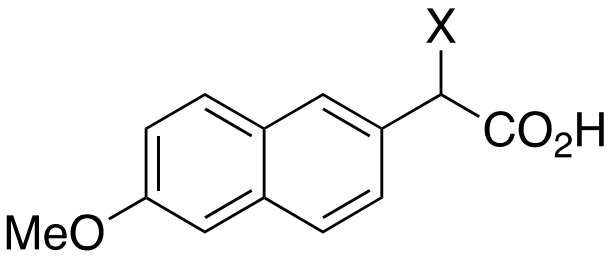
a) Provide a detailed description of the four levels of protein structure. **[6 Marks]**

b) Using the pK_a details provided in the table below, calculate the pI for the amino acids glutamic acid and lysine, showing all your working. **[4 marks]**

Amino acid	pK_a α-COOH	pK_a α-$\overset{+}{N}H_3$	pK_a Side chain
Alanine	2.34	9.69	—
Arginine	2.17	9.04	12.48
Asparagine	2.02	8.84	—
Aspartic acid	2.09	9.82	3.86
Cysteine	1.92	10.46	8.35
Glutamic acid	2.19	9.67	4.25
Glutamine	2.17	9.13	—
Glycine	2.34	9.60	—
Histidine	1.82	9.17	6.04
Isoleucine	2.36	9.68	—
Leucine	2.36	9.60	—
Lysine	2.18	8.95	10.79
Methionine	2.28	9.21	—
Phenylalanine	2.16	9.18	—
Proline	1.99	10.60	—
Serine	2.21	9.15	—
Threonine	2.63	9.10	—
Tryptophan	2.38	9.39	—
Tyrosine	2.20	9.11	10.07
Valine	2.32	9.62	—

Question 9

You are provided with the following information on naproxen and an analogue of this drug below:



Compound	Nature of X	pK_a
Naproxen	CH_3	4.6
Naproxen analogue	Cl	2.5

a) Estimate the approximate ionization of naproxen at pH 6.5.
[1 Mark]

b) Outline if the chloro-analogue is a stronger or weaker acid than naproxen and explain your answer. **[2 Marks]**

c) Following oral administration, both molecules are absorbed from the small intestine via passive diffusion. Which molecule is expected to have the higher permeability? Give a reason for your answer. **[2 Marks]**

SECTION C – Pharmacy Practice

Section C consists of Questions 10 – 12 and is worth a total of 25 marks. The section has a maximum word limit of 1500 words.

Question 10

There are eight principles of person-centred care. Define three of these principles and explain how each one contributes to better patient care. Provide an example, for each of your chosen three principles, of how they can be applied into pharmacy practice.

[9 Marks]

Question 11

a) Describe the importance of good communication skills for health care professionals and discuss the role empathy and active listening have in a consultation. **[5 Marks]**

b) Identify a patient population with communication challenges and describe two modifications that could be made in the consultation style used in this population. Explain how this would enable more effective communication. **[5 Marks]**

Question 12

In the UK, medications are classified according to their legal category. Explain how ibuprofen can have different legal classifications. In your answer, briefly describe the different legal categories of ibuprofen, as well as the legal requirements for sale and supply of each category. **[6 marks]**

SECTION D – Pharmaceutics

Section D consists of Question 13 and is worth a total of 25 marks. The section has a maximum word limit of 1500 words.

Question 13

Drug X has the following properties:

Molecular weight	1322 Da
Log *P*	0.8
Hydrogen bond donor	16
Hydrogen bond acceptor	15
pK_a	5.3

a) Explain whether Drug X would be expected to be orally active. **[3 marks]**

Recent batches of Drug X are found to have a lower melting point than previously measured. Further analysis confirms that the drug remains chemically unchanged, and the properties outlined in the table above remain the same.

b) Given that all measurements are accurate, explain this phenomenon and state why it affects the melting point but not the properties in the table above. **[5 marks]**

Upon further testing, the following powder properties of Drug X have been determined. Assume the particle size is uniform.

Particle size (μm)	150
Bulk volume (mL)	136
Tapped volume (mL)	102

c) Using the data above, calculate Carr's compressibility index and the Hausner ratio for this powder. Provide your answers to one decimal place. **[2 marks]**

d) Without adding any excipient, outline **three** strategies for enhancing the flowability of the powder. In your answer explain how each strategy enhances powder flowability. **[6 marks]**

e) The water solubility of Drug X, at 25°C and pH 7, is 0.2 mg/mL. Drug X is to be formulated as a single-dose intravenous solution at 0.01 mg/mL. This has an osmolality of 265 mOsm/kg. Describe the formulation considerations when formulating this specific dosage form. **[9 Marks]**

End of Assessment