

### Practical 3 - N (d)(m)Urine Analysis –Evaluating and reporting on observations



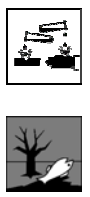
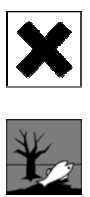
This practical focuses on – **Recording data, drawing conclusions** and **evaluation**.  
You will also be developing other assessed skills throughout the practical

#### Intended learning outcomes

By the end of this practical and its write-up you should be able to:

- Use relevant scientific methods to produce a set of data.
- Record data reliably, using appropriate scientific terminology where necessary.
- Diagnose a medical condition by analysis of a sample of ‘urine’.
- Analyse data and produce a reasoned, valid conclusion.
- Support your conclusion with evidence gathered from a reference table.

#### Safety information

	You should wear eye protection throughout this practical.
	Sodium chloride is an <b>irritant</b> .
	Ammonia is <b>corrosive</b> and <b>dangerous to the environment</b> .
	Benedict’s solution is <b>harmful</b> and <b>dangerous to the environment</b> .

#### Background information

- The urine can be used to find out about a person’s health because of the role of the kidney in homeostasis.
- Urine analysis is a particularly useful tool for diagnosis of some metabolic conditions relating as toxins and excess substances are filtered into urine.
- Typical tests that would be performed on a urine sample include odour, clarity, colour, pH and presence or absence of protein or glucose.
- A table of reference values for healthy urine has been provided for comparison. The terms used in the table those appropriate in describing a urine sample.
- The presence of glucose can be tested using Benedict’s reagent.
- The presence of protein can be tested using the Biuret test.

You will carry out an analysis of 3 ‘urine’ samples in order to diagnose medical conditions.

- Read the information above.
- Produce a results table for your investigation.
- Familiarise yourself with the reference values for urine tests.

The 'urine' samples have been obtained from patients who may be suffering from either protein urea, diabetes or renal disease. The 'urine' samples are artificial as actual samples may contain pathogens.

**Table of reference values**

	Normal Reference Values		
	Adult	Child	Newborn
Colour	Light straw / Dark amber	Light straw / Dark yellow	
Appearance	Clear	Clear	Clear
Odour	Aromatic	Aromatic	
pH	4.5 – 8.0	4.5 – 8.0	5.0 – 7.0
Specific gravity	1.005 – 1.030	1.005 – 1.030	1.001 – 1.020
Protein	2-8mg/dm <sup>3</sup>		
Glucose	Negative	Negative	
Ketones	Negative	Negative	
Microscopic examination			
RBC		Rare	
WBC	3-4	0-4	
casts	Occasional	Rare	

**Method**

Use the following procedure to test each of the 'urine' samples.

**Initial examination of urine**

- 1 Obtain approximately 10 cm<sup>3</sup> of one of the urine samples.
- 2 Examine the urine visually for odour and clarity, describe what you see and record this in your results table.
- 3 Comment on the odour of the urine sample by wafting vapours toward you nose with your hand – DO NOT put your nose directly over the sample and inhale.

**Testing for pH**

- 1 Tear off approximately 3 cm of universal indicator paper
- 2 Briefly dip the paper in the urine.
- 3 Remove the paper and compare its colour against a universal indicator chart.
- 4 Record the pH in your results table.

**Testing for protein**

- 1 Put 2 cm<sup>3</sup> of the urine sample into a clean test tube.
- 2 Put 1 cm<sup>3</sup> of Biuret A (sodium hydroxide) into the test tube.
- 3 Put 1 cm<sup>3</sup> of Biuret B (copper II sulphate) into the test tube.
- 4 Observe any colour change and comment on whether protein is present in your results table.

**Testing for glucose**

- 1 Put 2 cm<sup>3</sup> of the urine sample into a clean boiling tube.
- 2 Add 2 cm<sup>3</sup> of Benedict's reagent to the urine.
- 3 Heat the urine sample in a boiling water bath.
- 4 Observe any colour change and comment on whether glucose is present in your results table.

**Diagnosis**

- 1 Using the reference table of normal values, identify any abnormalities of the urine sample.
- 2 Using the clinical information table, make a diagnosis based on your findings.

**Write-up**

- Prepare a report of your findings considering:
  - the condition from which each person may be suffering
  - the scientific explanations of your conclusions that relate to kidney function.
  - an explanation of the changes in metabolism that have caused the changes in the urine.

## Lesson Plan

### Urine Analysis –Evaluating and reporting on observations

#### Context

A practical investigation set in the context of 9700 Syllabus – **section N – excretion, control of water and metabolic wastes**. The investigation will improve understanding of urine production and removal of metabolic wastes and develop a students' evaluating skills. It is anticipated that students will have completed an AS practical course so that they will have good basic practical skills and will be familiar with tests for reducing sugar and protein.

#### Key aims of lesson

This practical is designed to develop the skills of making and recording observations. In addition students will also evaluate observations and experimental data in relation to theoretical knowledge.

#### Intended learning outcomes

By the end of this practical and its write-up a student should be able to:

- Use relevant scientific methods to produce a set of data.
- Record data reliably, using appropriate scientific terminology.
- Diagnose a medical condition via analysis of a sample of 'urine'.
- Analyse data and produce a reasoned, valid conclusion.
- Support conclusions with evidence gathered from a reference table.
- Explain results in relation to theoretical knowledge.

#### Resources required

White board or flipchart and suitable pens or blackboard and chalks

Practical materials specified on the Technical Information sheet

Some spare copies of the student worksheet

**Planned activities** (timings can be altered to suit shorter or longer lessons)

Timings/ minutes	Teacher / Student Activities
End of previous lesson	<b>Preparation</b> – students given theory on urine production. Students to consider possible problems that could arise during urine production. This could be presented as class discussion. Students to be reminded of Benedict's test and Biuret test, as experienced in AS syllabus.
0-4	<b>Introduction</b> to the aims, intended outcomes and shape of the lesson - teacher led oral presentation
4-8	<b>Context</b> – briefly discuss urine production and potential problems with it – teacher led discussion / question and answer session.
8-12	<b>Introduction to method</b> – teacher to discuss appropriate terms to describe colour, clarity, and odour of urine. Teacher demonstration of correct way to determine odour. Optional teacher demonstration of Benedict's and Biuret tests.
12-20	<b>Student preparation exercises</b> – students to work through second box on page 1.

20-50	<b>Carrying out the practical</b> – students carry out entire investigation on at least 1 urine sample (all three samples, time permitting) and tidy away apparatus when they have finished.
50-60	<b>Drawing together the threads</b> - teacher-led discussion on the diagnoses the students have come to. Discussion on skills used and developed. Introduction to write up, students to complete report as homework.

### Useful information

Students should construct a table that shows the tests carried out, the results obtained and any conclusions based on the results of the tests.

Explanations of the results should be related to metabolic reactions and the role of the kidney, giving reasons why sample 1 is more likely to be from a diabetic than sample 3, why sample 2 is more likely to be from a person with protein urea and why sample 3 is more likely to be from a person with renal failure.

Students should make reference to;

- the role of the liver in converting glucose to glycogen and the role of the pancreas in monitoring and responding to glucose concentration in the blood,
- the role of the kidney is reabsorption of glucose and the effect of high blood glucose on reabsorption,
- the structure of the Bowman's capsule and capillary wall in relation to pore size and the 'normal' filtration of these layers,
- A suitable table of results would incorporate columns indicating the number of the urine sample being tested and rows indicating the test results of each of the different urine tests. A final row could indicate the proposed diagnosis of each particular sample.

The following is a brief guide to the clinical problems indicated by abnormal urine results, in relation to this investigation:

<b>Colour</b>	colourless or pale	diabetes or chronic kidney / renal disease
<b>Appearance</b>	hazy or cloudy	bacterial infection or blood cells present
<b>Odour</b>	ammonia foul or putrid sweet or fruity	urea breakdown by bacteria bacterial infection diabetes mellitus (sugar diabetes)
<b>pH</b>	<4.5 >8.0	respiratory acidosis or starvation urinary tract infection
<b>Protein</b>	present	protein urea or renal disease
<b>Glucose</b>	present	diabetes mellitus or renal disease

### Technical Information

#### Urine Analysis –Evaluating and reporting on observations

- Prepare 3 'urine' samples as follows:

*Sample 1 (patient suffering from diabetes)*

250 cm<sup>3</sup> distilled water  
1 g sodium chloride  
1 g potassium phosphate  
2 g glucose powder  
A few drops of fruit juice  
to give a fruity smell

*Sample 2 (patient suffering from protein urea)-*

250 cm<sup>3</sup> distilled water  
1 g sodium chloride  
1 g potassium phosphate  
1 g albumen powder  
3 cm<sup>3</sup> 1M ammonia  
(pH10)

*Sample 3 (patient suffering from renal disease)-*

250 cm<sup>3</sup> distilled water  
1 g glucose powder  
1 g albumen powder

- All samples can be coloured to appear more realistic by adding tea, yellow ink, food colouring or dye.
- Albumen powder may be substituted by other proteins, for example 1 cm<sup>3</sup> egg white.

The **apparatus and materials** required for this are listed below.

The amount of apparatus listed is for **one student or one group of students** if they are to work in groups.

For some of the chemicals, it is convenient to make up more than is required in order to give sufficient quantities for accurate measurement.

- The 'urine' samples may be prepared up to a week in advance but may require either gently shaking or inverting prior to use as particulate matter will settle.
- It is suggested that students complete a whole investigation on each urine sample but to save time, some students could investigate only sample 1, some only sample 2 and some only sample 3 and then the class may share results.

- 1 10 cm<sup>3</sup> of each 'urine' sample
- 2 Benedict's reagent
- 3 Biuret A solution (Sodium hydroxide)
- 4 Biuret B solution (Copper II sulphate)
- 5 Universal indicator paper and comparison chart
- 6 Test tube
- 7 Boiling tube1

- 8 250 cm<sup>3</sup> beaker
- 9 3 dropping pipettes or other suitable pipette
- 10 Bunsen burner, tripod and gauze – or access to a water bath set at >60°C)
- 11 6 x 10 cm<sup>3</sup> graduated pipettes / syringes / measuring cylinders

Safety Precautions/Risks.

Sodium chloride = H (Irritant only)



Ammonia = C, N



Benedict's = H, N



A risk assessment should be carried out as a matter of course.