VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education 2015

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER | | | | | | | | | Letter |

VCE VET LABORATORY SKILLS

Written examination

Wednesday 18 November 2015

Reading time: 9.00 am to 9.15 am (15 minutes)
Writing time: 9.15 am to 10.45 am (1 hour 30 minutes)

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	20	20	20
B	20	20	80
			Total 100

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers and one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

Materials supplied
- Question and answer book of 19 pages.
- Answer sheet for multiple-choice questions.

Instructions
- Write your **student number** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- All written responses must be in English.

At the end of the examination
- Place the answer sheet for multiple-choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

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SECTION A – Multiple-choice questions

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** for the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1

When opening the mouth of a culture container, the correct technique is to

A. hold the lid in your fingers.

B. flame the lid until it glows red.

C. place the lid face-up on the bench.

D. place the lid face-down on the bench.

Question 2

A sample of iodine-stained potato cells is viewed under a light microscope at 400× total magnification.

Which of the following structures would be visible?

A. a few scattered green organelles

B. many clustered dark-blue granules

C. a single light-blue sphere in each cell

D. yellow lines across the surface of many cells

Question 3

A pathology laboratory technician notices that a co-worker has not been following the standard operating procedure (SOP).

The technician should

A. report the situation to the supervisor.

B. do nothing as it is not part of their job role.

C. advise the co-worker to think about what they are doing.

D. talk the situation over with a friend before doing anything.

Question 4

A standard solution of 0.105 M hydrochloric acid (HCl) has been prepared in a volumetric flask.

It is best practice to store the solution in a labelled

A. volumetric flask.

B. reagent bottle with a screw cap.

C. beaker with a watch glass on top.

D. measuring cylinder with a rubber stopper.

Question 5

Sampling plans are used in food testing to

A. prevent microbial contamination.

B. reduce the amount of waste materials.

C. assess the presumed 'safety' of foods.

D. ensure adherence to good manufacturing practices.

Question 6

When performing a titration between nitric acid (HNO_3) and a solution of potassium hydroxide (KOH), where the HNO_3 is the titrant, the conical flask should be rinsed with

A. tap water.

B. distilled water.

C. the KOH solution.

D. the HNO_3 solution.

Question 7

To observe bacterial cells on a slide in detail, you should use a

A. 40× objective with a blue filter.

B. 40× phase contrast objective lens.

C. 100× objective with oil on the slide.

D. 100× objective with water on the slide.

Question 8

The calibration marks on a piece of glassware are very faint and hard to read.

What action should be taken?

A. Report the glassware to the laboratory's purchasing officer.

B. Use a permanent marker to redraw the calibration marks.

C. Continue using the glassware as new glassware can be expensive.

D. Clean the glassware more thoroughly to see if the marks become clearer.

Question 9

A technician has decanted 200 mL of a stock solution of sodium chloride to use in a test. After the test has been completed, there is 50 mL of stock solution remaining.

What should be done with the remaining solution?

A. Pour it down the sink.

B. Use a funnel to pour it back into the stock solution bottle.

C. Pour it into the toxic-waste disposal bottle in the fume cupboard.

D. Keep it on the bench for the next time that stock solution is needed.

Question 10

A number of streak plates of stock cultures have been prepared.

The best method for disposing of the stock cultures is to

A. pour them into a container of 70% w/v ethanol, leave for 30 minutes and then pour down the sink.

B. heat them in an oven at 60 °C for 60 minutes and then pour down the sink.

C. autoclave at 121 °C for 60 minutes and then pour down the sink.

D. place them in the biohazard bag for incineration.

Question 11

43 g of potassium chloride is dissolved in 250 mL of water.

What is the concentration in g/L?

A. 215

B. 172

C. 86

D. 11

Question 12

The correct position for the label on an agar plate is

A. on the inside of the lid.

B. in the centre of the base.

C. around the edge of the lid.

D. around the edge of the base.

Question 13

The process by which cells engulf materials from the outside environment is called

A. phagocytosis.

B. plasmolysis.

C. cytolysis.

D. osmosis.

Question 14

What is the best way to dispose of unused concentrated hydrochloric acid?

A. Return it to the stock bottle for re-use.

B. Pour the undiluted acid down the sink.

C. Dilute it 50:50 with water and then pour it down the sink.

D. Neutralise it with sodium carbonate and then pour it down the sink.

Question 15

What is the v/v% concentration achieved when 10 mL of ethanol is mixed with enough water to make 200 mL of solution?

A. 2

B. 5

C. 10

D. 20

Question 16

To inoculate an agar deep with a bacterial culture, the most appropriate equipment to use would be a

A. glass ‘hockey stick’ heated in a Bunsen burner flame until it glows red.

B. glass rod dipped in 80% v/v ethanol and passed through a Bunsen burner flame.

C. needle heated in a Bunsen burner flame until it glows red, and then cooled by touching the agar.

D. wire loop heated in a Bunsen burner flame until it glows red, and then cooled by touching the agar.

Question 17

A supervisor might organise laboratory staff into work teams because

A. the members of each team are friends and like to spend time together.

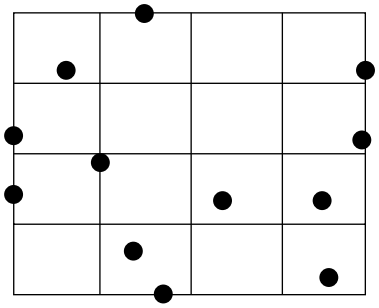
B. having teams will save the company money by reducing the use of resources.

C. staff will be able to showcase their individual achievements within the group.

D. team members complement each other's skills and knowledge to achieve a goal.

Question 18

A technician has performed a cell count using a haemocytometer, or counting chamber. Below is an image of the counting grid.



What is the number of cells counted?

A. 12

B. 10

C. 9

D. 8

Question 19

When preparing multiple slides from different patient samples, the best way to reduce the chance of cross-contamination is to

A. use a fume cupboard to store the prepared slides.

B. sterilise all equipment before beginning to prepare the slides.

C. wipe the bench surface with 70% w/v ethanol between each sample.

D. open all the sample containers at the same time to reduce over-handling.

Question 20

A technician in a food-testing laboratory has noticed that a product labelled 'nut free' has, on three occasions, been found to contain nuts.

What action should the technician take?

A. Re-test the samples and record the results.

B. Discuss the results with work colleagues.

C. Write to the manufacturer to let them know that their quality control is poor.

D. Report the results to the laboratory manager using the laboratory reporting system.

END OF SECTION A
TURN OVER

SECTION B – Short-answer questions

Instructions for Section B

Answer **all** questions in the spaces provided.

Question 1 (5 marks)

Nutrient agar powder is a mixture containing the following components:

- beef extract 10.0 g
- peptone 10.0 g
- sodium chloride 5.0 g
- agar 15.0 g

This is sufficient to make 1 L of nutrient agar.

Each agar plate requires 15 mL of nutrient agar for it to be filled to the correct level.

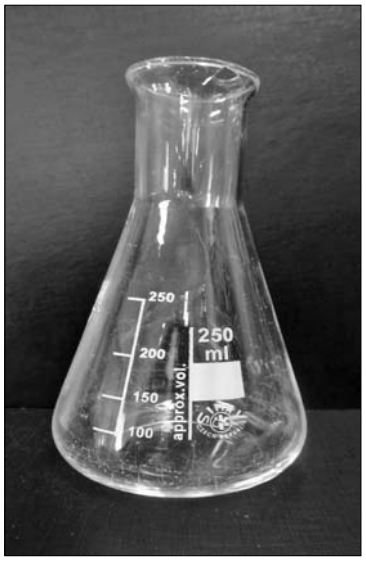
a. Calculate the weight of nutrient agar powder needed to make a batch of 50 nutrient agar plates. Show your working. 2 marks

b. What is the purpose of agar in the medium of nutrient agar? 1 mark

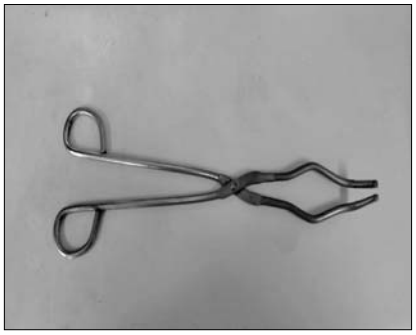
c. What are the **two** nutrient sources included in the above list of components? 2 marks

Question 2 (4 marks)

Name each of the following pieces of laboratory equipment.



1. _____ 2. _____



3. _____ 4. _____

Question 3 (2 marks)

a. What is a buffer solution? 1 mark

_____

_____

b. Suggest **one** use of a buffer solution in a laboratory setting. 1 mark

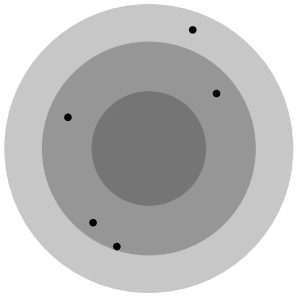
_____

_____

Question 4 (3 marks)

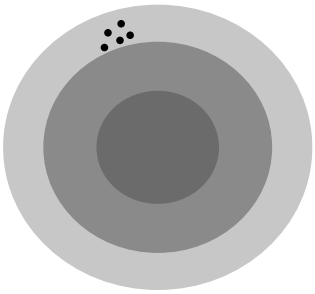
a. Which one of the following diagrams is paired with the correct description? Explain your answer. 2 marks

Diagram A



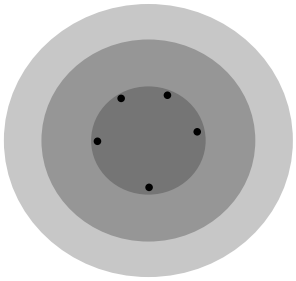
good accuracy
poor precision

Diagram B



poor accuracy
good precision

Diagram C



good precision
good accuracy

Diagram ☐

b. Why is it important to calibrate equipment? 1 mark

Question 5 (6 marks)

Binocular microscopes are used to examine prepared slides in laboratories.

a. List **three** items of equipment required for the care of a binocular microscope. 3 marks

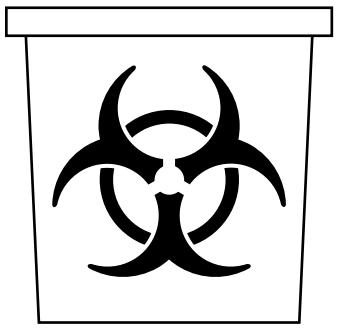
b. Give **three** examples of safety precautions necessary when using a binocular microscope. 3 marks

Question 6 (3 marks)

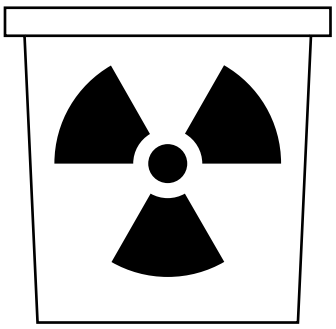
a. What are **two** examples of how waste can be minimised in a laboratory? 2 marks

b. Which one of the bins shown below should be used for biological waste? Circle your choice. 1 mark

1.



2.



Question 7 (5 marks)

a. A technician needs to prepare 500 mL of a standard solution of 0.500 M potassium chloride (KCl), molar mass 74.6 g/mol.

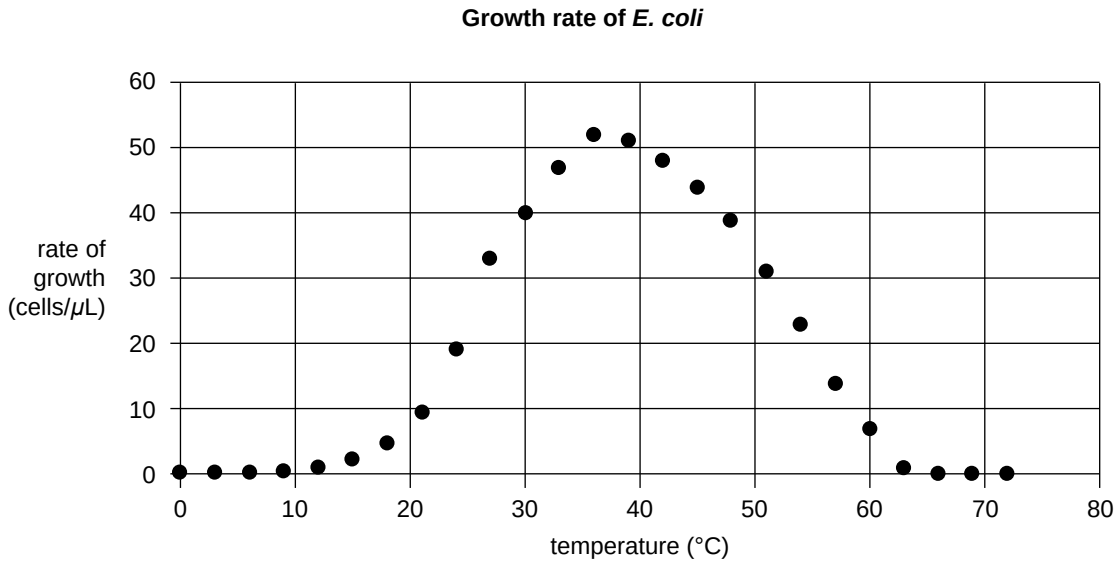
Calculate the mass of potassium chloride required to prepare this solution. 2 marks

b. Identify the glassware that should be used to prepare the solution. 1 mark

c. In the space provided below, write a suitable label for the storage bottle containing the solution prepared in **part a.** 2 marks

Question 8 (2 marks)

The graph below shows the rate of growth of *Escherichia coli* (*E. coli*) at various temperatures.



a. Describe what would happen to a culture of *E. coli* that was heated to 70 °C and then cooled to 35 °C. 1 mark

b. What would happen to a culture of *E. coli* if it was cooled to 10 °C and then heated to 35 °C? 1 mark

Question 9 (4 marks)

The following samples have arrived at the testing laboratory for examination under a light microscope: pus from a wound and water from a river.

For each sample, suggest an appropriate preparation of the sample slide and staining procedure, if required. Give a brief description of the possible results or observations for each sample.

- Pus from a wound

  Slide preparation and staining procedure (if required)

  _____

  _____

  Possible results

  _____

  _____

- Water from a river

  Slide preparation and staining procedure (if required)

  _____

  _____

  Possible results

  _____

  _____

Question 10 (2 marks)

A technician has been asked to pipette 20.0 mL of lead nitrate ($Pb(NO_3)_2$) solution into a flask for a particular test. The SOP requires that 30 mL of $Pb(NO_3)_2$ is poured from the stock bottle into a clean beaker, then 20.0 mL is pipetted from the beaker into the flask required.

a. What should be done with the $Pb(NO_3)_2$ remaining in the beaker? 1 mark

_____

_____

b. What could occur if the 20.0 mL is pipetted straight from the stock bottle? 1 mark

_____

_____

Question 11 (6 marks)

Peter works for a company that tests water quality. One routine laboratory procedure he performs is a most probable number (MPN) count of the number of coliforms (gram-negative bacteria) found in water samples from the city's beaches. The SOP determining the MPN is shown below.

Procedure name: The 15-tube multiple dilution technique for estimating the MPN of coliforms, including *E. coli*

Step 1: Water samples are inoculated into a set of five tubes containing improved formate-lactose-glutamate liquid media (IFLG, Oxoid) at each required dilution (i.e. 5 tubes × 10 mL of sample, 5 × 1 mL of sample and 5 × 0.1 mL of sample).

Step 2: Tubes are incubated at 37 °C for 48 hours.

Step 3: Tubes are inspected for growth at 24 hours and 48 hours, and the combination of positive tubes is used to calculate the MPN of coliforms per 100 mL using Table 1, provided below.

Table 1. Most probable number (MPN)

No. of tubes giving a positive reaction			**MPN**
5 × 10 mL	**5 × 1 mL**	**5 × 0.1 mL**	**(per 100 mL)**
0	0	0	<2
1	1	0	4
2	0	0	5
2	2	0	9
2	3	0	12
3	1	1	14
3	2	1	17
4	1	0	17
4	2	1	26
4	3	1	33
5	1	1	46
5	2	0	49
5	2	2	94
5	3	1	110

a. What would Peter use to inoculate the tubes of liquid media? Give a reason for your answer. 2 marks

b. Referring to the MPN in Table 1, explain why multiple tubes of each dilution are used in this procedure. 1 mark

c. Peter counted the number of positive tubes and his results were as follows:

- 10 mL tubes – 5 positive
- 1 mL tubes – 2 positive
- 0.1 mL tubes – 0 positive

He used the MPN table (Table 1) to work out the number of coliforms per 100 mL of sample.

What was his result? 1 mark

d. Peter repeated the procedure on another sample of water from a different beach. His results were as follows:

- 10 mL tubes – 0 positive
- 1 mL tubes – 2 positive
- 0.1 mL tubes – 5 positive

Give **two** procedural errors that could lead to these results. 2 marks

Question 12 (2 marks)

Explain the meaning of the term ‘meniscus’. Include a diagram to support your explanation.

Question 13 (5 marks)

A technician is required to conduct a titration between a standard 0.232 M sodium hydroxide (NaOH) solution and an oxalic acid ($H_2C_2O_4$) solution that is known to have a concentration of about 0.12 M. The equation for the reaction is

$$2NaOH(aq) + H_2C_2O_4(aq) \rightarrow Na_2C_2O_4(aq) + 2H_2O(l)$$

25.0 mL aliquots of the NaOH solution are added to a conical flask and are titrated with the $H_2C_2O_4$ solution using phenolphthalein as the indicator.

Indicator	Colour on acidic side	pH interval for colour change	Colour on basic side
thymol blue	red	0.0–1.6	yellow
bromophenol blue	yellow	3.0–4.6	blue
phenolphthalein	colourless	8.0–10.0	pink
alizarin yellow	yellow	10.0–12.0	red

a. Using the information in the table above, state the colour change at the end point. 1 mark

b. If the average titre is 26.2 mL, calculate the concentration of the $H_2C_2O_4$ solution.
Show your working. 2 marks

c. What is the difference between the terms ‘end point’ and ‘equivalence point’? 2 marks

Question 14 (3 marks)

A supervisor has asked a technician to check the prepared media stocks in the laboratory refrigerator to see if they are still suitable for use.

List **three** things the technician should check and report to the supervisor.

Question 15 (4 marks)

Sephora works in a busy pathology laboratory where she is responsible for the sterilisation of equipment and the disposal of biohazardous waste materials.

Describe how she would be expected to sterilise or dispose of the following equipment and materials.

- Cotton swabs to be used for sample collection

- Clean conical flasks

- Used micro-pipette tips

- Used scalpel blades

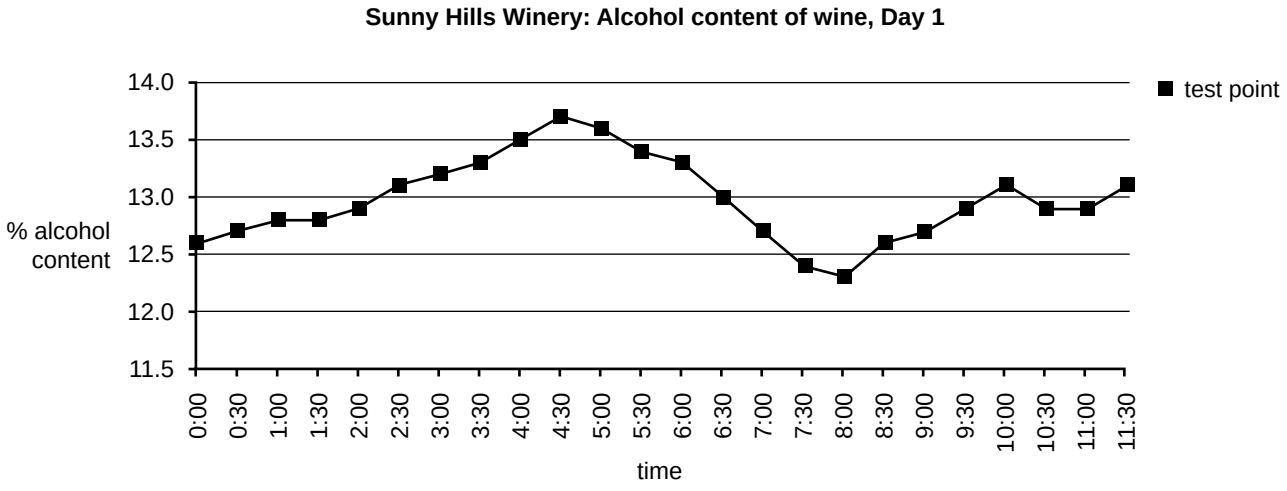
Question 16 (4 marks)

a. Give **two** reasons why following the 'right first time' objective should result in better work practices. 2 marks

b. Should it be part of a laboratory technician's role to make suggestions regarding improvements to their work practices? Give a reason for your answer. 2 marks

Question 17 (5 marks)

The graph below shows the alcohol content of wine made at the Sunny Hills Winery on a particular day. The alcohol content should be within the 12.5% v/v to 13.5% v/v range.



a. Draw lines on the graph above to assist in monitoring the range of % alcohol content. 1 mark

b. At which test points was the wine out of the specified range of % alcohol content? 2 marks

c. Give **two** reasons why it is important that the alcohol content of the wine be kept within the specified range. 2 marks

Question 18 (4 marks)

a. Explain what happens if a bacterial cell is placed in a hypertonic solution (a solution that has a higher solute concentration than inside of the cell). 1 mark

b. What is the difference between bacterial morphology and bacterial arrangement? 1 mark

c. How would you prepare a bacterial smear from each of the following? 2 marks

- An agar plate
- A broth culture

Question 19 (6 marks)

a. List three parts of a microscope that have a lens through which light passes. 3 marks

1.

2.

3.

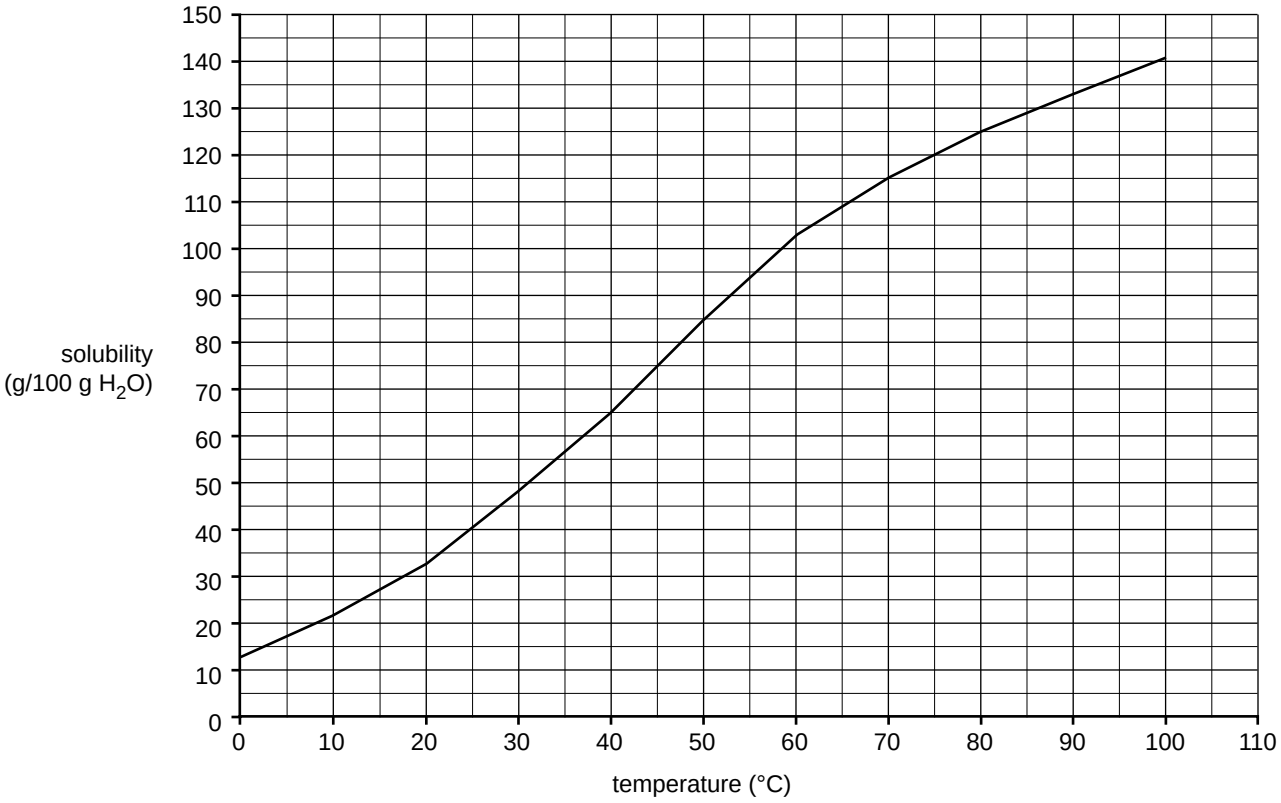
b. Name the method used by microscopists to provide the optimum specimen illumination by aligning the light path correctly. 1 mark

c. When examining a slide, a technician notices a black dot in the field of view. When the slide is moved up or down, left or right, the black mark does not move.

Give a reason for this observation and suggest a way to rectify this problem. 2 marks

Question 20 (5 marks)

The graph below shows the solubility of potassium nitrate in 100 g of water at different temperatures.



a. How much potassium nitrate dissolves in 100 g of water at 60 °C? 1 mark

_____

b. At what temperature will 40 g of potassium nitrate dissolve in 50 g of water? 1 mark

_____

c. How much water at 90 °C will just dissolve 150 g of potassium nitrate? 2 marks

_____

_____

d. What will a technician notice when a solution of 50 g of potassium nitrate in 100 g of water is cooled from 60 °C to 10 °C? 1 mark

_____

_____

END OF QUESTION AND ANSWER BOOK