請考生依指示填寫准考證末兩碼
Fill in the boxes the last 2 digits of exam ID number

基北區臺北市立西松高級中學
112 學年度高級中等學校特色招生考試分發入學測驗

2023 Taipei Municipal XiSong High School Special Enrollment Program Examination for Taipei and Keelung Area

資料判讀測驗
112 年 6 月 25 日（星期日）
測驗時間為 **10:40** 到 **12:00**, 共 **80** 分鐘

Source Analysis
Sunday 25 June 2023
10:40-12:00 (80 minutes)

請閱讀以下測驗作答說明 Instructions to Examinees：

- 請先不要翻到次頁，讀完本頁說明，聽從監試委員的指示才開始作答！
  Do not open this examination paper until instructed to do so.
- 請檢視答案卷上**准考證號碼**與**桌面貼條**是否相符。如有不符，請立即向監試委員反映。
  Please carefully check if your **exam ID number** matches **the ID number on the desk**. If they do not match, please inform the invigilator immediately.
- 資料判讀分為**社會科問答題**及**數理科題組**。社會科答案卷僅一張(雙面)供社會科作答，數理科答案卷亦僅一張(雙面)供數理科作答，請斟酌使用。**若於他科答案卷上應答，不予計分。**
  Source Analysis consists of two sections: **Individuals and Societies** and **Mathematics and Science**. **Only ONE double-sided answer sheet will be provided for EACH section.** Please use them wisely. **No grades will be awarded to the misuse of answer sheets.**
- 試題本和答案卷請保持清潔完整，**不得**汙損、破壞或塗改准考證號碼及條碼。
  Please make sure your examination paper and answer sheets are clean. **Do not** damage or change the exam ID number and bar code.
- 考生**不得**於此份題本內書寫考生姓名、准考證號碼或與答案無關之文字符號。
  Please **do not** write your name, your exam ID number or any content unrelated to the answer on the examination paper.

【測驗語言說明 Instructions of Language Use】

本測驗的所有題目均有中英文翻譯，考生請自行選擇自己擅長之語言來閱讀及作答。但答題時請勿夾雜中文與英文，請使用同一語言作答。

All the questions are written in both Chinese and English languages. Please be consistent with language when answering the questions, only in **English** or **Chinese**. **Do not mix up languages.**

- **資料判讀**測驗題目採雙面印刷，共 **17** 頁
  Source Analysis is printed double-sided, **17** pages in total.

【第一部分—社會科問答題】【Section 1－Individuals and Societies】

請先閱讀以下資料，並回答下列問題。
（※試題請統一以同一語言作答，可選擇全部使用中文或英文回答，請勿夾雜英文及中文。）
Read the source given below and answer the question in **English** or **Chinese**.
Language mixing is not allowed.

以圖表中的數據為基礎，說明此資料與時事的連結，並討論其欲傳達的觀點。
（建議文長：350 至 500 字；共 50 分）
Based on the statistics shown in the graph below, describe the connection between the source and current events, and discuss what point of view(s) the source is trying to express.
(Recommended word count: 300 to 450 words; maximum mark: 50)

【第二部分—數理科計算題組】

請根據題目要求回答問題，答題時請詳細寫下解題過程。

（※試題請統一<u>以同一語言作答</u>，可選擇<u>全部使用</u>中文或英文回答，請勿夾雜英文及中文。）

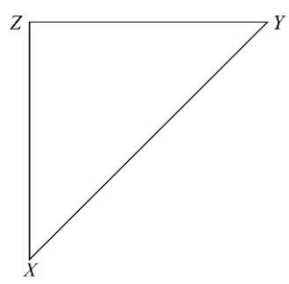
<u>第 1 題：共 6 分</u>

已知 ΔXYZ 為等腰直角三角形，且 $\overline{XZ}=\overline{YZ}=32$。如圖一，在 ΔXYZ 的三邊各取中點 A、B、C，使得 $\overline{AB}$、$\overline{BC}$、$\overline{AC}$ 將 ΔXYZ 切割為四塊三角形，再將 ΔAZB 塗黑；接著在下方的 ΔXAC 三邊各取中點 D、E、F，並將 ΔDAE 塗黑，依照此規則繼續做下去，在 ΔXDF 的三邊各取中點 G、H、K，並將 ΔGDH 塗黑。重複這樣的步驟 6 次可得圖六，試求：

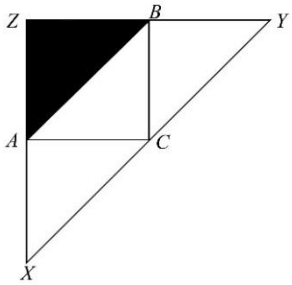
(a) ΔAZB 的面積。（1 分）

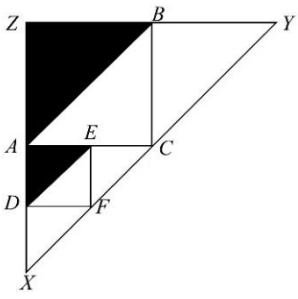
(b) 與圖三相比，圖四中增加的黑色三角形面積。（3 分）

(c) 圖六中 6 塊塗黑的三角形面積總和。（2 分）

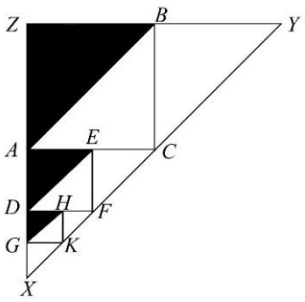


圖一





圖二



圖三

<u>第 2 題：共 5 分</u>

教室裡 Lisa 和其他 9 位同學圍成一圈進行遊戲活動，由 Lisa 開始喊數字 1，第二個人喊 2，第三個人喊 3，第四個人喊 4，直到第 10 個人喊 10，再輪回 Lisa 喊 11，依序以此類推。過程中只要喊到的數字為 3 的倍數或數字中有 3，皆拍手一次，而不喊號碼。例如：數字 3，拍手一次；數字 33，拍手一次；數字 37，拍手一次。請問從數字 1 喊到數字 100，所有人總共拍手了多少次？

第 3 題：共 14 分

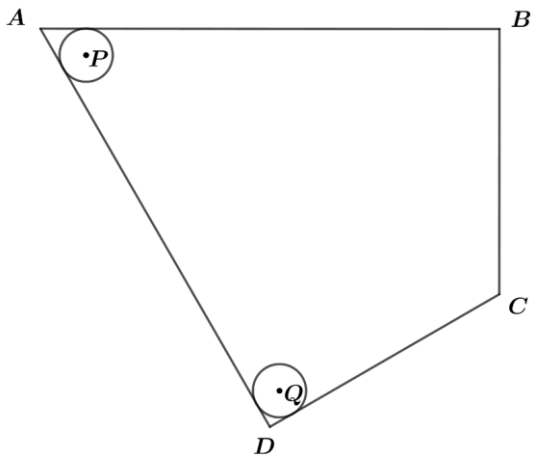
如圖七所示，西松親子遊戲區為一個四邊形 $ABCD$ 的空間，已知 $\angle ABC$ 及 $\angle ADC$ 皆為直角，$\angle BCD$ 為 $\angle BAD$ 的兩倍，$\overline{AC}$ 垂直 $\overline{BD}$，且 $\overline{BC}=\overline{CD}=4$ 公尺。某天，工作人員為了清掃遊樂區，買了一台直徑為 40 公分的圓形掃地機器人。已知掃地機器人從 A 處角落出發，出發時的機器中心為 P 點，且機身分別與 $\overline{AB}$、$\overline{AD}$ 相切，沿著 $\overline{AD}$ 清掃地面，到達 D 處角落，此時機器中心為 Q 點，且機身分別與 $\overline{AD}$、$\overline{CD}$ 相切，接著沿著牆邊 $\overline{CD}$、$\overline{BC}$、$\overline{AB}$ 依序清掃後，再進行內部區域清潔。試求：

(a) $\angle BCD$ 的值。（2 分）

(b) $\overline{PQ}$ 的長度。（4 分）

(c) 四邊形 $ABCD$ 區域內掃地機器人無法清掃到的區域面積總和。（5 分）

(d) 若管理單位想要製作一個圓形護欄將遊戲區圍住，試求此圓形護欄的直徑最小值。（3 分）



圖七

第 4 題：共 11 分

請閱讀下列文本並回答問題

以人類唾液作為表面清潔劑

2018 搞笑諾貝爾化學獎

唾液長期以來被廣泛用作各種表面的清潔劑，並表現出良好的清潔力，有些文物保存研究者指出，他們更喜歡用自己的唾液來清潔脆弱的油畫表層，而不是使用一般的溶劑。為了更認識其科學原理並找出更衛生的替代品，葡萄牙里斯本的 Paula M. S. Romão 開始了以下研究。

他準備了數種溶劑，包含唾液、松香水、2-甲基庚烷和甲苯，對 18 世紀的藝術品進行了溶解性(solubility)測試，用以比較不同溶劑對古物表面顏料的清潔程度，針對油畫顏料的清潔效果，結果如下表：

油畫顏料顏色	黑色	粉紅色	綠色	紅色
唾液	＋	＋	＋	＋
松香水	±	－	－	±
2-甲基庚烷	±	－	－	－
甲苯	±	－	－	±

＋：顏料不溶且清潔效果佳 和／或 溶劑不會滲入顏料層中、
－：與「＋」效果相反、±：介於「＋」「－」效果之間

研究中推測唾液可清潔表面的原理，可能和唾液中的酶促作用(Enzymatic action)和洗滌作用(Washing action)有關。酶促作用是指由酶作為催化劑來催化的化學反應，當唾液酶催化髒污分解時，有些物質會溶解在水中；洗滌作用則和水的活性有關。

為了確認酶促作用是否有效，他分離出天然食物中含的 α-澱粉酶，用以和普通唾液、透析過的唾液和變性唾液的清潔能力進行比較。結果發現，在四個樣品中，天然食物中的 α-澱粉酶的清潔能力與普通唾液相似，透析並不影響唾液清潔能力，但變性唾液的清潔能力最差。

另外經由其他實驗發現，脂肪酸和磷脂會凝集有機物中的蛋白質，進而形成污垢，而唾液中的另外兩種酶，水解酶可以催化脂肪酸的分解、脂酶可以催化磷脂的分解，使唾液有著優良的表面清潔能力。

現今市面上有很多酵素清潔劑，和唾液分解髒污的原理相似，透過這些產品的開發讓我們在清潔藝術品時有更衛生的選擇，所以下次看到物品上的污垢時，可不要再把口水塗上去了！

(a) 研究中發現，有機溶劑(松香水、2-甲基庚烷和甲苯)容易溶解油畫顏料或滲入油畫顏料中，根據此結果，可以推測什麼原因會影響物質的溶解度？（2分）

(b) 酶促作用在催化反應時，通常只能作用於單一種物質，並產生特定的生成物，酶的此種特性稱之為何？（2分）

(c) 試用實驗室常用的方法，說明一種製備「變性唾液」的方法，並說明唾液變性後清潔能力不佳的原因。（2分）

(d) 根據文章，唾液的表面清潔能力可能和哪些酵素有關？(全對才給分)（1分）

(e) 某生受此實驗啟發，想進一步研究「唾液的 pH 值是否會影響其清潔能力」，試設計出該研究所需的實驗記錄表格，並舉出兩種實驗中的控制變因。（4分）

第 5 題：共 14 分

請閱讀下列文本並回答問題

水果電池

我們可以應用鋅銅電池的原理製作一個檸檬電池。將鋅片與銅片插入檸檬中，因檸檬富含維他命 C (抗壞血酸)而呈酸性，酸性溶液中的氫離子在正極被還原成氫氣、而活性較大的金屬片則在負極被氧化。此氧化還原機制，會在兩金屬片之間產生電位差，使檸檬電池可產生足夠的電流讓燈泡發亮，如下圖 8。

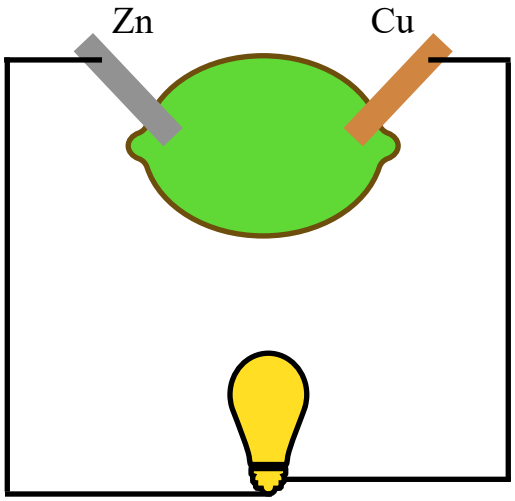


圖 8

(a) (i) 試指出檸檬電池中，作為正極和負極的金屬分別為何。(2 分)

(ii) 試分別列出檸檬電池正極與負極的半反應（需平衡）。(2 分)

然而，檸檬電池並不是一個完美的導體。檸檬電池內部的物質組成會構成電阻，稱此為內電阻 (r)。當電流流經檸檬電池內部時，有些能量會因內電阻而消耗，導致檸檬電池放電時，兩端的端電壓值（V_t）比理想的電壓值（V_i）還低。而這電壓的差值來自於電池的內電阻。下圖 9 為電池內部的基本模型，且流經該電池的電流為 I。因此，V_t 與 V_i 的關係為：$V_t = V_i - Ir$。

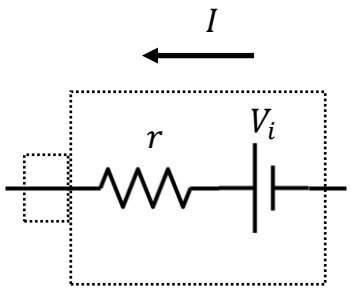


圖 9

為了測量檸檬電池內部的內電阻，可將檸檬與外部的可變電阻連接形成迴路。當改變可變電阻的量值時，測量檸檬電池兩端的端電壓 V_t 與流經檸檬電池的電流 I。測量電壓的工具為伏特計，而測量電流的工具為安培計。

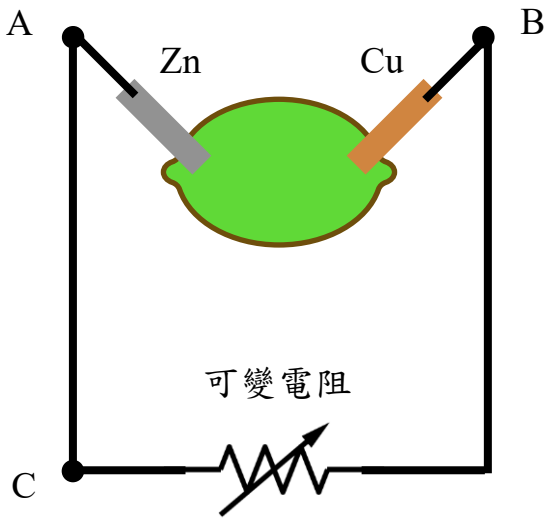


圖 10

(b) 為測量檸檬電池兩端的端電壓，依據上圖 10，試說明伏特計應連接哪兩點或是取代哪一線段。（1 分）

(c) 為測量電流流經檸檬電池兩端的數值，依據上圖 10，試說明安培計應連接哪兩點或是取代哪一線段。（1 分）

下表 1 為根據圖 10 的實驗裝置，測量出檸檬電池端電壓與電流的資料表。

端電壓 V_t (V)	電流 I (A)
1.08	0.05
0.96	0.10
0.84	0.15
0.72	0.20
0.60	0.25

表 1

(d) (i) 根據上表 1 的資料，以端電壓為 y 軸，電流為 x 軸，請在答案紙上，繪製端電壓與電流的關係圖。（3 分）

(ii) 試求出端電壓與電流的直線方程式。（1 分）

(e) 試求出檸檬電池內部的內電阻 r (Ω)。（1 分）

(f) 試求出檸檬電池的理想電壓 V_i (V)。（1 分）

(g) 不考慮此檸檬電池的內電阻，若今欲透過串聯或並聯檸檬電池，用來驅使 3.5V 的 LED 燈泡，其方法和數量分別為何？（2 分）

【Section 2—Mathematics and Science】

Answer the question according to the requirements of the prompt and provide a detailed explanation of the solving process.

Answer the question in **English** or **Chinese**. **Language mixing is not allowed.**

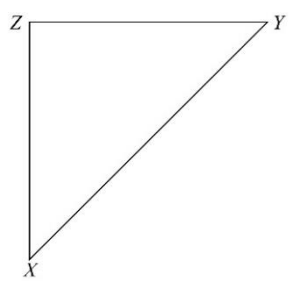
Question 1. [Maximum marks: 6]

ΔXYZ is an isosceles right triangle, where $\overline{XZ} = \overline{YZ} = 32$. As shown in Figure 1, connect the midpoints A, B, and C of each side of ΔXYZ, so that $\overline{AB}$, $\overline{BC}$, $\overline{AC}$ cut ΔXYZ into four triangles, and shade ΔAZB black. Continue by connecting the midpoints D, E, and F of each side of ΔXAC, and shade ΔDAE black. Continue by once again connecting the midpoints G, H, and K of each side of ΔXDF, and shade ΔGDH black. Repeat this procedure 6 times in total to produce Figure 6. Find:

(a) the area of ΔAZB. [1]

(b) the area of the black triangle newly added in Figure 4, comparing to Figure 3. [3]

(c) the total area of the six shaded triangles in Figure 6. [2]



Figure

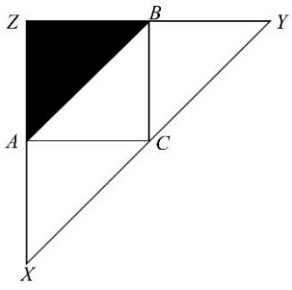


Figure 2

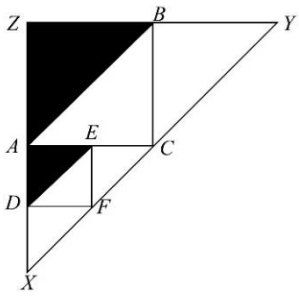
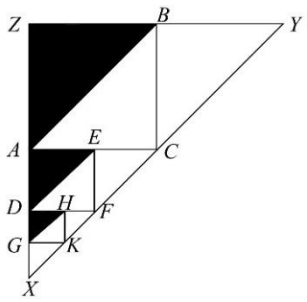


Figure 3



Question 2. [Maximum marks: 5]

Lisa and her 9 classmates form a circle in their classroom to play a game. Lisa starts by saying the number 1, the second person says 2, the third person says 3, the fourth person says 4, …, and the tenth person says 10. Then it goes back to Lisa who says 11, and so on in order. If the number being said is a multiple of 3 or contains the digit 3, clap once instead of saying the number. For example: if the number is 3, clap once; 33, clap once; 37, clap once. If they continue from 1 to 100, how many times did everyone clap in total?

Question 3. [Maximum marks: 14]

The Xisong parent-child game area is a quadrilateral $ABCD$, as shown in Figure 7. It is known that $\angle ABC$ and $\angle ADC$ are both right angles. Moreover, $\angle BCD$ is twice $\angle BAD$, $\overline{AC}$ perpendicular to $\overline{BD}$, and $\overline{BC} = \overline{CD} = 4$ meters long. One day, in order to clean the game area, the staff bought a circular sweeping robot with a diameter of 40 cm. The robot will begin sweeping from corner A, and we will label the center of the robot at the time of departure as P. Note that the body is tangent to both $\overline{AB}$ and $\overline{AD}$, and the robot will first sweep the ground along $\overline{AD}$ until reaching corner D. At this time, label the center of the robot as Q point, and observe that it is tangent to both $\overline{AD}$ and $\overline{CD}$. Next, the robot will clean along the wall $\overline{CD}$, $\overline{BC}$, $\overline{AB}$ in sequence, before finally cleaning the interior. Find:

(a) the value of $\angle BCD$. [2]

(b) the length of $\overline{PQ}$. [4]

(c) the sum of the areas within the area of the quadrilateral $ABCD$ that the sweeping robot cannot clean. [5]

(d) If the management unit wants to make a circular guardrail to enclose the play area, find the minimum diameter of the circular guardrail. [3]

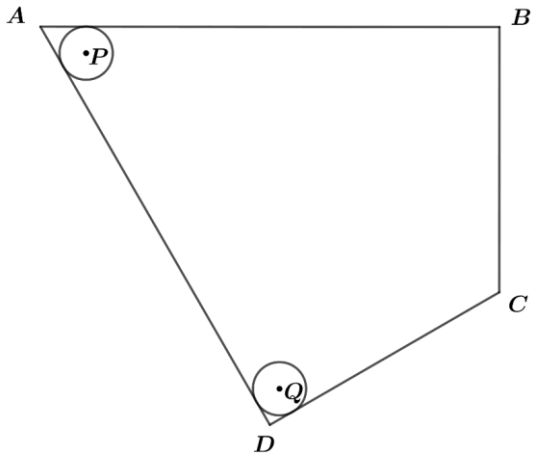


Figure 7

Question 4. [Maximum marks: 11]

Read the following article and answer the questions:

Human Saliva as a Cleaning Agent for Dirty Surfaces

2018 Ig Nobel Prize for Chemistry

Saliva has long been widely used as a cleaning agent for all kinds of surfaces and has shown good performance. It was noticed that some conservators preferred their own saliva to any other solvent for cleaning fragile painted layers. In order to obtain scientific support for these statements and possibly a more hygienic substitute, Paula M. S. Romão from Lisbon, Portugal initiated a research project.

Solubility test was performed on some artworks dating from the eighteenth century, in order to research in a qualitative way the effect of different agents applied on various painting on the surfaces, namely saliva, white spirit, 2-methyl heptane, and methyl benzene. For the cleaning effect of oil paint, the results are as follows:

Colour of oil painting	black	carnation	green	red
Saliva	+	+	+	+
White spirit	±	−	−	±
2-methyl heptane	±	−	−	−
Methyl benzene	±	−	−	±

+ : *no pigment dissolution, good cleaning power and/or no penetration into the paint layer;*

− : *reverse*; ± : *an intermediate situation*

The mechanism of the cleaning process with saliva is related to enzymatic and washing action. Enzymatic action is the chemical reaction that is catalyzed by enzyme; some substances are solubilized in water when saliva enzymes catalyze dirt degradation, and washing action is a result of aqueous activity.

The enzymatic action was confirmed by testing the fractions resulting from the natural food, α-amylase was separated from food and the qualitative result were compared to normal, dialyzed and denatured saliva. All the amylase extracts showed similar behaviour which was essentially identical to normal saliva. Dialysis did not affect saliva cleaning power. Denatured saliva presented a "negative answer" to the qualitative test.

Other experiments confirmed that fatty acid and phospholipids are the main components of dirt and that they agglutinate proteins in organic residues. This is one of the reasons for saliva having good cleaning power on dirty surfaces, the hydrolase catalyzed the degradation of fatty acids and the lipase catalyzed the degradation of phospholipids.

There are many enzyme cleaners on the market today, which are similar to the cleaning principle of saliva. Through the development of these products, we have more hygienic choices when cleaning artworks now. So next time if you see dirt on items, DO NOT put saliva on it!

(a) It is found in the research that organic solvents (pine water, 2-methylheptane and toluene) can easily dissolve oil paints or penetrate into oil paints. According to this result, what factors determine the solubility of a substance in a solvent? [2]

(b) Enzymatic action usually only acts on a single substance and produces a specific product when the enzyme catalyzes a reaction. What is this characteristic of an enzyme? [2]

(c) State one method commonly used in the laboratory to prepare "denatured saliva", and explain the reasons for the poor cleaning ability of denatured saliva. [2]

(d) According to the article, which enzymes may be involved in the surface cleaning ability of saliva? (Marks will be given only if all answers are correct.) [1]

(e) A student was inspired by this experiment and wanted to study "whether the pH value of saliva affects its cleaning ability". Try to design a table to record the experimental data for the study, and list two control variables in the experiment. [4]

Question 5. [Maximum marks: 14]

Read the following article and answer the questions:

Fruit Battery

We can apply the theory of Voltaic cells to make a fruit battery. Zinc and Copper strips can be inserted into a lemon. The lemon is acid because riches in vitamin C. The hydrogen ion of the acid solution is reduced to hydrogen gas at positive electrode. The higher reactivity metal is oxidized at negative electrode. This Redox mechanism can produce the electric potential difference between these two metals. The lemon battery can generate enough electricity to drive the light bulb as you can see in Figure 8.

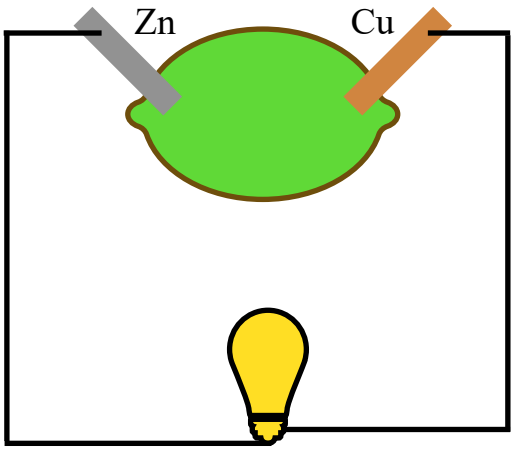


Figure 8

(a) (i) Identify the metal acts as positive electrode and the metal acts as negative electrode. [2]

(ii) Show the balanced half-reaction for both electrodes. [2]

The lemon battery is not the perfect conductors of electricity because the internal substances of the lemon have resistance, called the internal resistance. As current flow through the lemon battery during discharging, some energy will be lost because of its internal resistance, and consequently the terminal voltage (V_t) of the lemon battery is less than the ideal voltage (V_i). The lost voltage of the lemon battery is due to internal resistance (r). The simple model of the lemon battery is shown in Figure 9 and the current flow in the battery is I. So that the relationship between V_t and V_i is: $V_t = V_i - Ir$.

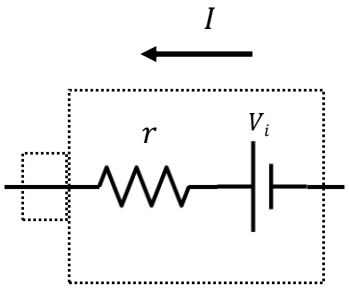


Figure 9

There is a method to investigate the internal resistance of the lemon. The lemon is connected to an external variable resistor to form a circuit. Measure the V_t across the battery and current I flow inside the battery when adjusting the variable resistor.

The terminal voltage of the lemon battery can be measured by a voltmeter and the current flowing inside the lemon can be measured by an ammeter.

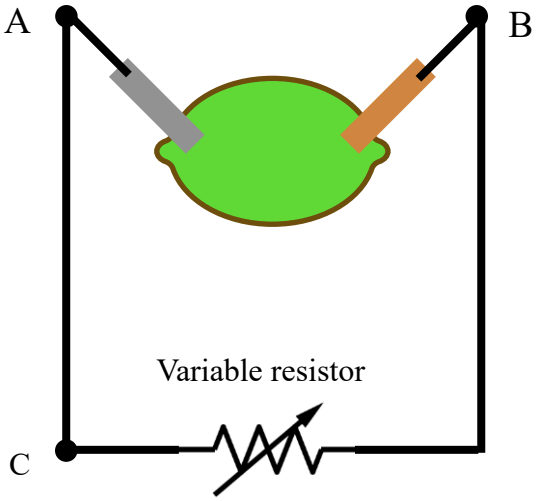


Figure 10

(b) In order to measure the terminal voltage of the lemon battery, which two points should be connected to the voltmeter or which line segment should be replaced to the voltmeter in Figure 10? [1]

(c) In order to measure the current flow of the lemon battery, which two points should be connected to the ammeter or which line segment should be replaced to the ammeter in Figure 10? [1]

According to the experimental set-up in Figure 10, a set of measurement results for the lemon battery is shown in below Table 1.

Terminal voltage, V_t (V)	Current, I (A)
1.08	0.05
0.96	0.10
0.84	0.15
0.72	0.20
0.60	0.25

Table 1

(d) (i) According to Table 1, the terminal voltage V_t acts as y axis and the current I as x axis. Draw the plotted diagram of V_t against I of the lemon battery. [3]

(ii) Deduce the linear equation of terminal voltage and current. [1]

(e) Determine the internal resistance r (Ω) of the lemon battery. [1]

(f) Determine the ideal voltage V_i (V) of the lemon battery. [1]

(g) Explain the set-up method and amount of lemon battery to drive the 3.5V LED bulbs. The internal resistance of the lemon battery is negligible. [2]