



Coimisiún na Scrúduithe Stáit State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2018

PHYSICS AND CHEMISTRY – ORDINARY LEVEL

WEDNESDAY, 20 JUNE – MORNING, 9:30 to 12:30

Six questions to be answered.

Answer any **three** questions from **Section I** and any **three** questions from **Section II**.

All the questions carry equal marks.

However, in each section, one additional mark will be given to each of the first two questions for which the highest marks are obtained.

N.B. Relevant data are listed in the *Formulae and Tables* booklet, which is available from the superintendent.

SECTION I – PHYSICS (200 marks)

1. Answer **eleven** of the following items (a), (b), (c), etc. All the items carry equal marks.
Keep your answers short.

- (a) **Figure 1** shows a robot vacuum cleaner. The vacuum cleaner moves in a straight line at a speed of 0.32 m s^{-1} .
What length of floor would it clean in 5 seconds?



Figure 1

- (b) In the equation, $F = ma$, what does 'a' represent?
- (c) A bag of cement of weight 196 N is lifted 3 m above the ground.
Calculate the work done.
- (d) Name any **two** terminals inside a three-pin plug.
- (e) The temperature on the surface of the moon can reach 123°C .
What is this temperature on the Kelvin scale?

- (f) Give one use for a concave mirror.

- (g) **Figure 2** shows a waveform.
What term is given to the distance marked **X**?

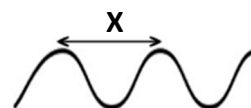


Figure 2

- (h) An electric shower rated at 9 kW is in use for 6 minutes.
Calculate the number of units (kW h) used.

- (i) **Figure 3** shows a bar magnet.
Copy the diagram and sketch the magnetic field lines around the bar magnet.



Figure 3

- (j) Copy and complete the following statement:
"A carrying conductor in a magnetic field experiences a"
- (k) The electrical force between two identical point charges is 0.24 N.
State the value of the force if the magnitude of *each* charge were doubled.
- (l) Give one use of a gold leaf electroscope.
- (m) List the following types of electromagnetic radiation in order of *increasing* energy:
x-rays gamma ultraviolet
- (n) Which part of an atom of a radioactive isotope is unstable?
- (o) State Einstein's equation which relates energy and mass.

(11 × 6)

2. What is meant by (i) potential energy, (ii) kinetic energy?
State the law of conservation of energy. (18)

Figure 4 shows a diver of mass 60 kg about to step off a platform and drop into a pool which is 7.5 m below.

What is the potential energy gained by the diver when she climbs on to the platform from pool level? (9)

At an instant during the drop the diver's potential energy is 3,660 J. Calculate

- the kinetic energy of the diver at this instant
- the speed of the diver at this instant.

Calculate how long it takes, from the instant she steps off the platform, for the diver to strike the water 7.5 m below.

The next dive is from the 10 m platform.

Does the speed at which she strikes the water change?

Explain your answer.

[acceleration due to gravity, $g = 9.8 \text{ m s}^{-2}$]

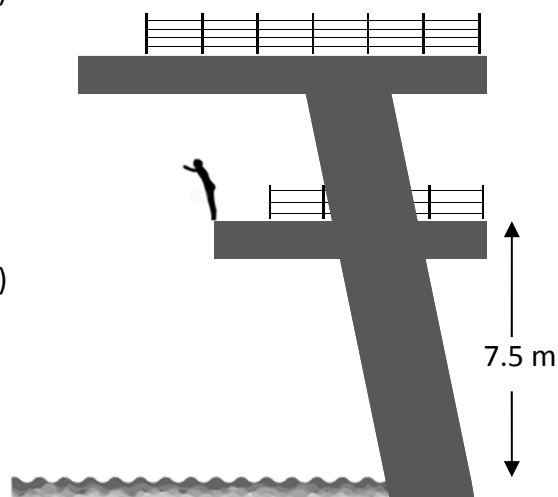


Figure 4

(27)

(12)

3. State Snell's law of refraction of light. (6)

Figure 5 shows the path of a laser passing through a transparent prism of refractive index 1.4.

What name is given to (i) angle **A**, (ii) angle **B**? (12)

Using Snell's law, calculate angle **B** if angle **A** is 35° . (12)

Identify the phenomenon which occurs at **C**.

How does angle **D** compare in size with the critical angle for the material in the prism? (12)

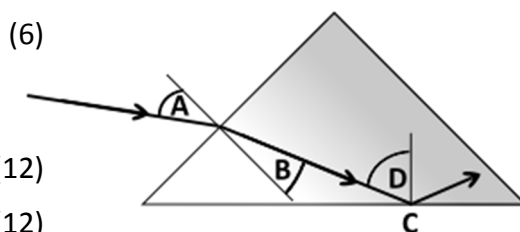


Figure 5

Figure 6 shows a convex lens on its principal axis and indicates the positions of the focus **F** and the point **2F**.

A magnified *real* image is formed when an object is placed between **F** and **2F**.

Identify where on the principal axis an object should be placed to form a magnified *virtual* image.

In what other way do these magnified images differ? (15)

Copy **Figure 6** and show the formation of *either* a magnified real image *or* a magnified virtual image. (9)

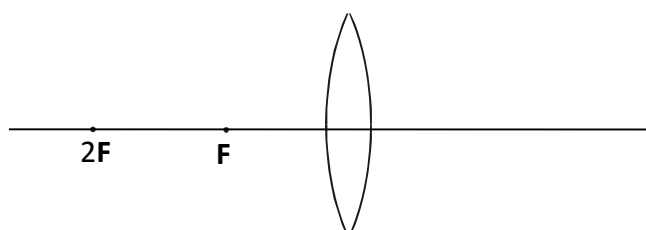


Figure 6

4. (a) State **two** assumptions of the kinetic theory of gases. (12)
 What is meant by *Brownian motion*? (9)
 Describe an experiment to show Brownian motion. (12)

- (b) The resistance of a metal is an example of a thermometric property. (6)
 Explain the underlined term. (6)
 A student collected the following data for the resistance of a length of copper wire over a range of temperatures:

Resistance ($\text{m}\Omega$)	74	77	80	83	86	89	92	95
Temperature ($^{\circ}\text{C}$)	10	20	30	40	50	60	70	80

- Draw a graph of resistance (y-axis) against temperature (x-axis). (21)
 Using your graph estimate the resistance of the copper wire at 0°C . (6)

5. (a) **Figure 7** shows a mobile phone charger. It contains a transformer which connects to an alternating current (*a.c.*) supply. (15)
 What is meant by the underlined term?
 Give one source of *a.c.*
 What is the purpose of a transformer?



Figure 7

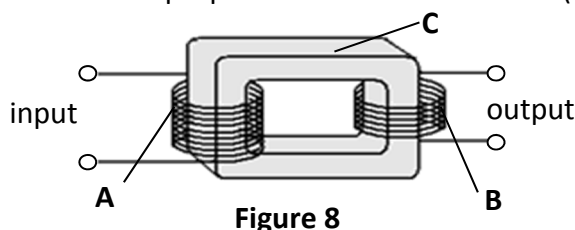


Figure 8

- Figure 8** shows the main parts of a transformer. (9)
 Identify the parts labelled **A**, **B** and **C**. (9)
 Part **A** has 4,600 turns and is connected to a 230 V *a.c.* supply.
 If the output voltage is 5 V *a.c.* how many turns are required on Part **B**? (9)

- (b) **Figure 9** shows two $150\ \Omega$ resistors connected to a 9 V d.c. supply. (6)
 What term describes this arrangement of the resistors?

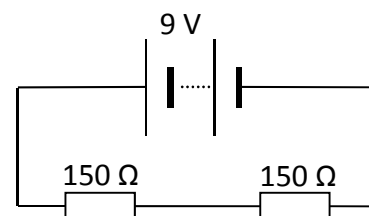


Figure 9

- Calculate (21)
 (i) the effective resistance of this arrangement of the two resistors
 (ii) the current in the circuit
 (iii) the power lost by the resistors.

- Draw a circuit using the same components that will conduct a larger current. (6)

6. Answer any **two** of the following parts (a), (b), (c), (d). Each part carries 33 marks.

(a) What is the *principle of conservation of momentum*?

Give the SI unit of momentum.

(12)

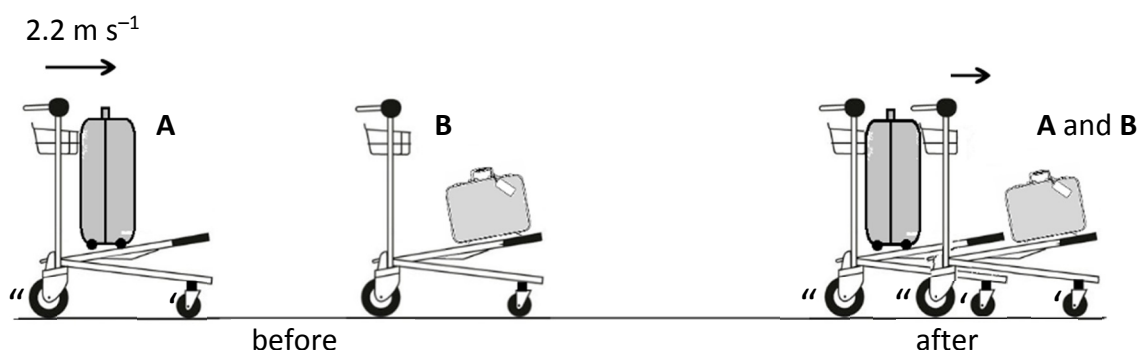


Figure 10

Figure 10 shows two airport trolleys, each of mass 25 kg, on a smooth floor. Trolley **A** is carrying a suitcase of mass 20 kg and trolley **B** is carrying a suitcase of mass 10 kg. What is the total mass of (i) trolley **A** and its baggage, (ii) trolley **B** and its baggage? (6)

Trolley **A** moving at 2.2 m s^{-1} collides with trolley **B** which is at rest. After the collision they connect and move together in the same direction.

Calculate the initial momentum of trolley **A** and its baggage.

Use the principle of conservation of momentum to find the speed of the connected trolleys and their baggage after the collision.

(15)

(b) **Figure 11** shows a self-illuminating device that can be attached to an object to locate it in the dark. It contains a tiny amount of tritium, a radioactive isotope of hydrogen, in a sealed transparent container.

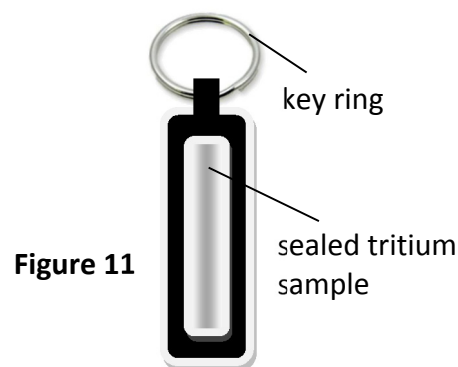


Figure 11

What is meant by the underlined term?

(6)

As the tritium decays it emits electrons which cause a phosphor coating to glow. Name the type of nuclear radiation emitted by tritium.

(6)

The half-life of tritium is 12.3 years.

What fraction of undecayed tritium will remain in the device after 24.6 years?

Does the device become brighter or dimmer over time?

Give a reason for your answer.

Give one safety precaution taken when using radioactive isotopes.

(21)

- (c) Over 200 years ago Thomas Young demonstrated that visible light has wave properties. Give **two** properties characteristic of wave motion. (12)

Figure 12 shows a beam of visible light passing through a glass prism.

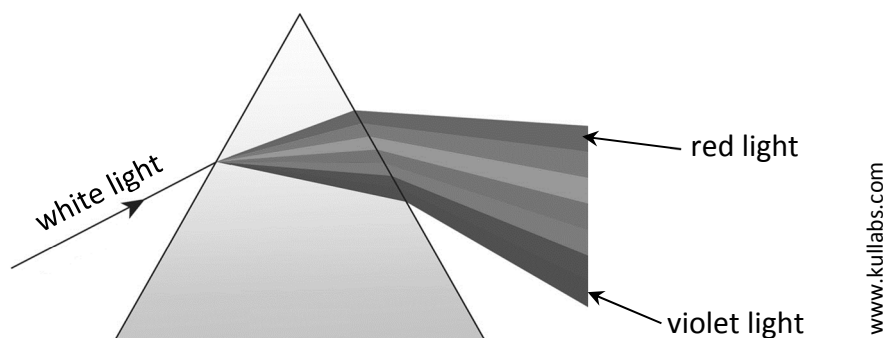


Figure 12

List **three** colours of light found between the red light and the violet light. Identify the type of invisible radiation located just beyond (i) red light, (ii) violet light. Describe how you would detect one of these radiations. (21)

- (d) Capacitors are commonly found in electronic devices. Give **two** devices which contain capacitors. (12)

Consider the descriptions in the table:

A	Stored on the plates of a capacitor
B	The unit used to measure capacitance
C	Defined as the ratio of charge to potential difference (voltage)
D	Substance commonly found between the plates of a parallel-plate capacitor
E	Type of current blocked by a capacitor
F	Arrangement of capacitors if total capacitance is the sum of their capacitances
G	Type of field which exits between the plates of a charged capacitor

In your answerbook match *each* of the descriptions (**A, B, C, D, E, F** or **G**) above with *one* of the words below.

air

direct

farad

charge

capacitance

parallel

electric

(21)

SECTION II – CHEMISTRY (200 marks)

7. Answer **eleven** of the following items (a), (b), (c), etc. All the items carry equal marks. *Keep your answers short.*

- (a) What are *isotopes* of an element?
- (b) Sketch a *p*-orbital.
- (c) What general term is given to the elements with atomic numbers 22 to 29?
- (d) Give the electron configuration (*s*, *p*) of an atom of carbon.
- (e) Copy and complete the following statement:
"Allotropes are different forms of the same"
- (f) **Figure 13** shows the liquid level in a 50 cm³ burette. What is the observed reading?
- (g) Give an example of a substance containing *hydrogen bonding*.
- (h) In the equation $E = hf$, what does '*f*' represent?
- (i) Calculate the percentage of oxygen by mass in methanol (**CH₃OH**).
[H = 1; C = 12; O = 16]
- (j) State *Hess's law*.
- (k) Select the **two** noble gases from the following:
oxygen helium nitrogen argon hydrogen
- (l) Calculate the number of molecules in 3 moles of water.
[Avogadro constant = $6.0 \times 10^{23} \text{ mol}^{-1}$]
- (m) Copy and complete the following equation for the reaction between an acid and a metal.
 $\text{H}_2\text{SO}_4 + \text{Zn} \rightarrow \text{_____} + \text{_____}$
- (n) Give a name for the molecule represented by the structure in **Figure 14**.
- (o) What name is given to the aromatic compound, **C₆H₆**?

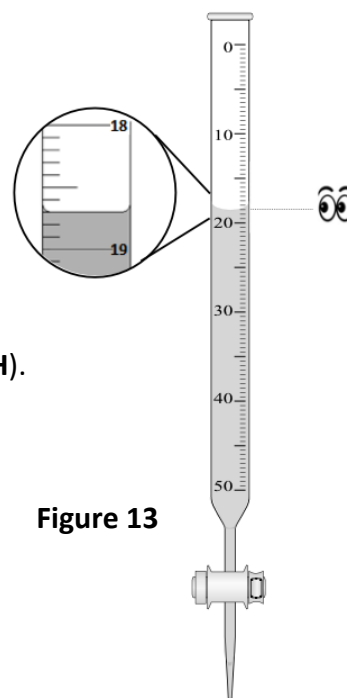


Figure 13

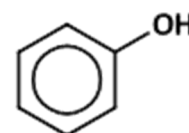


Figure 14

(11 × 6)

8. Copy and complete the table below using information from the *Formulae and Tables* booklet (pages 79 & 81). (24)

Element	Atomic number	Relative atomic mass	Group number	Period number	Electronegativity value
Mg				3	
Cl					3.16

Identify another element with the same group number as magnesium.
What do the elements with the same group number have in common? (6)

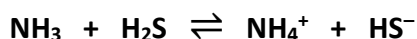
How many protons are there in an atom of magnesium?
What is meant by relative atomic mass (A_r)? (12)

10% of magnesium atoms have a mass number of 25.
How many neutrons are there in one of these atoms? (6)

The type of bonding in the compound magnesium chloride can be predicted from the electronegativity values of magnesium and chlorine.
What type of bonding exists in this compound? (6)

Give **two** properties of substances with this type of bonding. (12)

9. (a) Define (i) an acid, (ii) pH.
Calculate the pH of a 0.015 M hydrochloric acid (**HCl**) solution. (18)
Identify **two** acids, according to the Brønsted-Lowry theory, in the following equation:



Give an example of an acid-base conjugate pair in this equation. (15)

- (b) Define reduction in terms of electron transfer.
Figure 15 shows water, acidified by the addition of a few drops of sulfuric acid, undergoing electrolysis using platinum electrodes.
Identify **two** ions present in the solution. (15)

Name the electrode labelled (i) **A**, (ii) **B**.
At which electrode does reduction occur?
What gas is produced at this electrode? (18)

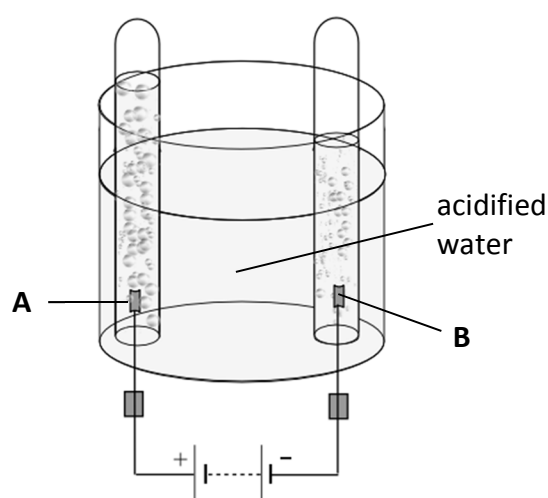


Figure 15

10. A student followed a procedure to standardise a solution of sodium hydroxide (NaOH) using a burette containing 0.18 M hydrochloric acid (HCl).

What is meant by the underlined term?

What solvent is used in making up the solution of sodium hydroxide?

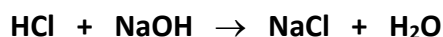
Figure 16 shows some of the equipment used.

- (a) Give **two** safety precautions taken during this procedure. (12)
- (b) Name the pieces of equipment: **A**, **B** and **C**. (9)
- (c) Why would a beaker not be a suitable alternative to **C**? (6)
- (d) What is the purpose of **B** during the procedure? (6)
- (e) A chemical was added to the sodium hydroxide solution in **C** before the addition of the acid solution. Why was this chemical added? (6)
- (f) The student recorded the following data from the burette containing the acid.

Initial reading	Final reading
24.5 cm^3	48.9 cm^3

- (i) How much acid was used during the procedure?
- (ii) This volume of 0.18 M hydrochloric acid neutralised 20.0 cm^3 of the sodium hydroxide solution.

The equation for the reaction is:



Calculate the concentration of the sodium hydroxide solution.

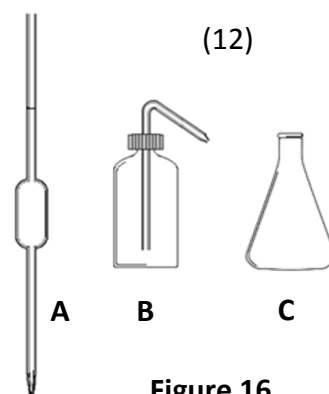


Figure 16

(12)

(12)

(9)

(6)

(6)

(6)

(15)

11. Figure 17 shows examples of common household products containing organic compounds.



Figure 17

Give the formula of butane, a propellant used in hair spray.

Sketch a structural formula for a butane molecule.

Sunscreen contains unsaturated carbon compounds.

Describe a test for unsaturated carbon compounds.

Name the carboxylic acid found in vinegar.

The equation for the heat of formation of the ketone found in nail polish remover is:



What is meant by the heat of formation?

Is this reaction exothermic or endothermic?

Give a reason for your answer.

Copy, complete and balance the equation for the combustion of the ketone.



Name the ketone found in nail polish remover.

(12)

(18)

(9)

(9)

(12)

(6)

12. Answer any **two** of the following parts (a), (b), (c). Each part carries 33 marks.

(a) Silver nitrate (**AgNO₃**) decomposes upon heating as shown in the equation:



Describe the appearance of each of the **three** products at s.t.p. (9)

What is the mass of one mole of silver nitrate? (6)

When 85 g of silver nitrate are decomposed, calculate

- (i) the number of moles of silver produced
- (ii) the mass of silver produced
- (iii) the total number of moles of gases produced. (18)

[N = 14; O = 16; Ag = 108]

(b) **Figure 18** shows sulfur dioxide (**SO₂**) gas being prepared in the laboratory by the reaction between dilute sulfuric acid and solid sodium sulfite as shown. The gas jar contains a piece of moist red litmus paper and a piece of moist blue litmus paper.

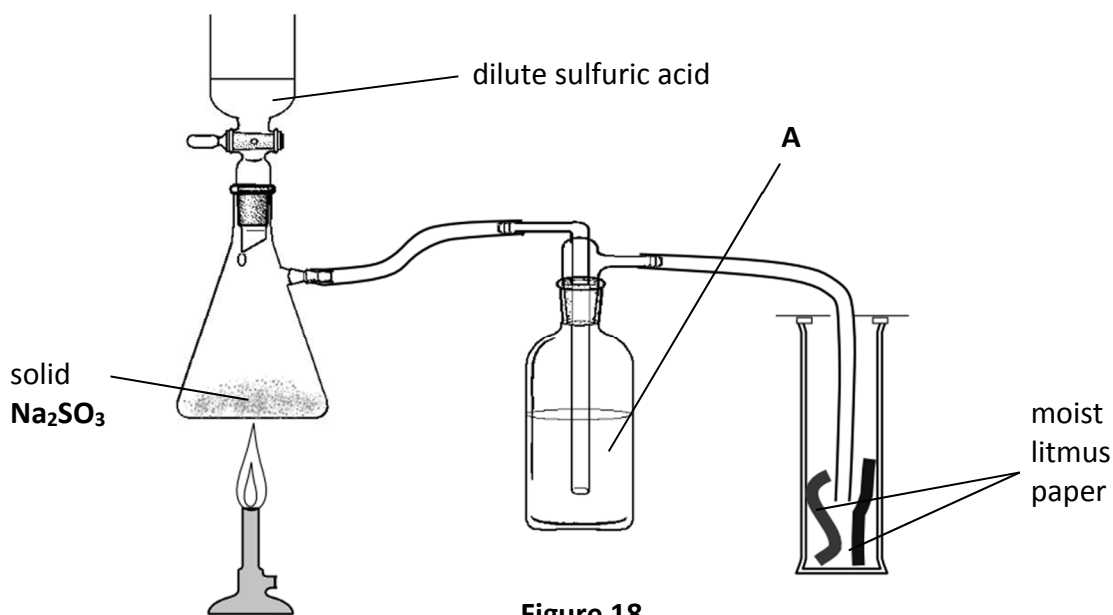


Figure 18

Identify liquid **A**.

Give the purpose of liquid **A**.

State one physical property of **SO₂** gas. (18)

What is observed in the gas jar as the **SO₂** is collected?

What chemical property of **SO₂** is responsible for this observation?

Why should we limit the release of **SO₂** gas into the environment? (15)

- (c) Many elements react with oxygen to form stable compounds.
The table below refers to oxides of four elements.

Element			calcium	
Name of oxide	water			
Formula of oxide		NO₂		CO

Copy the table above and complete it by filling in the missing information. (24)

From the table identify

(i) an acidic oxide

(ii) a basic oxide

(iii) a neutral oxide.

(9)

Blank Page