NS

2023

KAPASA MAKASA UNIVERSITY

CH 110 : GENERAL CHEMISTRY

OCTBER 2023 SESSIONAL EXAMINATION

TIME ALLOWED: 3 HOURS **100 MARKS**

INSTRUCTIONS TO CANDIDATES

1. There are **Eight (08)** questions in this paper. Candidates are expected to attempt any **Five (05)** questions
2. Each question carries **twenty (20)** marks. Marks allocated to each part of the question are enclosed in brackets **[ ]**.
3. Candidates are reminded of the need for a **clear presentation** of their work
4. Different parts of the same question must be answered strictly in continuation
5. You are allowed to use non-programable calculators
6. Do not turn this paper until you are told to do so.

Useful Information

Physical Constants		
Constant	Symbol	Value
Dissociation constant of water	Kw	1.0×10^{-14}
Avogadro's number	N_A	$6.02 \times 10^{23} mol^{-1}$
Gas constant	R	$8.314\ J\ K^{-1}mol^{-1}$
		$0.0821\ L\ atmK^{-1}mol^{-1}$
Faradays constant		96, 487C/mol
Ideal Gas Equation		$Pv = nRT$
1 amu = 1.66 X 10^{-27} kg or 1 amu = 931.2 MeV, 1 eV = 1.602 × 10^{-19}J, Fe-56 (55.921), mass of proton (1.00728amu), mass of neutron (1.008665amu)		
1 atm = 101325 Pa= 760mmHg = 760torr		

Question one (stoichiometry) — *20 MARKS*

a. Determine the relative molecular masses of the following

(i) Ethanol

(ii) Glucose [2]

b. A silicon chip used in an integrated circuit of a microcomputer has a mass of 4.55 mg. How many silicon (Si-28.09) atoms are present in this chip? [3]

c. Determine the empirical & molecular formulas of a compound that gives the following percent analysis: 71.65%Cl, 24.27%C, and 4.07%H. The molar mass is known to be 98.96g/mol [2]

d. 0.35g piece of aluminum foil is dissolved in excess HCl(aq).

(i) How many grams of $H_2(g)$ are produced?

(ii) How many moles of H_2 are produced?

(iii) How many molecules of H_2 are produced?

(iv) What mass of aluminum chloride is produced? [8]

e. Calculate the molarity of a solution prepared by bubbling 1.56 g of gaseous HCl into enough water to make 26.8 mL of solution. [2]

f. When 1.274 g of copper sulfate was reacted with excess zinc metal, 0.392 g of copper metal was obtained according to the equation:

$$CuSO_4(aq) + Zn(s) \longrightarrow Cu(s) + ZnSO_4(aq)$$

What is the percent yield? [3]

Question Two (Chemical Bonding) — *20 MARKS*

1 a. Explain what bonding is. [1]

b. Show the bonding in the following compounds.

(i) Potassium Fluoride

(ii) Methane [2]

c. What is electronegativity? Explain the trend in electronegativity across the period. [3]

d. Which of the following bonds would be the (i) **least polar** yet still be considered polar covalent and (ii) ionic? Mg–O C–O O–O Si–O N–O [2]

e. Identify each violation to the octet rule by drawing a Lewis electron dot diagram.

(i) $NO_3^{\cdot}$

(ii) H_3O^+

(iii) SF_4 [6]

3. Determine the type of hybridization in the following compounds.

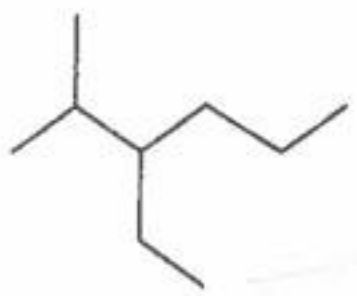
a. BeH_2

b. BH_3

c. XeF_4 [6]

Question Three (organic Chemistry) ***20 MARKS***

1. Give one example of an aromatic hydrocarbon. [1]
2. Write an equation for each of the following reactions.
   a. Halogenation of alkenes
   b. Hydrogenation of alkenes.
   c. Hydration of alkenes. [3]
3. Write the condensed formula of the skeletal structure below.



[2]

b. Draw two isomers of C_8H_{18} and correctly name them. [4]

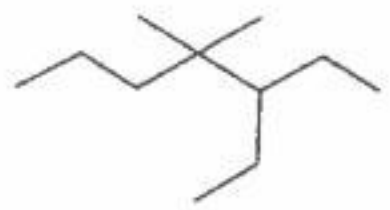
c. Draw an acceptable expanded structure and line drawing for the molecules

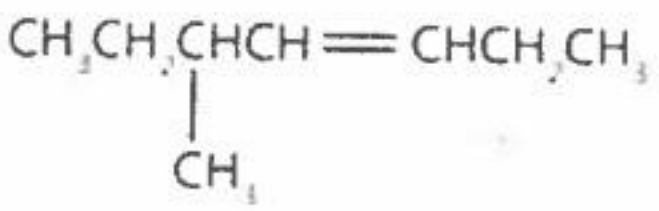
i. $CH_3CHFCH_2CH_2CH_2Cl$

ii. $CH_2CHOCH_2CH_3$

iii. $CH_3CH{=}CHCH_2CH_3$ [6]

d. Name the compounds below.





[4]

Question Four (Acid-base equilibria) — 20 marks

(a) Define the following terms

(i) An acid according to the Arrhenius theory

(ii) a base according to Lewis theory [2]

(b) Calculate the pK_a and pK_b values for an acid whose K_a value is 1.8×10^{-5}. [4]

(c) Determine the pH of a solution if the $[H_3O^+]$ concentration is 5.0×10^{-8}M? [3]

(d) Identify the Brønsted-Lowry acid and the Brønsted-Lowry base in this chemical equation.

$$C_6H_5OH + NH_2^- \rightarrow C_6H_5O^- + NH_3$$ [2]

(e) Write the balanced chemical equation for the neutralization reaction between HCl and $Mg(OH)_2$. What is the name of the salt that is formed? [2]

(f) Write an ionic equation for the reaction: $Mg_{(s)} + Pb(NO_3)_{2(aq)} \rightarrow Mg(NO_3)_{2(aq)} + Pb(s)$. [3]

(g) What is the pOH of the solution if the $[H_3O^+]$ concentration is 4.2×10^{-3}M? [4]

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Question five (Chemical Equilibrium) — 20 MARKS

a. Explain chemical equilibrium [2]

b. Write the expression for the reaction quotient for the following reaction

(i) $Ca(OH)_2(s) + 2H^+(aq) \rightleftharpoons 2H_2O(l) + Ca^{2+}(aq)$ [2]

c. Consider the following reversible reaction. In a 3.00 litre container, the following amounts are found in equilibrium at 400 °C: 0.0420 mole N_2, 0.516 mole H_2 and 0.0357 mole NH_3. Evaluate K_c.

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ [6]

d. Consider the following equilibrium for the production of hydrogen chloride from its elements:

$H_2(g) + Cl_2(g) \rightleftharpoons 2HCl(g)$ $K = 4.4 \times 10^{-2}$ at 440°C.

Initially, 1.50 mol of H_2 (g) and 1.50 mol of Cl_2 (g) are injected into a 750 mL refrigerated reaction vessel.

Find the concentrations and amount of all entities at equilibrium using the ICE table. [8]

e. Write an equilibrium constant expression for the reaction of nitrogen and hydrogen to form ammonia at 500°C. [2]

Question six (Atomic theory) — 20 MARKS

1 a. You are presented with the following elements P: $1s^2\ 2s^2\ 2p^4$ and Q: $1s^2\ 2s^2\ 2p^3$

(i) State the group number and the period to which P and Q belong. Justify your answer. [3]

b. Write the electronic configurations of O, S, Se. What feature makes them have similar chemical properties. [4]

c. Write condensed formulas of the following.

(i) Iodine

(ii) Boron

(iii) Krypton

(iv) Lead

(v) Bromine [10]

d. i. How many unpaired electrons are in (a) a fluorine atom, (b) an oxygen atom, (c) a boron atom? [3]

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Question seven (Nuclear chemistry) ***20 MARKS***

1. a. A nuclear reactor produces produce 20kg of uranium-235. If the half-life is about 70years, how long will it take to decay to 0.1kg. [4]

b. What is the half-life of a 100g sample of nitrogen that decays to 12.5g of nitrogen-16 in 21.6s. [4]

2. b. A sample of 100g has a half-life of 5years.

i. How much is left after 5 years. [2]

ii. How much is left after 2 half-lives or after 10years. [4]

iii. How much is left after 1 half- life. [2]

iv. The half-life of Molybdenum-99 is 67.0hrs. How much of the 1.000-mg sample of Molybdenum-99 remains after 335hrs? [4]

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Question Eight (Gas laws) ***20 MARKS***

(a) State the four assumptions of the molecular gas theory. [4]

(b) (i) A sample of carbon monoxide has a volume of 344 mL at 85°C and a pressure of 88.4 Pa. Determine the amount in moles of CO present. [3]

(ii) What volume does 0.056 mol of H_2 gas occupy at 25°C and 1.11 atm pressure? [2]

(c) State Boyles law [2]

(d) A gas exerts a pressure of 3 Pa on the walls of container 1. When container 1 is emptied into a 10-liter container, the pressure exerted by the gas increases to 6 Pa. Find the volume of container 1. Assume that the temperature and quantity of the gas remain constant. [4]

(e) Two moles of helium gas fill up an empty balloon to a volume of 2.5 L. What would be the volume of the balloon if an additional 1.5 moles of helium gas is added at constant temperature and pressure. [3]

(f) Write the expression for a non-ideal gas [2]

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-END OF EXAMINATION -

KAPASA MAKASA UNIVERSITY

2023 SESSIONAL EXAMINATION

BIOLOGY
(BIO 110/NR 100)

Time: 3hours Total marks: 100

INSTRUCTIONS:

1. There are two sections in this paper. Answer all questions in section A and ANY four (4) in section B.
2. Cell phones are not allowed in the examination room.
3. Write all your answers in the answer Booklet provided.

SECTION A **40 MARKS**

ANSWER ALL THE QUESTIONS

1.

(a) Name the four kingdoms to which eukaryotes belong [4]

(b) list the three classes of amphipathic lipids of the cell membrane [3]

(c) Which organelle:

i. Carries out aerobic respiration [1]

ii. Is the site of protein synthesis [1]

iii. Contains hydrolytic enzymes [1]

iv. Contains chromatin [1]

2.

(a)

i. What are photosynthetic pigments? [2]

ii. Give at least three example. [3]

(b) Describe the role of ATP in the Calvin cycle. [2]

2.

(a) Mention the three forms of classification [3]

(b) list the three major classes of viruses [3]

(c) Mention the phylum to which the following organisms belong. [2]

i. spider

ii. duck

3.

(a) define the term reproduction [1]

(b) mention any five types of Asexual reproduction [5]

4.

(a) outline any five benefits ecosystems provide to animal life [5]

(b) mention the three levels under which biodiversity can be considered [3]

SECTION B: **(60 MARKS)**

There are six (6) questions in this section. Each question carries 15 marks, **CHOOSE AND ANSWER ANY FOUR (4)**

Question 1

(a) Cell division involves the processes mitosis and meiosis.
Discuss, with suitable illustrations, the stages of one of these processes [15]

Question 2

(a) Draw and label the parts of a nucleotide. [3
(b) Describe in detail the central Dogma as it relates to gene expression. [4]
(c) Describe the structures in the formation of a polypeptide with reference to the Primary, Secondary, Tertiary and Quaternary protein structures. [4]
(d) Describe the phospholipid bilayer and explain the role of lipids in cell membrane formation. [3]
(e) Briefly explain the difference between alpha (α) and Beta (β) glucose molecules. [1]

Question 3

Gregor Mendel was an Austrian monk who studied the inheritance of characteristics in garden peas *(pisum sativum)* which he grew in the vegetable garden of his monastery.

(a) Give reasons why he chose this crop [5]
(b) Discuss the important facts established by Mendel which form the foundation of modern genetic [10]

Question 4

(a) Give an account on taxonomy with emphasis on the following;
i. Works of Aristotle. [3]
ii. Works of Carolus Linnaeus. [3]
iii. Modern phylogenetic. [3]
(b) Explain the concept of Binomial nomenclature with emphasis on the rules that governs it. [4]
(c) Describe the concept of dichotomous key. [2]

Question 5

(a) discuss the differences between class *Aves* and *Mammalia* [5]
(b) describe the various defence mechanisms of *Arachnids* [5]
(c) outline the ecological importance of fungi [5]

Question 6

(a) Describe how Ecosystems maintain themselves by cycling energy [5]
(b) Discus the importance of maintaining biodiversity. [10]

THE END

SESSIONAL EXAMINATION

2023 ACADEMIC YEAR

PH 110 - INTRODUCTORY PHYSICS

October, 2023

DURATION: 3 HOURS

INSTRUCTIONS:

1. Write your Student Identity Number (SIN) on the answer booklet provided.
2. This paper has **SIX (6)** questions; attempt any **FIVE (5)**.
3. Begin each question on a new page in your answer booklet.
4. Credit will be given for clarity of expression and orderly layout of work.
5. Formulae and Physical constants you may find useful have been provided on page 6, 7 and 8.

1. (a) Explain the meaning of the term dimension and write down the dimensions of torque. [2]

(b) When a car is in motion, it experiences a force F due to air resistance given by

$$F = \frac{1}{2}C\rho v^2 A$$

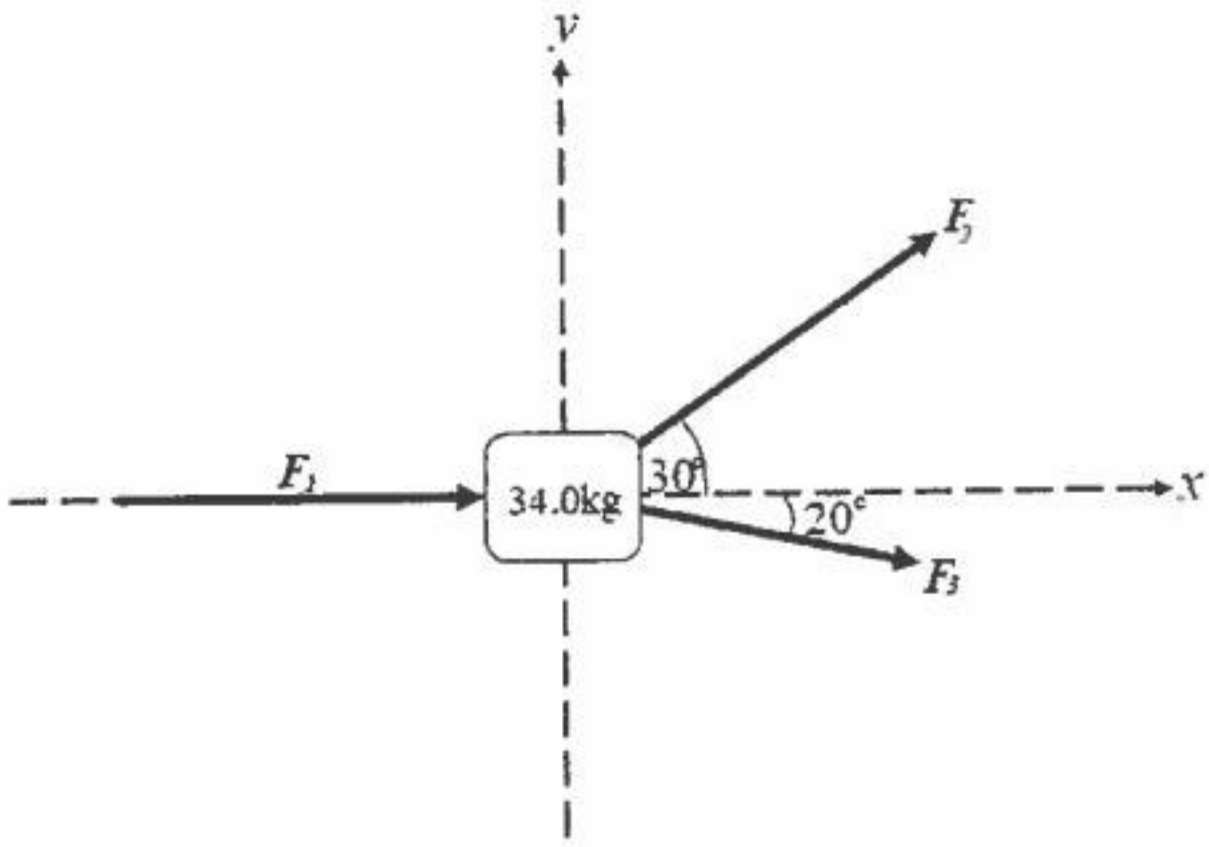
with v the car's velocity, A cross- section area, C a dimensionless quantity and ρ some physical quantity related to air.

(i) What are the dimensions of ρ? [3]

(ii) Name the physical quantity ρ. [1]

(c) (i) Force $F_1 = (\hat{\imath} + 2\hat{\jmath} + 3\hat{k})N$ and $F_2 = (2\hat{\imath} - \hat{\jmath})$N are concurrent coplanar forces. Find the angle between them. What conclusion can be made for the two forces? [4]

(ii) Three forces F_1 =100N, F_2 = 150N and F_3 = 120N act on a 34.0kg body as shown in the figure below.



How far does the body go in 2.5s starting from rest? [10]

2. (a) A body whose position vector is given by $\overrightarrow{r_o} = (3\hat{\imath} + 2\hat{\jmath} - \hat{k})$m moves to a new position whose vector is $\vec{r} = (6\hat{\imath} + 6\hat{\jmath} + 3\hat{k})$m. Find the magnitude of velocity of a body after 2s. [4]

(b) The diagram below shows a basketball player 2.0m tall shooting a ball at angle of 60° with the horizontal with an initial velocity of 5m/s.

4. (a) (i) State the law of conservation of angular momentum and the meaning of the term moment of inertia. [2]

(ii) A solid cylinder of mass 10kg and radius 250mm rotates freely about its axis. If it is rotating at 20rad/s^2 in 5s from rest, determine its angular momentum. [3]

(iii) Briefly discuss why when spinning with arms extended outward angular momentum is greater than when spinning with arms pulled inward. [2]

(b) (i) State the meaning of period of an oscillator. [2]

(ii) For an oscillator whose angular frequency is ω and amplitude of oscillation 1.0m, show that its period is $T = \frac{2\pi}{\omega}$. [3]

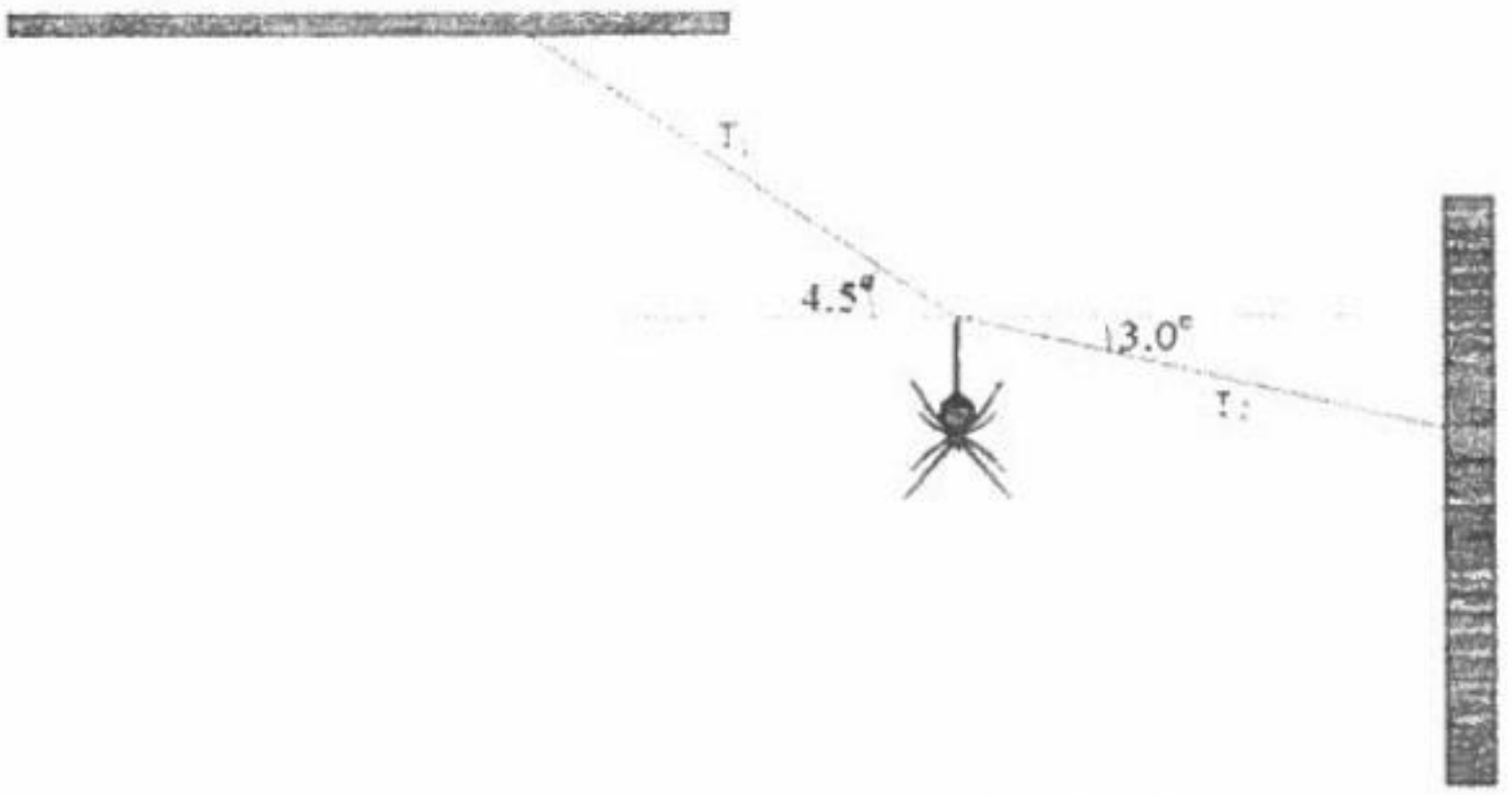
(c) A 2.0kg mass is attached to a spring and allowed to perform harmonic motion whose given by $y = 6.0Cos\left(5t + \frac{\pi}{4}\right)$cm.

(i) Calculate the spring constant of the attached spring. [2]

(ii) How far is the mass from equilibrium after 2.0s? [2]

(iii) Determine the maximum kinetic energy of the mass. [4]

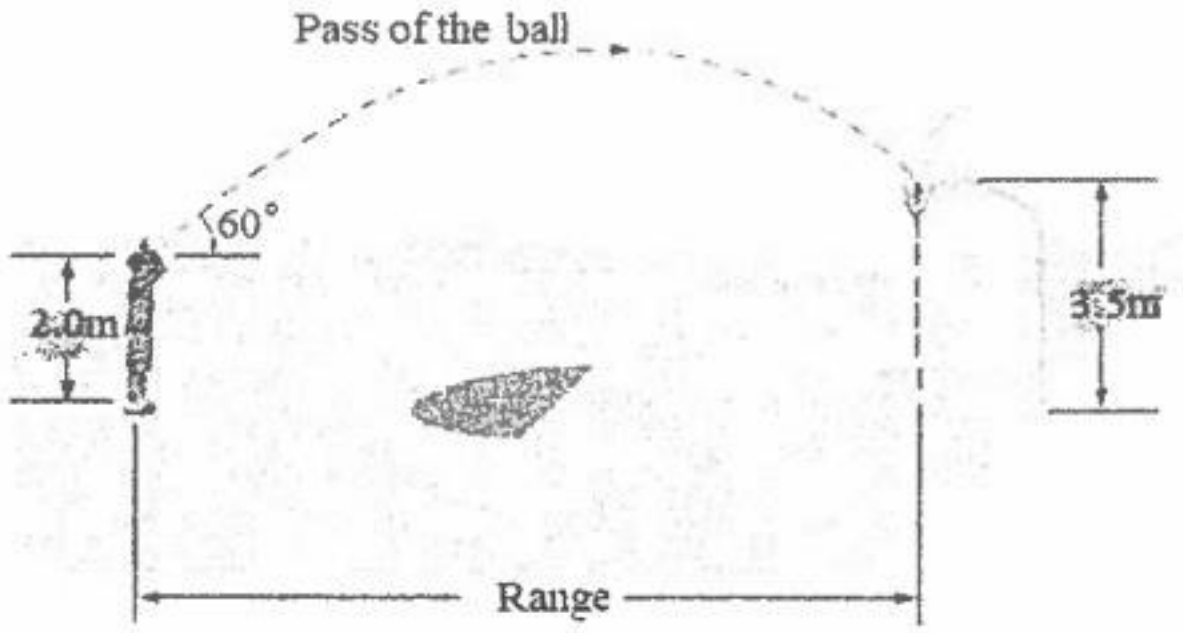
5. (a) (i) Briefly discuss how a body can achieve a state of static equilibrium. [2]
(ii)The figure below shows a spider hanging from the ceiling.



If the tension $T_1 = 10$N, calculate the mass of spider and tension T_2 [8]

(b) (i) Discuss the difference between gravitational and elastic potential energy. [2]

(ii) The figure below shows a car of mass 1400kg ascending a hill inclined at an angle of 10° with the horizontal. It ascends at a steady speed of 80km/h with a driving force



(i) State the name of path taken by the ball from the shooter to the basket [1]

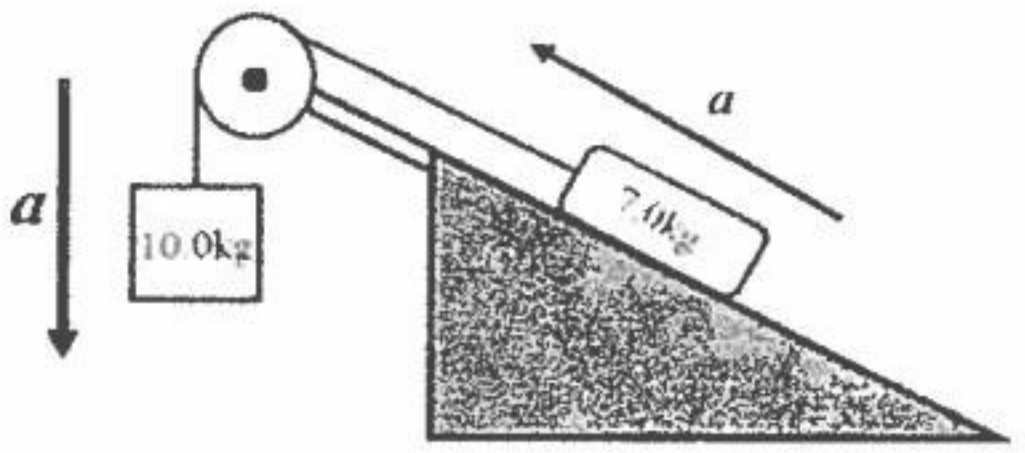
(ii) Calculate the range and maximum height reached by the ball from the ground. [4]

(c) (i) State the meaning of the term collision and discussion any two (2) features of a collision. [3]

(ii) A metal ball moving at 5m/s hit a stationery one of the same mass. After the collision, the first ball moves at 4m/s at an angle of 30° with the original path. Assume the collision is elastic, find the final velocity and direction in which second metal ball after the collision. [8]

3. (a) Discuss any two (2) problems associated with friction force and how the problems discussed are minimised. [4]

(b) The figure below shows a system of blocks.



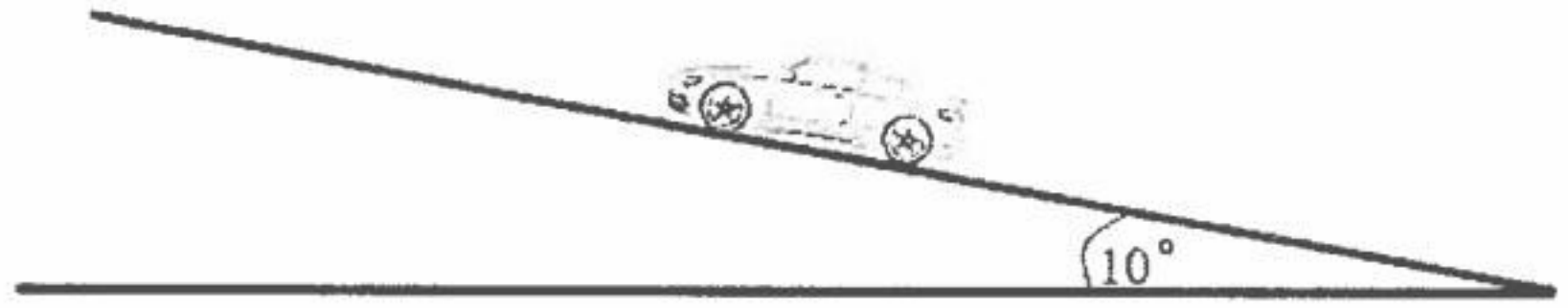
The coefficients of friction are $\mu_s = 0.7$ and $\mu_s = 0.5$ Calculate the;

(i) minimum tension in the rope for the system to move. [5]

(ii) acceleration of the system. [5]

(c) A thin spherical shell of mass ***M*** and radius ***R*** rolls from rest down the hill 12m high. If friction between the sphere and the surface of the hill is ignored, what is the translational velocity at the bottom of the hill. [6]

of 1000N provided by the engine.



Calculate the power needed for car to get to the top if the coefficient of kinetic friction between the tyres and surface of the hill is 0.3. [8]

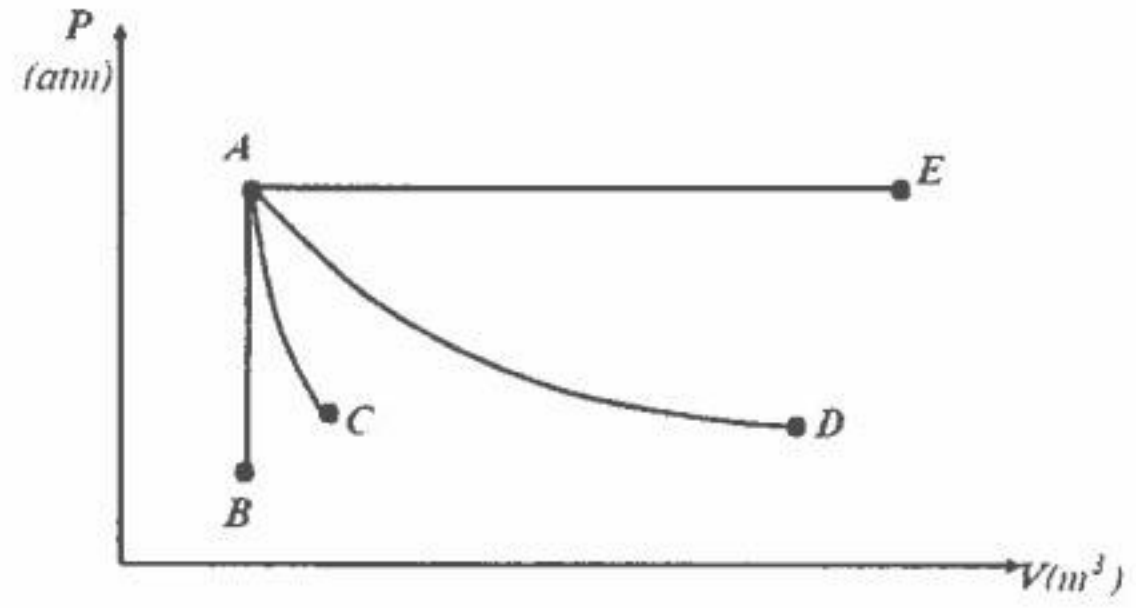
6. (a) The heating process has several effects. State any two (2) of such effects. [2]

(b) A brass sheet has its length 40cm at 10°C. If the surface area at 110°C is 320.1cm^2, find the width of the sheet [3]

(c) A well insulated electric kettle with a heating element rated 1200W is used to heat 4kg of water from 25°C in 10 minutes. Calculate the temperature of water after heating it for 10 minutes. [3]

(d) (i) State the meaning of a thermodynamic system and process. [2]

(ii) the figure below shows PV curve for a thermodynamic system.



From the curve identify and name the thermodynamic processes shown. [4]

(iii) 1.0m^3 of water converts 1.671m^3 of steam at atmospheric pressure and temperature of 100°C . If 2kg of water is converted to into steam at atmospheric pressure and 100°C temperature, how much will be the increase in change in internal energy? [6]

End of examination

List of constants

Density of water $\rho = 1000kg/m^3$

Specific heat capacity of water = 4200J/kg°C

Latent heant of vapourisation of water = 2.3×10^6J/kg

Latent heat of fusion of water = 3.34×10^3J/kg

Stefan – Boltzmann constant = $5.67 \times 10^{-8}W/m^2K^4$

Emissivity of black body = 1

Acceleration due gravity = $9.8m/s^2$,

Speed of sound in air = 340m/s,

Speed of light in vacuum = 3.0×10^8m/s

Universal gravitational constant = $6.67 \times 10^{-11}Nm^2/kg^2$

Mass of the earth = 6.0×10^{24}kg

Radius of the earth = 6400km

Universal gas constant = 8.31J/mol.K

Atmospheric pressure = 1.01×10^5 Pa

1 Pascal = $1N/m^2$

1 Cal = 4.18J

Equations

Uniformly accelerated motion:

$v=\frac{x}{t}$, $v = v_o + at$, $x = v_o t + \frac{1}{2}at^2$, $v^2 = v_o^2 + 2aS$, $v = v_o + at$

Projectile motion:

$v_x = v_o Cos\theta$, $v_y = v_o Sin\theta - gt$, $y = (v_o Sin\theta)t - \frac{1}{2}gt^2$ $T = \frac{2v_o sin\theta}{g}$,

$R = \frac{v_o^2 sin2\theta}{g}$, $y = (tan\theta)x - \left[\frac{g}{2v_o^2 Cos^2\theta}\right]$

Force and motion:

$F = ma$, $w = mg$, $F_{AB} = -F_{BA}$, $f = \mu F_N$

Energy:

$P.E = mgh$, $K.E = \frac{1}{2}mv^2$, $W = FxCos\theta$, $P = \frac{W}{t} = FvCos\theta$

Linear Momentum:

$p = mv$, $F\Delta t = \Delta mv$

Circular:

$T = \frac{2\pi}{v}$, $a_c = \frac{v^2}{r}$, $F_c = \frac{mv^2}{r}$,

Rotational and angular motion:

$\theta = \frac{S}{r} = \left(\frac{\omega_o + \omega_f}{2}\right)t$, $\theta = \omega_o t + \frac{1}{2}\alpha t^2$, $\omega_f = \omega_o + \alpha t$, $\omega = \frac{\theta}{t}$,

$v = r\omega$, $\omega_f^2 = \omega_o^2 + 2\alpha\theta$, $\alpha = \frac{\Delta\omega}{\Delta t} = \frac{a_T}{r}$, $I = \sum mr^2$, $K.E = \frac{1}{2}I\omega^2$

$\tau = Fr = I\alpha$, $W = r\theta$, $P = \tau\omega$, $L = I\omega$

Simple harmonic motion:

$F = -kx, \quad \omega = 2\pi f, \quad f = \frac{1}{2\pi}\sqrt{\frac{g}{L}}, \quad a = \omega^2 x, \quad P.E = \frac{1}{2}kx^2,$

$\frac{1}{2}kx^2 + \frac{1}{2}mv^2 = \frac{1}{2}kx_o^2, \quad \omega = \sqrt{\frac{k}{m}}, \quad f = \frac{1}{2}\sqrt{\frac{k}{m}}$

Moment of Inertia

Solid cylinder $I = \frac{1}{2}MR^2$

Solid sphere $I = \frac{2}{5}MR^2$

Thin spherical shell $I = \frac{2}{3}MR^2$

Thermal Properties of matter:

$\frac{Q}{t} = \varepsilon\sigma AT^4, \quad \frac{Q}{\Delta t} = \frac{kA\Delta T}{\Delta L}, \quad Q = mc\Delta T = nc\Delta T, \quad \Delta L = \alpha L\Delta T,$

$\Delta V = \gamma V\Delta T, \quad C_V = C_p - R, \quad PV = nRT, \quad P_1V_1^\gamma = P_2V_2^\gamma, \quad W = P\Delta V$

Thermodynamic:

$Q = \Delta U + W, \quad \eta = 1 - \frac{T_2}{T_1} = \frac{work\ done}{input\ heat\ high\ temperature}, \quad W = nRT.In\left(\frac{v}{v_o}\right)$

$C_V = C_p - R, \quad PV = nRT, \quad P_1V_1^\gamma = P_2V_2^\gamma, \quad W = P\Delta V$

KAPASA MAKASA UNIVERSITY

PRICNCIPLES OF EDUCATION (PE110) EXAMINATION.

DURATION: 3HRS MARK: 60

INSTRUCTIONS:

There are seven [7] questions in this paper and each question carries twelve **[12]** marks.

You are required to answer only five [5] questions and each question to be answered in essay form

Make sure you indicate the exam number and class number on your answer booklet and answer margin.

1. In 400 words discuss strength and weakness of education in pre-colonial and colonial era. **[12 marks]**
2. Define and discuss the challenges of access to formal education in Zambia since independence and explain four government interventions to provide solution **[12 marks]**
3. There are a numerous challenges influencing girl child education in Zambia. List three educational policies made after independence. Discuss any two policy documents supporting child education in Zambia. **[12 marks]**
4. Quality education entails quality input, process and outcome. Describe what is required in quality education according to education for all policy. **[12 marks]**
5. Discuss materialist and idealist philosophical world view by indicating their impact on current education system. **[12 marks]**
6. Define philosophy of education. With clear examples explain how education philosophy influences educational system in Zambia. **[12 marks]**
7. In 400 words describe the benefits of training teachers of ICT in Zambia **[12 marks]**

THE END

KAPASA MAKASA UNIVERSITY

DEPARTMENT OF EDUCATION, OPEN AND DISTANCE LEARNING

NR 120: COMMUNICATION SKILLS EXAMINATION- 2023

TIME: 3 HOURS **MARKS: 100**

INSTRUCTIONS TO CANDIDATES

- Answer only **four (4)** questions out of the **seven** (7) questions given.
- Read all questions carefully before selecting those you wish to attempt.
- Each question carries **twenty-five (25)** marks.
- Write all your answers in the answer booklet provided.
- Write your **Student Identity Number** on each of the answer sheets used.
- Indicate the **number** of each question you attempt.

1. (a) What is communication? [1]

(b) Identify **six (6) key** components in the communication process, and briefly discuss them. [12]

(c) Explain the reason why information overload is regarded as a barrier to effective human communication. [1]

(d) With **one (1)** example on each, show ways in which linguistic barriers manifest themselves. [6]

(d) Apart from information overload and linguistic barriers, list other **five (5)** barriers to effective human communication. [5]

2. (a) Define reading and discuss its stages which the learner passes through. [12]

(b) Discuss the technique of reading, basic skills of reading and types of reading in detail. [13]

3. (a) Write a 500 word essay on **one (1)** of the following topics:

(i) Effective listening to lectures and note taking [20]

(ii) Communication process [20]

(iii) Successful note making [20]

(b) What does referencing or citing mean? [1]

(c) Use the following jumbled information to write **four (4)** references in the Harvard system:

(i) Lusaka, 1995, Longman, Mulenga J, Effective Ways of Teaching Language [1]

(ii) Urban Land Use Policy, New York, Andrew P, The Free Press, 1979 [1]

(iii) McMillan, Urban Land Use Planning, 1979, London, Chapin F, Kaiser H [1]

(iv) Journal of Linguistics, Mwansa R, Mwape C, Kabwe G, Noun Class System of Bisa Dialect, 2018, pp.150-180, (3), vol. 2 [1]

4. (a) Describe how an effective meeting should be conducted by highlighting all important elements involved in it. [20]

(b) Identify any **five (5)** policies which should be established in the first meeting. [5]

5. Define job interview and discuss its three basic steps in detail. [25]

6. (a) Briefly, explain what Office Memorandum (Memo) is and indicate who should draft it. [5]

(b) Apart from Office Memorandum, list **five (5)** other types of official correspondence [5]

(c) With clear examples, define library and discuss its organisation in terms of sections. [10]

(d) State any **five (5)** activities a teacher can use to teach speaking skills to learners. [5]

7. (a) Discuss entrepreneurial process in detail. [20]

(b) Briefly, explain any **five (5)** benefits associated to development of entrepreneurship. [5]

END OF EXAMINATION!!

KAPASA MAKASA UNIVERSITY

DEPARTMENT OF EDUCATION, OPEN AND DISTANCE LEARNING

2023 ACADEMIC YEAR

SESSIONAL EXAMINATIONS

MA110: MATHEMATICS

13[111] OCTOBER, 2023

TIME ALLOWED: 3 HOURS

INSTRUCTIONS

1. WRITE YOUR **SIN** NUMBER AND PROGRAM OF STUDY ON EACH ANSWER BOOKLET USED.
2. ATTEMPT **FIVE** OUT OF SEVEN QUESTIONS
3. EACH QUESTION CARRIES **20** MARKS
4. BE **NEAT** AND SHOW **ALL** ESSENTIAL WORK TO AVOID LOSS OF MARKS.
5. CALCULATORS ARE **NOT** ALLOWED IN THIS PAPER

DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO.

SESSIONAL EXAMINATION

2023 ACADEMIC YEAR

PH 110 - INTRODUCTORY PHYSICS

October, 2023 Deferred Examination

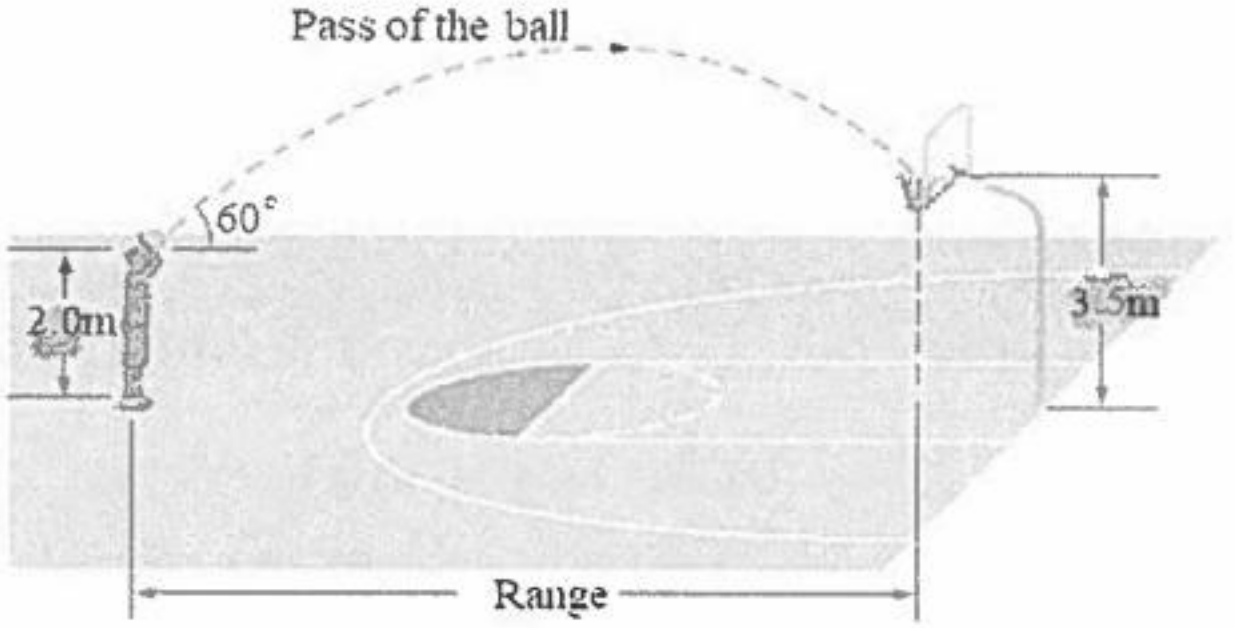
DURATION: 3 HOURS

INSTRUCTIONS:

1. Write your Student Identity Number (SIN) on the answer booklet provided.
2. This paper has **SIX (6)** questions; attempt any **FIVE (5)**.
3. Begin each question on a new page in your answer booklet.
4. Credit will be given for clarity of expression and orderly layout of work.
5. Formulae and Physical constants you may find useful have been provided on page 6, 7 and 8.

1. (a) A body whose position vector is given by $\overrightarrow{r_o} = (3\hat{\imath} + 2\hat{\jmath} - \hat{k})$m moves to a new position whose vector is $\vec{r} = (6\hat{\imath} + 6\hat{\jmath} + 3\hat{k})$m. Find the magnitude of velocity of a body after 2s. [4]

(b) The diagram below shows a basketball player 2.0m tall shooting a ball at angle of 60° with the horizontal with an initial velocity of 5m/s.



(i) State the name of path taken by the ball from the shooter to the basket [1]

(ii) Calculate the range and maximum height reached by the ball from the ground. [4]

(c) (i) State the meaning of the term collision and discussion any two (2) features of a collision. [3]

(ii) A metal ball moving at 5m/s hit a stationery one of the same mass. After the collision, the first ball moves at 4m/s at an angle of 30° with the original path. Assume the collision is elastic, find the final velocity and direction in which second metal ball after the collision. [8]

2. (a) Explain the meaning of the term dimension and write down the dimensions of torque. [2]

(b) When a car is in motion, it experiences a force F due to air resistance given by

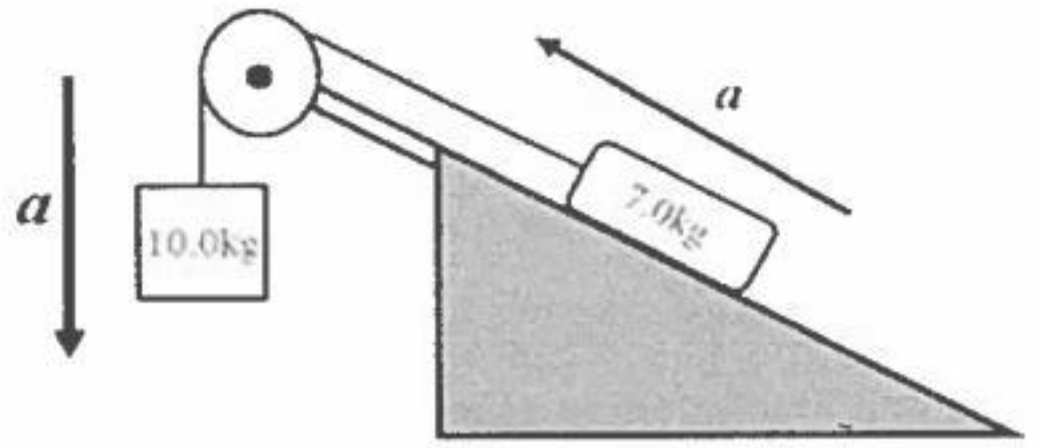
$$F = \frac{1}{2} C\rho v^2 A$$

with v the car's velocity, A cross- section area, C a dimensionless quantity and ρ some physical quantity related to air.

(i) What are the dimensions of ρ? [3]

(ii) Name the physical quantity ρ. [1]

(c) The figure below shows a system of blocks on an incline inclined at an angle of inclination of 30°.



The coefficients of friction are $\mu_s = 0.7$ and $\mu_s = 0.5$ Calculate the;

(i) minimum tension in the rope for the system to move. [5]

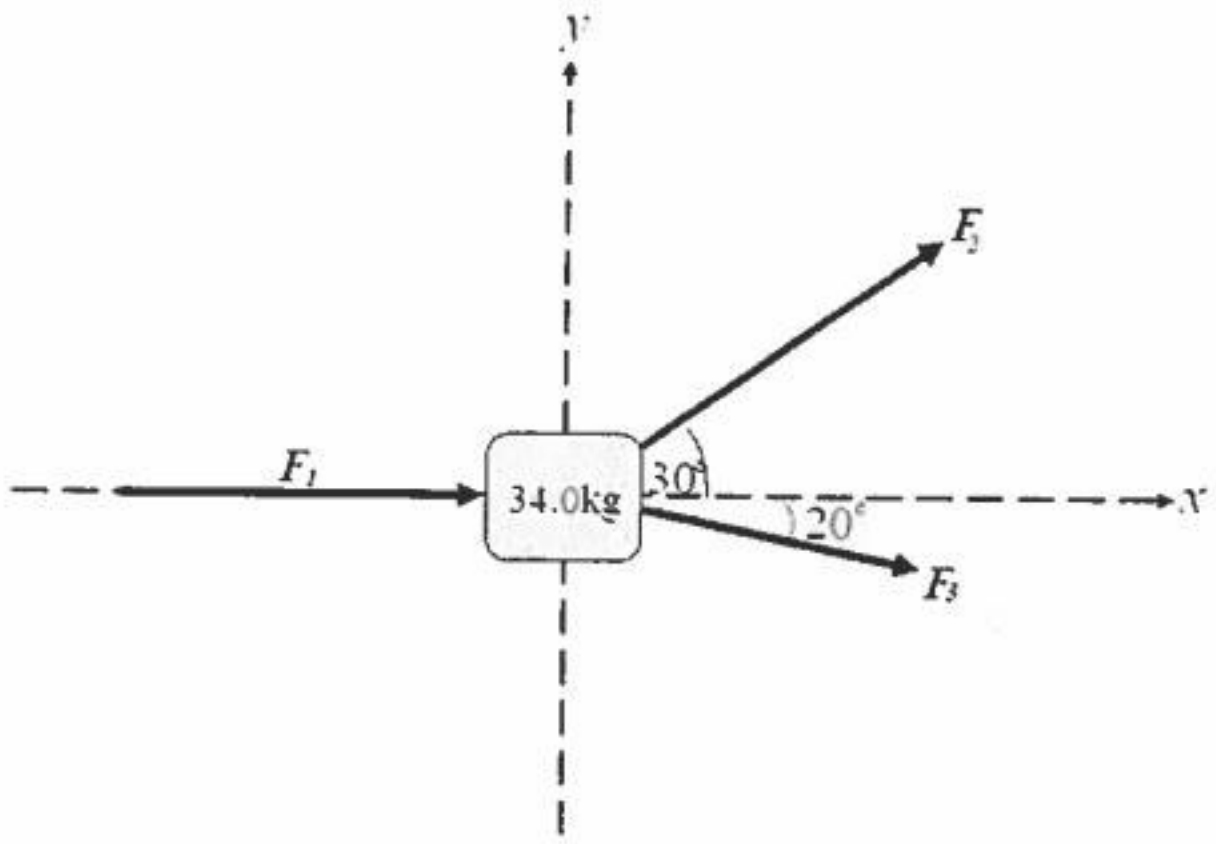
(ii) acceleration of the system. [5]

(d) Force $F_1 = (\hat{\imath} + 2\hat{\jmath} + 3\hat{k})N$ and $F_2 = (2\hat{\imath} - \hat{\jmath})$N are concurrent coplanar forces. Find the angle between them. What conclusion can be made for the two forces? [4]

3. (a) Discuss any two (2) problems associated with friction force and how the problems discussed are minimised. [4]

(c) A thin spherical shell of mass M and radius R rolls from rest down the hill 12m high. If friction between the sphere and the surface of the hill is ignored, what is the translational velocity at the bottom of the hill. [6]

(d) Three forces F_1 =100N, F_2 = 150N and F_3 = 120N act on a 34.0kg body as shown in the figure below.



How far does the body go in 2.5s starting from rest? [10]

4. (a) (i) State the law of conservation of angular momentum and the meaning of the term moment of inertia. [2]

(ii) A solid cylinder of mass 10kg and radius 250mm rotates freely about its axis. If it is rotating at 20rad/s^2 in 5s from rest, determine its angular momentum. [3]

(iii) Briefly discuss why when spinning with arms extended outward angular momentum is greater than when spinning with arms pulled inward. [2]

(b) (i) State the meaning of period of an oscillator. [2]

(ii) For an oscillator whose angular frequency is ω and amplitude of oscillation 1.0m, show that its period is $T = \frac{2\pi}{\omega}$. [3]

(c) A 2.0kg mass is attached to a spring and allowed to perform harmonic motion whose given by $y = 6.0Cos\left(5t + \frac{\pi}{4}\right)$cm.

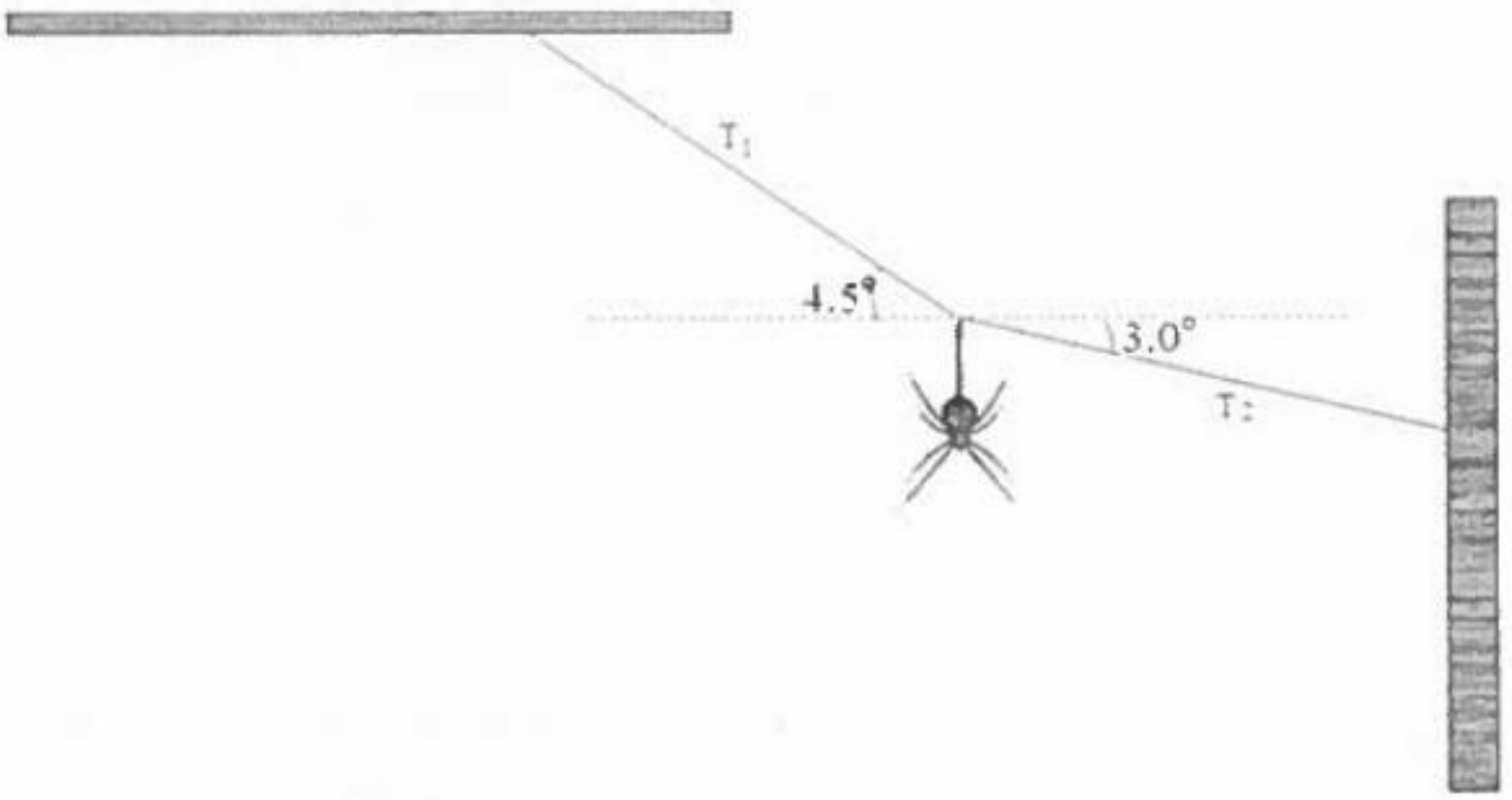
(i) Calculate the spring constant of the attached spring. [2]

(ii) How far is the mass from equilibrium after 2.0s? [2]

(iii) Determine the maximum kinetic energy of the mass. [4]

5. (a) (i) Briefly discuss how a body can achieve a state of static equilibrium. [2]

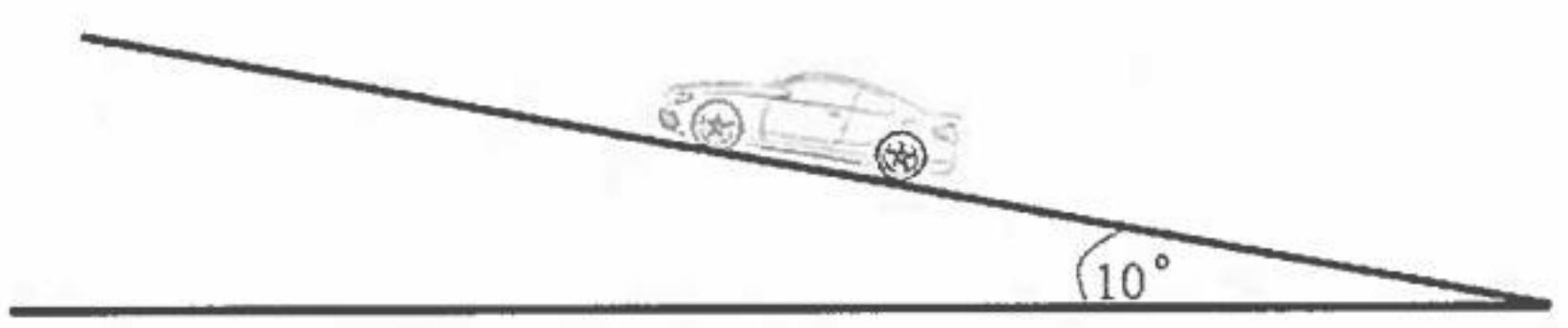
(ii)The figure below shows a spider hanging from the ceiling.



If the tension $T_1 = 10N$, calculate the mass of spider and tension T_2 [8]

(b) (i) Discuss the difference between gravitational and elastic potential energy. [2]

(ii) The figure below shows a car of mass 1400kg ascending a hill inclined at an angle of 10^o with the horizontal. It ascends at a steady speed of 80km/h with a driving force of 1000N provided by the engine.



Calculate the power needed for car to get to the top if the coefficient of kinetic friction between the tyres and surface of the hill is 0.3. [8]

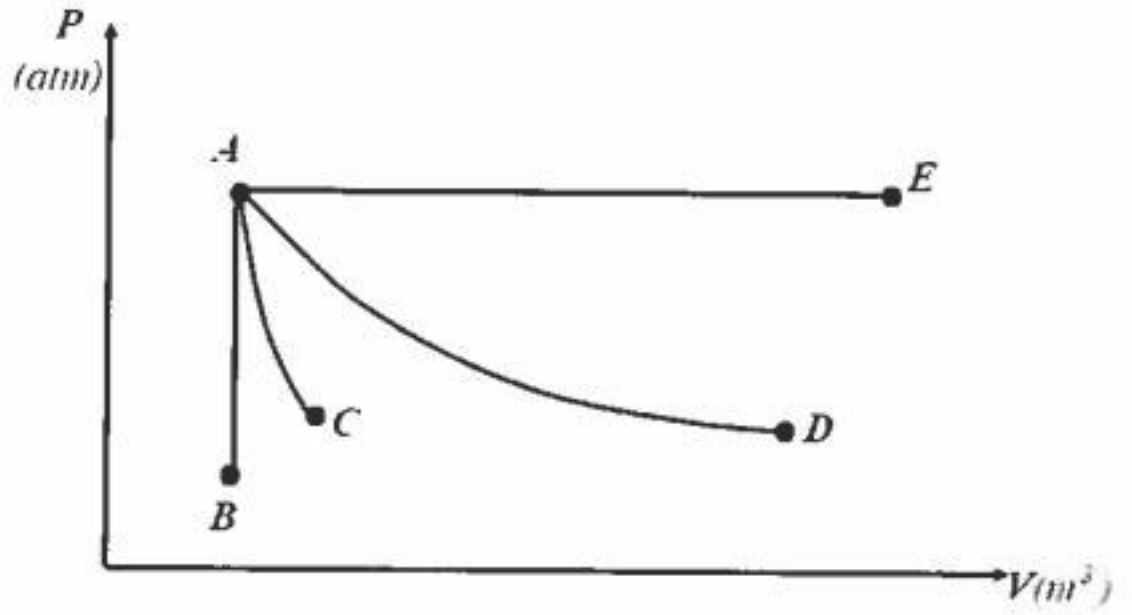
6. (a) The heating process has several effects. State any two (2) of such effects. [2]

(b) A brass sheet has its length 40cm at 10°C. If the surface area at 110°C is 320.1cm^2, find the width of the sheet [3]

(c) A well insulated electric kettle with a heating element rated 1200W is used to heat 4kg of water from 25°C in 10 minutes. Calculate the temperature of water after heating it for 10 minutes. [3]

(d) (i) State the meaning of a thermodynamic system and process. [2]

(ii) the figure below shows PV curve for a thermodynamic system.



From the curve identify and name the thermodynamic processes shown. [4]

(iii) $1.0m^3$ of water converts $1.671m^3$ of steam at atmospheric pressure and temperature of 100°C . If 2kg of water is converted to into steam at atmospheric pressure and 100°C temperature, how much will be the increase in change in internal energy? [6]

End of examination

List of constants

Density of water $\rho = 1000kg/m^3$

Specific heat capacity of water = 4200J/kg°C

Latent heant of vapourisation of water = 2.3×10^6J/kg

Coefficient of thermal conductivity of brass = 3×10^{-5} °C^{-1}

Latent heat of fusion of water = 3.34×10^3J/kg

Stefan – Boltzmann constant = 5.67×10^{-8}W/ m^{2}K^4

Emissivity of black body = 1

Acceleration due gravity = $9.8m/s^2$,

Speed of sound in air = 340m/s,

Speed of light in vacuum = 3.0×10^8m/s

Universal gravitational constant = 6.67×10^{-11}Nm^2/kg^2

Mass of the earth = 6.0×10^{24}kg

Radius of the earth = 6400km

Universal gas constant = 8.31J/mol.K

Atmospheric pressure = 1.01×10^5 Pa

1 Pascal = $1N/m^2$

1 Cal = 4.18J

Equations

Uniformly accelerated motion:

$v = \frac{x}{t}$, $v = v_o + at$, $x = v_o t + \frac{1}{2}at^2$, $v^2 = v_o^2 + 2aS$, $v = v_o + at$

Projectile motion:

$v_x = v_o Cos\theta$, $v_y = v_o Sin\theta - gt$, $y = (v_o Sin\theta)t - \frac{1}{2}gt^2$ $T = \frac{2v_o sin\theta}{g}$,

$R = \frac{v_o^2 sin2\theta}{g}$, $y = (tan\theta)x - \left[\frac{g}{2v_o^2 Cos^2\theta}\right]$

Force and motion:

$F = ma$, $w = mg$, $F_{AB} = -F_{BA}$, $f = \mu F_N$

Energy:

$P.E = mgh$, $K.E = \frac{1}{2}mv^2$, $W = FxCos\theta$, $P = \frac{W}{t} = FvCos\theta$

Linear Momentum:

$p = mv$, $F\Delta t = \Delta mv$

Circular:

$T = \frac{2\pi}{v}$, $a_c = \frac{v^2}{r}$, $F_c = \frac{mv^2}{r}$,

Rotational and angular motion:

$$\theta = \frac{S}{r} = \left(\frac{\omega_o + \omega_f}{2}\right)t, \quad \theta = \omega_o t + \frac{1}{2}\alpha t^2, \quad \omega_f = \omega_o + \alpha t, \qquad \omega = \frac{\theta}{t},$$

$$v = r\omega, \qquad \omega_f^2 = \omega_o^2 + 2\alpha\theta, \quad \alpha = \frac{\Delta\omega}{\Delta t} = \frac{a_T}{r}, \qquad I = \sum mr^2, \qquad K.E = \frac{1}{2}I\omega^2$$

$$\tau = Fr = I\alpha, \qquad W = r\theta, \qquad P = \tau\omega, \qquad L = I\omega$$

Simple harmonic motion:

$$F = -kx, \qquad \omega = 2\pi f, \quad f = \frac{1}{2\pi}\sqrt{\frac{g}{L}}, \qquad a = \omega^2 x, \quad P.E = \frac{1}{2}kx^2,$$

$$\frac{1}{2}kx^2 + \frac{1}{2}mv^2 = \frac{1}{2}kx_o^2, \qquad \omega = \sqrt{\frac{k}{m}}, \qquad f = \frac{1}{2}\sqrt{\frac{k}{m}}$$

Moment of Inertia

Solid cylinder $I = \frac{1}{2}MR^2$

Solid sphere $I = \frac{2}{5}MR^2$

Thin spherical shell $I = \frac{2}{3}MR^2$

Thermal Properties of matter:

$$\frac{Q}{t} = \varepsilon\sigma AT^4, \qquad \frac{Q}{\Delta t} = \frac{kA\Delta T}{\Delta L}, \qquad Q = mc\Delta T = nc\Delta T, \qquad \Delta L = \alpha L\Delta T,$$

$$\Delta V = \gamma V\Delta T, \qquad C_V = C_p - R, \quad PV = nRT, \qquad P_1V_1^\gamma = P_2V_2^\gamma, \qquad W = P\Delta V$$

Thermodynamic:

$$Q = \Delta U + W, \qquad \eta = 1 - \frac{T_2}{T_1} = \frac{work\ done}{input\ heat\ high\ temperature}, \qquad W = nRT.In\left(\frac{v}{v_o}\right)$$

$$C_V = C_p - R, \quad PV = nRT, \qquad P_1V_1^\gamma = P_2V_2^\gamma, \qquad W = P\Delta V$$

KAPASA MAKASA UNIVERSITY

DEPARTMENT OF EDUCATION, OPEN AND DISTANCE LEARNING

2023 ACADEMIC YEAR

SESSIONAL EXAMINATIONS

MA110: MATHEMATICS

13TH OCTOBER, 2023

TIME ALLOWED: 3 HOURS

INSTRUCTIONS

1. WRITE YOUR **SIN** NUMBER AND PROGRAM OF STUDY ON EACH ANSWER BOOKLET USED.
2. ATTEMPT **FIVE** OUT OF SEVEN QUESTIONS
3. EACH QUESTION CARRIES **20** MARKS
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DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO.

ATTEMPT ANY FIVE QUESTIONS FROM 1 TO 7.

1. a). Solve for x ; $9(3x + 4) - 2x = 11 + 5(4x - 1)$ **(3)**

b). Evaluate $\sum_{i=1}^{4}(-1^i)(i+1)^i$ **(4)**

c). If the roots of $x^2 - 7x + 15 = 0$ are α and β. Determine the equation with roots α^2 and β^2. **(6)**

d). Find the equations of the tangent and the normal to the curve;

$x^2 + y^2 + 3xy - 11 = 0$ at the point $x = 1$ and $y = 2$. **(7)**

2. a). Find the value of x satisfying; $\text{Log}_a x = 2\text{Log}_a 3 + \text{Log}_a 20 - \text{Log}_a 1.8$ **(4)**

b). Determine the mid term of the expansion $(2p - \frac{1}{2q})^{10}$. **(5)**

c). Solve the system of equations;

$2x + y + z = 2$

$3x + 2y + z = -3$

$2x + y + 2z = 1$ **(7)**

d). Find the third derivative of the function defined by $y = 6x^{2/3}$ **(4)**

3. a). Solve for x;

i. $\text{Log}(7x + 23) = 2$

ii. $16^{3x} = 64^x . 8^{3x-1}$ **(6)**

b). Decompose into partial fractions; $\frac{2x^2+7}{(x+2)(x^2+1)}$ **(5)**

c). Solve the absolute equation; $|x^2 + 2x - 4| = 4$. **(6)**

d). Evaluate $\int_0^1 (e^{2x} + x + 2)dx$ **(3)**

4. a). Simplify and rationalise the denominator; $\frac{\sqrt{8}}{3\sqrt{6}-5\sqrt{2}}$ **(4)**

b). Solve the system of equations;

$-8x + 2y = 10$

$\frac{2}{3}x - \frac{1}{3}y = 1$ **(4)**

c). Convert the polar coordinates $(-4, 2\pi/3)$ into Cartesian coordinates. **(4)**

d). Solve the inequality and show your solution on the number line;

$\frac{-1}{x-3} \geq 1$ **(8)**

5. a). Determine the value of:

$$\begin{vmatrix} 2y & 1+y & 3 \\ 1-y & 1 & y \\ 0 & 4y & 5 \end{vmatrix}$$ **(4)**

b). When simplified the polynomial, $\frac{y^3-8}{y-2}$ transforms to the form $ay^2 + by + c$.

Simplify and state the numerical values of a, b, and c. **(7)**

c). Prove that; $1+3+5+\text{---}+(2n-1) = n^2$. **(5)**

d). Find two integers whose sum is 12 and whose product is a maximum. **(4)**

6. a). Determine the minimum, maximum or point of inflection for $y^3 - 48x + 17$.

b). Prove that $(1 + \sec x)(1 - \cos x) = \sin x \tan x$. **(4)**

c). Sketch and determine the area of the region bounded by the curves:

$y = 3 - x^2$ and $y = -x + 1$, between $x = 0$ and $x = 2$. **(10)**

7. a). Simplify $\left[\frac{a^x+a^{-x}}{2}\right]^2 - \left[\frac{a^x-a^{-x}}{2}\right]^2$. **(5)**

b). If n(A) = 12, n(B) = 14, $n(A \cap B) = 5, n(A \cap C) = 6, n(B \cap C) = 4,$ $n(A \cap B \cap C) = 2, and\ nA \cup B \cup C) = 27$. Find n(C)? **(5)**

c). Differentiate: $f(x) = \frac{Ln(2x)}{e^{2x}+2}$ **(5)**

d). Integrate $\int y \cos(y)\, dy$ **(5)**

End of examination

GOOD LUCK

NS

2024

KAPASA MAKASA UNIVERSITY
DEPARTMENT OF AGRICULTURE AND AQUATIC SCIENCES
2024 ACADEMIC YEAR
SESSIONAL EXAMINATIONS
MA110: MATHEMATICS

Date 14 /10/2024
DURATION : 3 HOURS

INSTRUCTIONS

1. WRITE YOUR **SIN** NUMBER AND PROGRAM OF STUDY ON EACH ANSWER BOOKLET USED
2. ATTEMPT **FIVE** OUT OF SEVEN QUESTIONS
3. EACH QUESTION CARRIES **20** MARKS
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5. CALCULATORS ARE NOT ALLOWED IN THIS PAPER

DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO

1. (a) The cubic equation $2z^3 - 5z^2 + cz - 5 = 0$, $c \in R$ has a solution $z = 1 - 2i$. Find in any order
   (i) The other two solutions of the equation [6]
   (ii) The value of c [2]

   (b) Find the range of values k can take for $kx^2 - 3k - 12 = 0$ to have real roots [4]

   (c) If α and β are the roots of the equation $x^2 - x - 3 = 0$. State the values of $(\alpha + \beta)$ and $(\alpha\beta)$ and find the values of
   (i) $\alpha^2 + \beta^2$ [4]
   (ii) $(\alpha - \beta)^2$ [4]

2. (a) Decompose $\frac{x^3 - x^2 - 3x + 5}{(x-1)(x^2-1)}$ into partial fraction [7]

   (b) Find x if $|2x + 1| > 7$ [3]

   (c) Solve the equation $\sqrt{4 - x} - \sqrt{6 + x} = \sqrt{14 + 2x}$ [4]

   (d) Given that $z = 4 - 4\sqrt{3}i$. Find the cubic root of z give your answer in polar $r(cos\theta + isin\theta)$, $r > 0$, $-\pi < \theta \leq \pi$ [6]

3. (a) A curve C has the equation $x^3 - 2xy + y^2 - 13 = 0$.
   Find the equation of the normal to C at the point $P(-2, 3)$ [6]

   (b) Solve the equation $2^{x^2} = 16^{x-1}$ [3]

   (c) Find the value of K if the remainder when the polynomial $2x^4 + kx^3 - 11x^2 + 4x + 12$ is divided by $(x - 3)$ is 60 [3]

   (d) Resolve into partial fraction $\frac{5}{x^2 + x - 6}$ [5]

   (e) Using first principle find the derivative of $f(x) = x^3$ [3]

4. (a) A curve has implicit function $9x^2 + 2y^2 + y = 1$
   (i) Show clearly that $\frac{dy}{dx} = \frac{-18x}{4y+1}$ [4]
   (ii) Hence find the coordinates of the turning points [4]

   (b) If line L_1 and L_2 have slopes $m_1 = 3$ and $m_2 = -2$ respectively. Find the angle from L_1 to L_2 [4]

   (c) A point P lies on the line AB. If A has the point $(-1, 5)$ and B has coordinate $(7, 1)$ such that $\frac{\overrightarrow{AP}}{\overrightarrow{AB}} = \frac{2}{3}$. Find the point of P [4]

   (d) Expand $(2+x)^4$ and use your expansion to find $(2.1)^4$ [4]

5. (a) Find an equation of an ellipse if the length of the minor axis is 6 and the foci are $(4,0)$ and $(-4,0)$ [4]

(b) Find the indefinite integral of $\int(2x+\frac{3}{x}+\frac{4}{x^2})dx$ [3]

(c) Evaluate $\lim_{x\to 1}\frac{x^2+x-2}{x^2-x}$ [4]

(d) Find the equation of the circle through the points (1,5), (-2,3) and (2,-1) [9]

6. (a) Find the limit $\lim_{x\to 1}\frac{x^3-1}{x-1}$ [4]

(b) Find the gradients of the tangents drawn to the curve $x^2+y^2-2x-2y=3$ at $x=2$ [6]

(c) The parametric equations of a function are given by $y = 3cos2t$, $x = 2sint$. Determine the expressions of

(i) $\frac{dy}{dx}$ [2]

(ii) $\frac{d^2y}{dx^2}$ [2]

(d) A DC circuit comprises three closed loops. Applying Kirchhoff's laws to the closed loops gives the following equations for the circuit flow in milliamperes;

$$2I_1 + 3I_2 - 4I_3 = 26$$

$$I_1 - 5I_2 - 3I_3 = -87$$

$$-7I_1 + 2I_2 + 6I_3 = 12$$

Use cramers rule to solve for I_1, I_2 and I_3 [6]

7. (a) Evaluate $\int_1^3 5x\sqrt{2x^2+7}dx$ [4]

(b) If $\mathbf{Z_1} = 1-3i$, $\mathbf{Z_2} = -2+5i$ and $\mathbf{Z_3} = -3-4i$ determine in the form $a+bi$ of

(i) $\mathbf{Z_1}\,\mathbf{Z_2}$ [2]

(ii) $\frac{\mathbf{Z_1}}{\mathbf{Z_3}}$ [2]

(c) Prove that $\sqrt{\left(\frac{1-cos\theta}{1+cos\theta}\right)} \equiv cosec\theta - \cot\theta$ [4]

(d) Differentiate the following $wrt\ x$

(i) $y = ln(x^2+1)$ [4]

(ii) $y = e^{-3x}sin2x$ [4]

KAPASA MAKASA UNIVERSITY

CH 110 : GENERAL CHEMISTRY

OCTBER 2022 SESSIONAL EXAMINATION

TIME ALLOWED: 3 HOURS **100 MARKS**

INSTRUCTIONS TO CANDIDATES

1. There are **Nine (09)** questions in this paper. Candidates are expected to attempt any **Five (05)** questions
2. Each question carries **twenty (20)** marks. Marks allocated to each part of the question are enclosed in brackets [ ].
3. Candidates are reminded of the need for the **clear presentation** of their work
4. Different parts of the same question must be answered strictly in continuation
5. You are allowed to use non programable calculators
6. Do not turn this paper until you are told to do so.

Useful Information

Physical Constants		
Constant	***Symbol***	***Value***
Speed of light (vacuum)	c	$2.998 \times 10^8\ m\ s^{-1}$
Avogadro's number	N_A	$6.02\ x\ 10^{23} mol^{-1}$
Gas constant	R	$8.314\ J\ K^{-1}mol^{-1}$
		$0.0821\ L\ atmK^{-1}mol^{-1}$
Faradays constant		*96, 487C/mol*
Ideal Gas Equation		$Pv = nRT$
1. 1 amu = 1.66 X 10^{-27} kg or 1 amu = 931.2 MeV. 1 eV = 1.602 × 10^{-19} J, Fe-56 (55.921), m_p (1.00728amu), m_n (1.008665amu)		
1 atm = 101325 Pa= 760mmHg = 760torr		

Question one (Atomic Structure) — 20 MARKS

(a) You are presented with the following elements P: $1s^2\ 2s^2\ 2p^4$ and Q: $1s^2\ 2s^2\ 2p^3$

State the group number and the period to which P and Q belong. Justify your answer. [3]

(b) Write the electronic configurations of O, S, Se. What feature makes them have similar chemical properties. [4]

(c) Write condensed formulas of the following.

(i) Iodine

(ii) Boron

(iii) Krypton

(iv) Lead

(v) Bromine [5]

D. i. How many unpaired electrons are in (a) a fluorine atom, (b) an oxygen atom, (c) a boron atom? [3]

ii. Write the set of quantum numbers for hydrogen in its ground state.

E. State whether each of the following sets of quantum numbers is permissible for an electron in an atom. If a set is not permissible, explain why.

i. $n = 1, l = 1, ml = 0, ms = +\frac{1}{2}$

ii. $n = 3, l = 1, ml = -2, ms = -\frac{1}{2}$

iii. $n = 2, l = 1, ml = 0, ms = +\frac{1}{2}$

iv. $n = 2, l = 0, ml = 0, ms$ 1

v. $n = 2, l = 3, ml = 0, ms = -\frac{1}{2}$

[5]

Question Two (Chemical Bonding) — 20 MARKS

(a) Draw the Lewis dot structure for PBr_3. For this structure, how many lone pairs of electrons are on the central atom? [3]

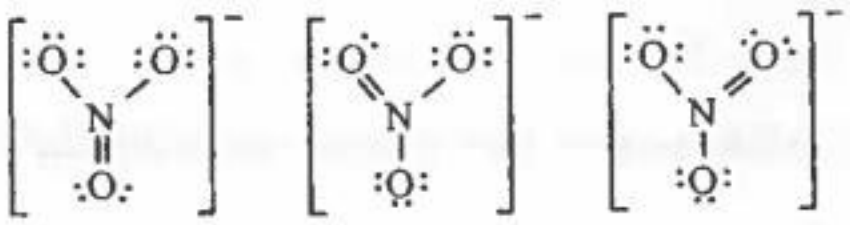
(b) Identify each violation to the octet rule by drawing a Lewis electron dot diagram.

(i) IF_5

(ii) XeF_3

(iii) SO_3 [6]

(c) Determine the formal charges for the nitrogen and oxygen in the resonance structures of NO_3^-



[3]

(d) What is hybridization? [2]

(e) Show the hybridization in the following molecules.

i. SF_6

ii. CH_4

iii. PCl_5 [6]

.....

Question Three (Nuclear Chemistry) 20 MARKS

(a) Give two differences between nuclear and chemical reactions. [2]

(b) Write a nuclear reaction for each step in the formation of $^{208}_{82}Pb$ from $^{228}_{90}Th$, which proceeds by a series of decay reactions involving the stepwise emission of α, α, α, α, β, β, α particles, in that order. [5]

(c) Explain the meaning of nuclear binding energy. [2]

(d) Write balanced equations for the following processes.

i. $^{11}_{6}C$ produces a positron

ii. $^{214}_{83}Bi$ produces a β particle

iii. $^{237}_{93}Np$ produces an α particle

iv. $^{39}_{19}K \longrightarrow {}^{0}_{-1}e + $ ———

v. $^{239}_{94}Pu \longrightarrow {}^{4}_{2}He + $ ———

vi. $^{235}_{92}U \longrightarrow + $ —— $^{231}_{90}Th$ [6]

a. Determine the mass defect and the average binding energy per nucleon for an iron – 56 nucleus in Mev. [5]

.....

Question Four (Stoichiometry and Mole concept) — 20 marks

a. Determine the molecular formula of styrene, used to prepare the plastic wrapping material polystyrene. It is a compound of carbon and hydrogen only that contains 92.26% carbon, and has a molar mass of 104 g/mol. [4]

b. Calculate the relative molecular masses of the following.

i. sucrose

ii. ethanol

iii. sodium chloride [3]

c. Calculate the number of moles of sulphuric acid present in 27.0g sample of H_2SO_4. [2]

d. A silicon chip used in an integrated circuit of a microcomputer has a mass of 5.68 mg. How many silicon (Si-28.09) atoms are present in this chip? [3]

e. What is the empirical formula of a chromium oxide that is 68.4% Cr by mass? [2]

f. One way of producing $O_2(g)$ involves the decomposition of potassium chlorate into potassium chloride and oxygen gas. A 25.5 g sample of Potassium chlorate is decomposed.

i. How many moles of $O_2(g)$ are produced?

ii. How many grams of potassium chloride are produced?

iii. How many grams of oxygen gas are produced [6]

Question five (Acid base equilibria) — 20 MARKS

(a) Define the following terms

(i) A base according to the Arrhenius theory [1]

(ii) Buffer solution [1]

(b) Formic acid (HCOOH) is a typical weak acid whose ($K_a = 1.78 \times 10^{-4}$)

$$HCOOH_{(aq)} + H_2O_{(l)} \longrightarrow HCOO^-_{(aq)} + H_3O^+_{(aq)}$$

If the concentration of Formic acid is 0.24M,

(i) Write the K_a expression for the reaction above [2]

(ii) Calculate the PK_a of the reaction [2]

(iii) Calculate the PH of the reaction [4]

(d) Calculate the pH of a buffer solution made from 0.50 M nitrous acid (HNO_2) and 0.80 M sodium fluoride with acid dissociation constant of HF , Ka = 4.02×10^{-4}. [6]

(e) You are given two solutions in beakers labeled A and B containing colourless solutions. One of them is suspected to contain a base. Describe briefly using appropriate apparatus and testing instruments how you can identify the solution containing the base. [4]

Question six (Chemical Equilibrium) — 20 MARKS

(a) State the Le Chatelier's principle [2]

(b) Consider the following equilibrium, for which $\Delta H < 0$

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

How will each of the following changes affect an equilibrium mixture of the three gases?

(i) $O_2(g)$ is added to the system; [1]

(ii) the reaction mixture is heated; [1]

(c) If the $[O_2] = 0.023M$ and that $[SO_2] = 0.0067M$, calculate the $[SO_3] = ?$ $K_c = 1.54 \times 10^{-5}$ [4]

(d) Balance this reaction in acidic medium,

$$OBr^- + I^- \longrightarrow I_2 + Br_2$$ [6]

(e) The ksp for Magnesium Fluoride $[MgF_2(s)]$ is 8.0×10^{-8} .

(i) Calculate the concentration of each ion [6]

.....

Question seven (chemical kinetics) — 20 MARKS

(a) Explain briefly how each one of the following affect the rate of a reaction.

(i) Surface Area [2]

(ii) Catalyst [2]

(b) Nitrogen (II) oxide reacts with oxygen in the following way:

$$2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$$

Experiments were carried out to determine the orders of reaction with respect to NO and O_2. The results of these experiments are shown below.

Experiment	$[NO_{(g)}]$ / moldm^{-3}	$[O_{2(g)}]$ / moldm^{-3}	Rate / moldm^{-3} s^{-1}
1	1.5×10^{-5}	0.5×10^{-5}	2.1×10^{-7}
2	4.5×10^{-5}	0.5×10^{-5}	1.9×10^{-6}
3	1.5×10^{-5}	2.0×10^{-5}	8.4×10^{-7}

(i) Calculate the order of the reaction with respect to NO? 0.11 [2]

(ii) Calculate the order of the reaction with respect to O_2? [2]

(iii) Calculate the overall order of the reaction 0.33 [1]

(iv) Write the rate law expression for this reaction [1]

(v) Calculate the value of the rate constant, k with units [3]

(c)One mechanism for the destruction of ozone in the upper atmosphere is

$H_2 + NO \rightarrow N + H_2O$ Slow

$N + NO \rightarrow N_2O$ Fast

(i) Which one is the rate determining step [1]

(ii) Which species is an intermediate? [1]

(iii) What is the overall reaction? [1]

(iv) Write the rate law for the reaction [2]

(d) Calculate the activation energy of a reaction which takes place at 400 K, where the rate constant of the reaction is $6.25 \times 10^{-4}\ s^{-1}$. Given that $A = 4.6 \times 10^{13}$ and $R = 8.31\ J\ mol^{-1}\ K^{-1}$. [4]

.....

.....

Question Eight (Gas laws) — *20 MARKS*

(a) Mention the four parameters under which the gas laws are based. [4]

(b) A container containing 5.0 L of gas is collected at 100K and then allowed to expand to 20.0L

What must the new temperature be in order to maintain the same pressure. [6]

(c) 548mmHg of Methane gas has a volume of 2.4L . If 0.456g of methane gas was used, at what temperature was this reaction possible.[methane CH4 C= 12 , H = 1] [5]

(d) If neon gas travels at 400 m/s at a given temperature, calculate the velocity of butane, C_4H_{10}, at the same temperature. [Mr for Ne = 20.2g/mol, C= 12 , H = 1] [5]

.....

uestion Nine (Electrochemistry) 20 MARKS

Given that, Sn^{2+}[0.02M] /Sn , E^0cell = - 0. 136V Au^{3+} [0.2M] /Au E^0cell = +1.498V [1]

(a) Write the anode half reaction [1]

(b) Write the cathode half reaction [2]

(c) Write the overall reaction [3]

(d) Calculate the E^0cell potential for the galvanic cell at 25^0C [5]

(e) Calculate the overall cell potential under the stated conditions. [3]

(f) Calculate the Gibbs free energy (delta G) for the cell [3]

(g) Calculate the equilibrium concentration(Kc) for the cell [2]

(h) State whether the reaction is spontaneous or non spontaneous. Justify.

.....

~END OF EXAMINATION ~

The Periodic Table of the Elements

1 **H** Hydrogen 1.00794																	2 **He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012182											5 **B** Boron 10.811	6 **C** Carbon 12.0107	7 **N** Nitrogen 14.00674	8 **O** Oxygen 15.9994	9 **F** Fluorine 18.9984032	10 **Ne** Neon 20.1797
11 **Na** Sodium 22.989770	12 **Mg** Magnesium 24.3050											13 **Al** Aluminum 26.981538	14 **Si** Silicon 28.0855	15 **P** Phosphorus 30.973761	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.4527	18 **Ar** Argon 39.948
19 **K** Potassium 39.0983	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.955910	22 **Ti** Titanium 47.867	23 **V** Vanadium 50.9415	24 **Cr** Chromium 51.9961	25 **Mn** Manganese 54.938049	26 **Fe** Iron 55.845	27 **Co** Cobalt 58.933200	28 **Ni** Nickel 58.6934	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.39	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.61	33 **As** Arsenic 74.92160	34 **Se** Selenium 78.96	35 **Br** Bromine 79.904	36 **Kr** Krypton 83.80
37 **Rb** Rubidium 85.4678	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.90585	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.90638	42 **Mo** Molybdenum 95.94	43 **Tc** Technetium (98)	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.90550	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.8682	48 **Cd** Cadmium 112.411	49 **In** Indium 114.818	50 **Sn** Tin 118.710	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.60	53 **I** Iodine 126.90447	54 **Xe** Xenon 131.29
55 **Cs** Cesium 132.90545	56 **Ba** Barium 137.327	57 **La** Lanthanum 138.9055	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.9479	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.217	78 **Pt** Platinum 195.078	79 **Au** Gold 196.96655	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.3833	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.98038	84 **Po** Polonium (209)	85 **At** Astatine (210)	86 **Rn** Radon (222)
87 **Fr** Francium (223)	88 **Ra** Radium (226)	89 **Ac** Actinium (227)	104 **Rf** Rutherfordium (261)	105 **Db** Dubnium (262)	106 **Sg** Seaborgium (263)	107 **Bh** Bohrium (262)	108 **Hs** Hassium (265)	109 **Mt** Meitnerium (266)	110 (269)	111 (272)	112 (277)	113	114				

58 **Ce** Cerium 140.116	59 **Pr** Praseodymium 140.90765	60 **Nd** Neodymium 144.24	61 **Pm** Promethium (145)	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.964	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.92534	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.93032	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.93421	70 **Yb** Ytterbium 173.04	71 **Lu** Lutetium 174.967
90 **Th** Thorium 232.0381	91 **Pa** Protactinium 231.03588	92 **U** Uranium 238.0289	93 **Np** Neptunium (237)	94 **Pu** Plutonium (244)	95 **Am** Americium (243)	96 **Cm** Curium (247)	97 **Bk** Berkelium (247)	98 **Cf** Californium (251)	99 **Es** Einsteinium (252)	100 **Fm** Fermium (257)	101 **Md** Mendelevium (258)	102 **No** Nobelium (259)	103 **Lr** Lawrencium (262)

KAPASA MAKASA UNIVERSITY

SCHOOL OF APPLIED SCIENCE AND OPEN LEARNING

BACHELOR OF SCIENCE – (ICT with Education)

COURSE CODE: PE 110 (Principles of Education)

2024 SESSIONAL EXAMINATIONS

Date: 17th October, 2024. **Duration: 3 hours** **Marks: 100**

INSTRUCTIONS:

(a) Write your Student Identification Number on the Answer Booklet provided

(b) The paper comprised of **EIGHT [8]** questions.

(c) Attempt any **FIVE [5]** questions in the answer booklet provided.

(d) Always clarify key concepts in a question.

(e) Use examples relevant to your field of specialisation or study where possible.

1. Explain the Zambian government language policy and state its merits and implication on quality education delivery process. **[20 marks]**

2. Philosophy provides a guide in human activities. Explain the branches of philosophy and its theories of knowledge. **[20 marks]**

3. Illustrate how Ministry of Education in utilizing the principles governing education in Zambia in order to achieve its vision by 2030. **[20 marks]**

4. Evaluate the strengths and limitations of African Traditional education and suggest ways of improving traditional education to meet the needs of the present day society. **[20marks]**

5. The aims of Education intends to produce the desired changes in human beings and they are crystal clear in "Educating our future". Describe the distinct factors that facilitates the setting up of these aims. If possible give examples. **[20marks]**

6. Describe any one of the gender relate policies as you outline educational challenges faced by girls in Zambia during and after independence. **[20 marks]**
7. Describe the educational inequalities inherited at independence and outline ways of alleviating them. **[20 marks]**
8. Briefly discuss the significance of philosophies of education and bring forth alternatives in events were there is an outbreak of a pandemic in a state. **[20marks]**

THE END

KAPASA MAKASA UNIVERSITY

FACULTY OF APPLIED SCIENCE AND OPEN LEARNING

DEPARTMENT OF AGRICULTURE AND AQUATIC SCIENCES

CHINSALI, MUCHINGA PROVINCE

BIOLOGY – NR 100

END OF YEAR FINAL SESSIONAL EXAMINATION

17TH OCTOBER 2024

INSTRUCTIONS TO CANDIDATES

1. Time allowed is **THREE (3) HOURS.**
2. Remember to write your student identity number (SIN) on the provided answer sheets.
3. All questions carry equal marks **(20 Marks).**
4. Question one is **COMPULSORY.**
5. Attempt a total of **FIVE** questions.
6. Where necessary, use a diagram for illustration.

CELLPHONES AND OTHER RELATED GAGETS ARE NOT ALLOWED IN THE EXAMINATION ROOM

DO NOT TURN THIS PAGE UNTIL YOU HAVE BEEN TOLD TO DO SO BY THE CHIEF INVIGILATOR

QUESTION ONE

1.

A. Briefly describe the structure of a virus. **(4 marks)**

B. Describe how viruses affect the cells in the human body. **(8 marks)**

C. Show two ways in which viruses are classified. **(4 marks)**

D. Mention two diseases that are caused by retroviruses. **(4 marks)**

QUESTION TWO

2.

A. With an example of an organism, explain the concept of 'Binomial nomenclature'. **(4 marks)**

B. Describe the three domains of life. **(6 marks)**

C. Give three rules for binomial nomenclature as outlined in the international code of botanical nomenclature. **(6 marks)**

D. Describe a botanical key using any member of kingdom Plantae. **(4 marks)**

QUESTION THREE

3.

A. Differentiate Chromosomes from DNA. **(4 marks)**

B. Explain the concepts of co-dominance and incomplete dominance. **(4 marks)**

C. Explain why Gregor Mendel used peas for his experiments on inheritance. **(8 marks)**

D. Describe the law of independent assortment in relation Gregor Mendel's laws on inheritance. **(4 marks)**

QUESTION FOUR

4.

A. What is aerobic respiration? **(2 marks)**

B. Describe the following stages of respiration:

i. Glycolysis. **(6 marks)**

ii. Krebs cycle. **(6 marks)**

iii. Electron transport. **(6 marks)**

QUESTION FIVE

5.

A. Outline the differences between open circulatory system and closed circulatory system in reference to specific examples of invertebrates. **(4 marks)**

B. Give the advantages of an open circulatory system in reference to invertebrates. **(6 marks)**

C. Give the advantages of a closed circulatory system in reference to invertebrates. **(6 marks)**

D. Explain the concept of ecdysis (moulting) in reference to arthropods and give its importance to the stated group of organisms. **(4 marks)**

QUESTION SIX

6.

A. Explain the interactions of the abiotic and biotic factors of the ecosystem. **(10 marks)**

B. Differentiate a niche from a habitat in reference to an ecosystem. **(5 marks)**

C. Explain why it is important to conserve plants and animals in an environment. **(5 marks)**

QUESTION SEVEN

7.

A. Give the importance of Mitosis in reference to cell division. **(5 marks)**

B. Describe the process of Meiosis in reference to cell division. **(15 marks)**

END OF EXAMINATION, BEST WISHES.

KAPASA MAKASA UNIVERSITY

SCHOOL OF APPLIED SCIENCE AND OPEN LEARNING

DEPARTMENT OF EDUCATION AND OPEN LEARNING

BACHELOR OF SCIENCE – SUSTAINABLE AGRICULTURE, ANIMAL SCIENCE, FISHERIES AND AQUACULTURE AND ICT WITH EDUCATION

COURSE CODE: NR 120 **COURSE TITLE: COMMUNICATION SKILLS**

SESSIONAL EXAMINATION

DATE: OCTOBER, 2024 **DURATION: 3 HOURS** **MARKS: 100**

INSTRUCTIONS TO CANDIDATES

- Answer only **five (5)** questions out of **seven (7)** questions given.
- Read all questions carefully before selecting those you wish to attempt.
- Each question carries **twenty (20)** marks.
- Write all your answers in the answer booklet provided.
- Write your **Student Identity Number** on each of the answer sheets used.
- Indicate the **number** of each question you attempt.

1. (a) What are communication skills? [1]
   (b) List any **six (6)** elements of the communication process and define them. [12]
   (c) In summary form, state **five (5)** reasons why we communicate. [5]
   (d) Define a barrier to effective human communication. [1]
   (e) Name a communication barrier which refers to one's state of mind during the communication act. [1]

2. With clear examples, explain in detail nonverbal communication by highlighting its definition, importance and types. [20]

3. Describe the library with its organisation in terms of groups of books, main sections, and clearly show why it is important to students in learning institutions. [20]

4. (a) Demonstrate how a good writer can write an attractive essay by following the stages of the writing process. [15]
   (b) What is plagiarism? [1]
   (c) Use the following jumbled information to write **four (4)** references in the Harvard system.
      (i) London, 1988, McMillan, Culling, J.B., Town and Country Planning in Britain. [1]
      (ii) Urban and Rural Settlements, New York, Carter, H., Longman, 1990. [1]
      (iii) Palgrave Publishers, Urban Economics: A Global Perspective, 2000, London, Balchin, P.N. and Chen, J. [1]
      (iv) Word Formation Processes, Journal of Linguistics, Mwenya, C. and Kaunda, J., pp. 120-145, (4), vol. 2, 2019. [1]

5. (a) Discuss how an effective meeting should be conducted by highlighting all important elements involved in it. [15]
   (b) Identify any **five (5)** policies which should be established in the first meeting. [5]

6. With clear examples, discuss in detail job interview and its basic steps. [20]

7. Define entrepreneurship, and explain in detail entrepreneurial process. [20]

END OF EXAMINATION

KAPASA MAKASA UNIVERSITY

SCHOOL OF APPLIED SCIENCE AND OPEN LEARNING

AGRICULTURAL AND AQUATIC SCIENCES DEPARTMENT

2024 SESSIONAL EXAMINATION

CH 110/ NR 130: GENERAL CHEMISTRY

OCTOBER/NOVEMBER SESSIONAL

DURATION: 3 HOURS **MARKS: 100**

INSTRUCTIONS TO CANDIDATES

1. THERE ARE **SEVEN** QUESTIONS IN THIS PAPER. ANSWER ANY **FIVE** QUESTIONS OF YOUR CHOICE.
2. ALL QUESTIONS CARRY EQUAL MARKS.
3. ANSWER EVERY NEW QUESTION ON A FRESH PAGE IN THE ANSWER BOOKLET. ADHERE TO THE NUMBERING FORMAT IN THAT APPEARS IN EACH QUESTION.
4. READ A QUESTION COMPLETELY BEFORE ATTEMPTING IT, YOU ARE REMINDED OF THE NEED FOR GOOD ENGLISH AND CLEAR PRESENTATION.
5. SHOW KEY STEPS IN YOUR WORKING TO SUPPORT YOUR ANSWERS.

QUESTION ONE: ACIDS AND BASES

a) Define each of the following
   i. Bronsted-Lowry Acid [1]
   ii. Lewis Acid [1]

b) At 298.15 K, the acid dissociation constant, K_a, for propanoic acid, CH_3CH_2COOH, is **1.35** $\times 10^{-5}$. Write an equation showing how the acid behaves in water and calculate the pH of 0.125 M aqueous propanoic acid at 298.15 K. [5]

c) Write the conjugate acid-base pairs for the following reactions:
   i. $HNO_2 + H_2O \rightarrow H_3O^+ + NO_2^-$ [2]
   ii. $H_2PO_4^- + H_2O \rightarrow H_3O^+ + HPO_4^{2-}$ [2]

d) Calculate the pH of the 0.20 M NH_3:0.20 M NH_4Cl buffer. What is the pH of the buffer after the addition of 0.10 M HCl to the buffer? The K_b for ammonia is 1.8×10^{-5} (Assume that there is no change in volume.) [5]

e) Calculate pK_a and pK_b values for an acid whose K_a value is 1.8×10^{-5} [4]

[Total: 20 marks]

QUESTION TWO: ELECTROCHEMISTRY & REDOX REACTIONS

a) A galvanic cell also known as a voltaic cell consists of a magnesium (Mg) electrode in a 1.0 M magnesium nitrate, $Mg(NO_3)_2$, solution and a silver (Ag) electrode in a 1.0 M silver nitrate $Ag(NO_3)$ solution. To calculate the standard emf of this electrochemical cell at 25 °C standard reduction potentials of its two electrodes are provided, namely, $E°_{Ag^+/Ag} = 0.80$ V and $E°_{Mg^{2+}/Mg} = -2.37$ V.
   i. The two electrodes of a chemical cell are the anode and cathode. Describe these two terms of a voltaic cell. [2]
   ii. Write the half-reactions of this galvanic cell and its overall reaction [3]
   iii. Calculate the standard emf of this cell [2]
   iv. Sketch and label the voltaic cell described in (a) above, write the line notation for this electrochemical cell. Indicate the purpose of the salt bridge and the external wire connection [6]

b) Balance the following equations using the electron-ion method;
   i. $Zn_{(s)} + NO_{3\,(aq)}^- \rightarrow Zn^{2+}_{(aq)} + NO_{(g)}$ (in acid solution) [3]
   ii. $OCl^-_{(aq)} + S_2O_{3\,(aq)}^{2-} \rightarrow Cl^-_{(aq)} + SO_{4\,(aq)}^{2-}$ (in basic solution) [4]

[Total: 20 marks]

QUESTION THREE: THERMOCHEMISTRY

a) State the first and second law of thermodynamics. [2]

b) i. State Hess's law [2]

ii. From the following enthalpies of reaction

$H_{2\,(g)} + F_{2\,(g)} \rightarrow 2\,HF_{(g)}$ $\Delta H = -537$ kJ

$C_{(s)} + 2\,F_{2\,(g)} \rightarrow CF_{4\,(g)}$ $\Delta H = -680$ kJ

$2C_{(s)} + 2\,H_{2\,(g)} \rightarrow C_2H_{4\,(g)}$ $\Delta H = +52.3$ kJ

Calculate the ΔH for the reaction of ethylene with F_2

$C_2H_{4\,(g)} + 6\,F_{2\,(g)} \rightarrow 2CF_{4\,(g)} + 4\,HF_{(g)}$ [5]

c) Why is it a good idea to rinse your thermos bottle with hot water before filling it with hot water? [2]

d) It has been suggested that hydrogen gas obtained by the decomposition of water might be a substitute for natural gas (principally methane). To compare the energies of combustion of these fuels, the following experiment was carried out using a bomb calorimeter with a heat capacity of 11.3 kJ/°C.
When a 1.50 g sample of methane gas was burned with excess oxygen in the calorimeter, the temperature increased by 7.3°C and when a 1.15 g of sample of hydrogen gas was burned with excess oxygen, the temperature increase was 14.3°C. Compare the energies of combustion (per gram) for hydrogen and methane. [5]

e) For mercury, the enthalpy of vaporization is 58.51 kJ/mol and the entropy of vaporization is 92.92 J/K.mol. What is the normal boiling point of mercury? [2]

f) Syngas can be burned directly or converted to methanol. Calculate $\Delta H°$ for the reaction.

$CO_{(g)} + 2H_{2\,(g)} \rightarrow CH_3OH_{(l)}$ [2]

Substance and state	$\Delta H°_f$ (kJ/mol)
CO (g)	**-110.5**
CH_3OH (l)	**-239**

[Total: 20 marks]

QUESTION FOUR: NUCLEAR CHEMISTRY

a) Define radioactivity [2]

b) What are the two principal differences between nuclear reactions and ordinary chemical changes? [2]

c) Nuclear reactors are the heart of nuclear power plant. Their main job is to house and control nuclear fission processes.

i. Differentiate between nuclear fission and nuclear fusion [2]

ii. Given that Thorium 232 contained 4.1×10^5 atoms with half-life of 20 min, how many atoms would remain after 42 min? [2]

iii. The isotope $^{90}_{38}Sr$ is one of the extremely hazardous species in the residues from nuclear power generation. The strontium in a 0.500 g sample diminishes to 0.393 g in 10.0 years. Calculate the half-life. [2]

d) The mass of an atom $^{23}_{11}Na$ is 22.9898 amu [6]

i. Calculate the positive mass defect in kilograms

ii. Calculate its binding energy per nucleus (J/nucleus)

iii. Calculate its binding energy per nucleon (J/nucleon)

b) Describe four ways in which radioactivity can be measured and detected. [4]

[Total: 20 marks]

QUESTION FIVE: CHEMICAL BONDING & ATOMIC THEORY

a) For each molecule below, write its lewis structure, molecular structure (including bond angles), hybridization of the central atom and the molecules overall polarity. [8]

i. $SPCl_3$

ii. TeF_6

b) When is resonance structures said to occur in chemical bonding? Give resonance structures for an ozone molecule (O_3). [2]

c) The electron configuration of an element describes how electrons are distributed in its atomic orbitals.

i. Name and state three rules that govern the filling of atomic orbitals by electrons in atoms [3]

ii. Using the periodic table of elements provided, give the electronic configurations for the following elements; Sulfur – $_{16}S$, Cadmium – $_{48}Cd$, Hafnium – $_{72}Hf$ [3]

d) Calculate the frequency and wavelength of the line in the hydrogen spectrum that corresponds to an electron transition from n = 3 level to n = 2 level. [4]

[Total: 20 marks]

QUESTION SIX: CHEMICAL EQUILIBRIUM

a) State Le Chateliers principle [2]

b) Write the expressions for K and Kp for the decomposition of solid phosphorus pentachloride to liquid phosphorus trichloride and chlorine gas. [3]

c) For the equilibrium

$$CH_3OH_{(g)} \rightleftharpoons CO_{(g)} + 2H_{2(g)}$$

At 275 °C, Kp is 1.14×10^{-2}. Calculate the value of K and determine the values of K and Kp for the reverse reaction. [6]

d) A mixture of 0.0080 mol $SO_{2(g)}$ and 0.0056 mol of $O_{2(g)}$ is placed in a one litre container at 1000 K. When equilibrium is established, 0.0040 mol $SO_{3(g)}$ is present

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

What are the equilibrium concentrations of $SO_{2(g)}$ and $O_{2(g)}$ and determine the value of K for the equilibrium at 1000 K. [6]

e) Predict the direction in the net reaction that will occur for each of the following processes when the pressure is reduced. [3]

i. $2PbS_{(s)} + 3O_{2(g)} \rightleftharpoons 2PbO_{(s)} + 2SO_{2(g)}$

ii. $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{(g)}$

iii. $H_{2(g)} + CO_{2(g)} \rightleftharpoons H_2O_{(g)} + CO_{(g)}$

[Total: 20 marks]

QUESTION SEVEN: STOICHIOMETRY

a) Calcium is a vital element in living organisms. It is one of the components that keeps the bones strong. If meat contains 50 g of calcium, how many atoms are in 50 g of calcium? [2]

b) Chalcopyrite, the principal ore of copper (Cu) contains 34.63% Cu by mass. How many grams of copper can be obtained from 5.11×10^3 Kg of Cu ore? [3]

c) A compound of sodium hydrogen carbonate is used as baking soda. Calculate the percent composition by mass of each element in sodium hydrogen carbonate [4]

i. When sodium hydrogen carbonate is heated, it decomposes to sodium carbonate, carbon dioxide and water vapor. Write the balanced equation for this reaction. [2]

ii. If 12.00 g of sodium carbonate are formed from 24.98 g of the decomposed sodium hydrogen carbonate, what is the percent yield? [4]

d) A compound consists of 40.7% C, 5.1% H, and 54.2% O?

i. What is its empirical formula? [3]

ii. The molar mass of this compound is 118 grams/mol. What is the molecular formula of this compound? [2]

[Total: 20 marks]

APPENDIX I: Useful Information

Physical Constants		
Constant	**Symbol**	**Value**
Ion-Product Constant	Kw	1.0×10^{-14}
Avogadro's number	N_A	6.02×10^{23} mol^{-1}
Faraday's constant	F	96, 487 C/mol
Gas Constant	R	8.314 J/K. mol or 0.0821 L. atm/K. mol
Speed of Light	C	3.0×10^{8} m/s
Mass of proton Mass of neutron		1.00728 amu 1.008665 amu
Planks constant	h	6.63×10^{-34} J. s

The Periodic Table of the Elements

1 **H** Hydrogen 1.00794																	2 **He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012182											5 **B** Boron 10.811	6 **C** Carbon 12.0107	7 **N** Nitrogen 14.00674	8 **O** Oxygen 15.9994	9 **F** Fluorine 18.9984032	10 **Ne** Neon 20.1797
11 **Na** Sodium 22.989770	12 **Mg** Magnesium 24.3050											13 **Al** Aluminum 26.981538	14 **Si** Silicon 28.0855	15 **P** Phosphorus 30.973761	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.4527	18 **Ar** Argon 39.948
19 **K** Potassium 39.0983	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.955910	22 **Ti** Titanium 47.867	23 **V** Vanadium 50.9415	24 **Cr** Chromium 51.9961	25 **Mn** Manganese 54.938049	26 **Fe** Iron 55.845	27 **Co** Cobalt 58.933200	28 **Ni** Nickel 58.6934	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.39	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.61	33 **As** Arsenic 74.92160	34 **Se** Selenium 78.96	35 **Br** Bromine 79.904	36 **Kr** Krypton 83.80
37 **Rb** Rubidium 85.4678	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.90585	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.90638	42 **Mo** Molybdenum 95.94	43 **Tc** Technetium (98)	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.90550	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.8682	48 **Cd** Cadmium 112.411	49 **In** Indium 114.818	50 **Sn** Tin 118.710	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.60	53 **I** Iodine 126.90447	54 **Xe** Xenon 131.29
55 **Cs** Cesium 132.90545	56 **Ba** Barium 137.327	57 **La** Lanthanum 138.9055	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.9479	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.217	78 **Pt** Platinum 195.078	79 **Au** Gold 196.96655	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.3833	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.98038	84 **Po** Polonium (209)	85 **At** Astatine (210)	86 **Rn** Radon (222)
87 **Fr** Francium (223)	88 **Ra** Radium (226)	89 **Ac** Actinium (227)	104 **Rf** Rutherfordium (261)	105 **Db** Dubnium (262)	106 **Sg** Seaborgium (263)	107 **Bh** Bohrium (262)	108 **Hs** Hassium (265)	109 **Mt** Meitnerium (266)	110 (269)	111 (272)	112 (277)	113	114				

58 **Ce** Cerium 140.116	59 **Pr** Praseodymium 140.90765	60 **Nd** Neodymium 144.24	61 **Pm** Promethium (145)	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.964	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.92534	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.93032	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.93421	70 **Yb** Ytterbium 173.04	71 **Lu** Lutetium 174.967
90 **Th** Thorium 232.0381	91 **Pa** Protactinium 231.03588	92 **U** Uranium 238.0289	93 **Np** Neptunium (237)	94 **Pu** Plutonium (244)	95 **Am** Americium (243)	96 **Cm** Curium (247)	97 **Bk** Berkelium (247)	98 **Cf** Californium (251)	99 **Es** Einsteinium (252)	100 **Fm** Fermium (257)	101 **Md** Mendelevium (258)	102 **No** Nobelium (259)	103 **Lr** Lawrencium (262)

SESSIONAL EXAMINATION

2024 ACADEMIC YEAR

PH 110 - INTRODUCTORY PHYSICS

28TH October, 2024

Time: 14:00 Hrs. – 17:00 Hrs.

DURATION: 3 HOURS

INSTRUCTIONS:

1. Write your Student Identity Number (SIN) on the answer booklet provided.
2. This paper has **EIGHT (8)** questions; attempt any **FIVE (5)**.
3. Each question carries twenty (20) marks. Omission of essential working will result to loss of marks. Carefully assign ***S.I units*** to the appropriate physical quantities.
4. Begin each question on a new page in your answer booklet.
5. Credit will be given for clarity of expression and orderly layout of work.
6. Formulae and Physical constants that you may find useful have been provided on page 9, 10 and 11.

1. (a) (i) Clearly state the meaning of a measurement. [1]

(ii) Discuss the major difference between physical a dot and cross product of a vector and

Give one example of a physical quantity resulting from each product. [3]

(b) The acceleration a of a particle moving in a circular path of radius r with a constant velocity v is given by

$$a = kr^m v^n$$

With k a dimensionless constant. Derive a correct relationship between the physical quantities governing this motion. [4]

(c) In moving a particle from position $r_o = (5\hat{\imath} + 3\hat{\jmath} + \hat{k})m$ to another position $r = (13\hat{\imath} - 7\hat{\jmath} + 3\hat{k})m$, 130J of work is done on it by applying a force $(a\hat{\imath} + 3\hat{\jmath} + 4\hat{k})N$ at an angle of 60^o with the resultant displacement. Determine the value of a and the magnitude of the force. [7]

(d) Three forces, 120N at 30° counter clockwise from negative x - axis and 100N at 20° also counter clockwise from the positive y axis and the 75N acts along the positive x axis from the origin. Calculate the magnitude and direction of the resultant of the three forces. [5]

[20 Marks]

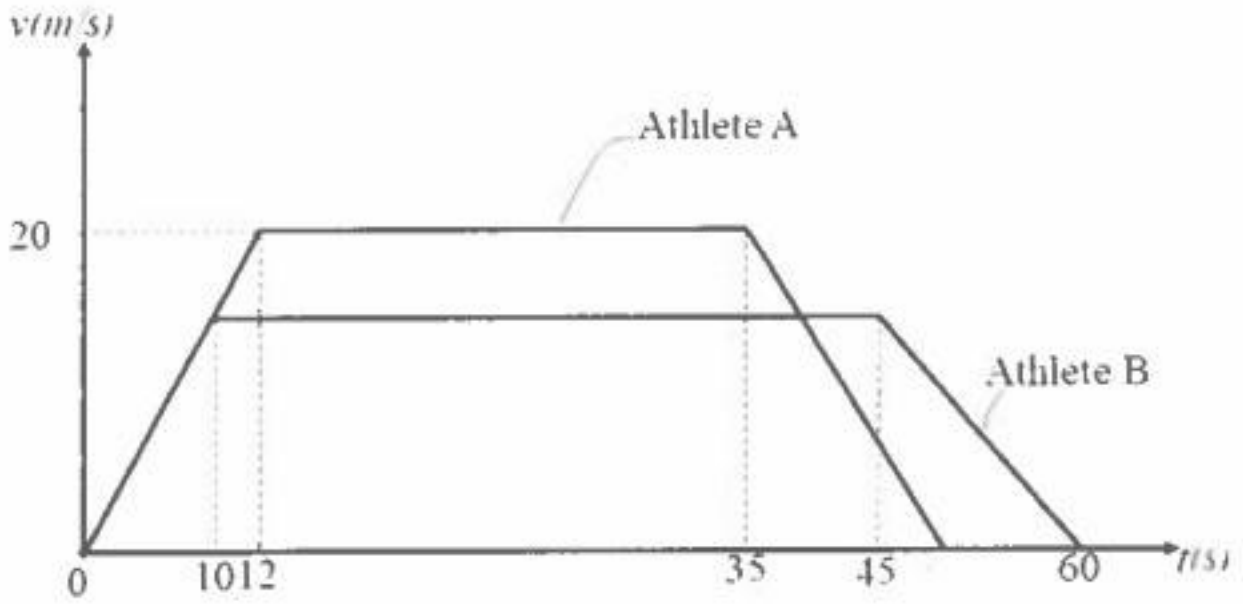
2. (a) (i) Explain the meaning of the terms projectile and trajectory. [2]

(ii) Show that a projectile projected upwards with an initial velocity v_o at angle θ with the horizontal its trajectory at any time t is given by:

$$y = x\tan\theta + \frac{gx^2}{2v_o^2 Cos^2\theta}$$ [8]

(iii) Determine the vertical position of a projectile projected at 30^o with the horizontal whose initial velocity is 5m/s when it covers a horizontal distance of 5m. [3]

(b) The graph below shows the velocity of two athletes A and B varied with time during a race. The athletes started the race at the same time.



The graph is **not** drawn to scale.

The velocity of the athletes was changing in the initial stage of the race.

(i) At what rate was the velocity changing? [1]

(ii) What was the maximum velocity that was attained by athlete **B**? [2]

(iii) Calculate the total distance covered by athlete **B**. [2]

(iv) The total distance covered by athlete **A** was 750m. How long did the athlete take to cover the distance? [2]

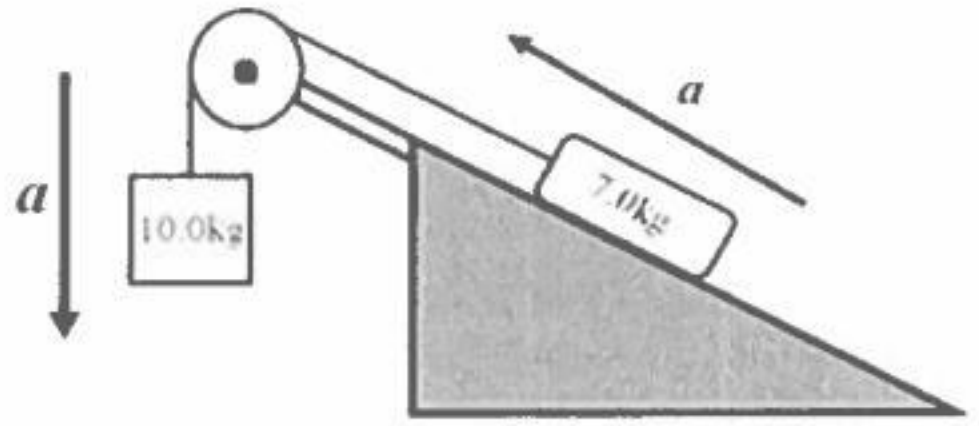
[20 Marks]

3. (a) Briefly discuss the difference between impulse and impulsive force. [2]

(b) Impulsive forces sometimes have a damaging effect. With clear examples, state any two damaging effects of these forces and explain how they are minimized. [4]

(c) A 3g pellet fired from a gun travelling at 90m/s buries itself in a 200g wooden bob of a pendulum of 1.5m length and the pendulum swings upward in an arc. Determine the vertical and horizontal component of the pendulum's displacement. [8]

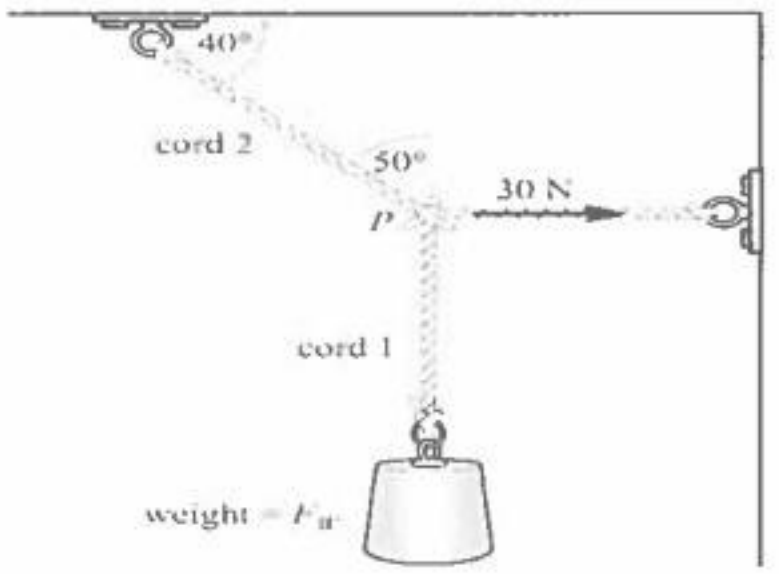
(d) The figure below shows a system of a block on an incline inclined at an angle of inclination 30^{o} accelerating at $3m/s^{2}$.



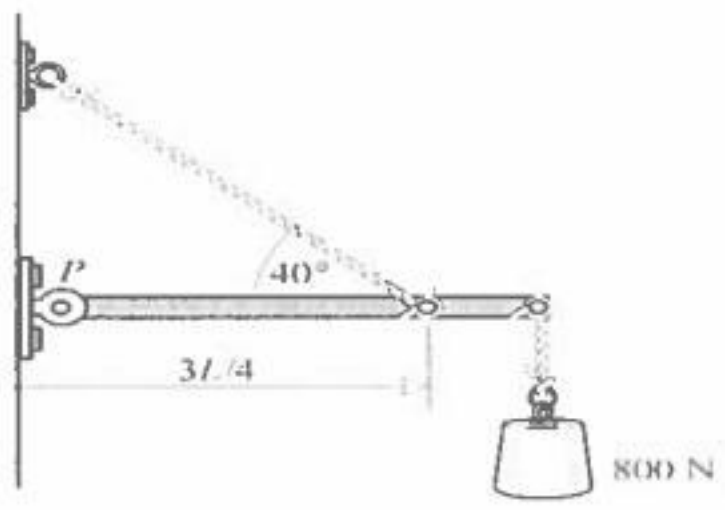
By ignoring friction between the string and the pulley, calculate the coefficient of friction between the surface of an incline and 7.0kg block. [6]

[20 Marks]

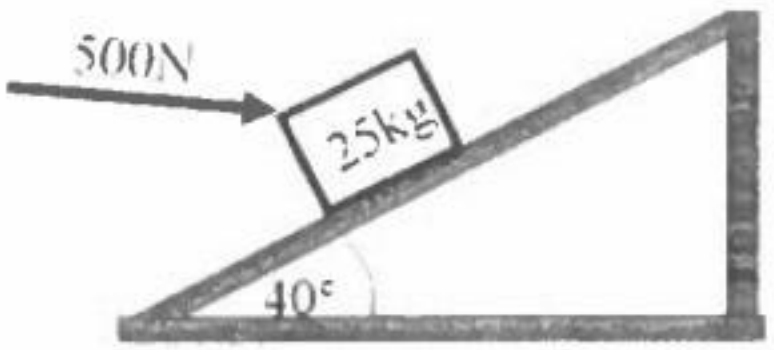
4. (a) In the figure below, the tension in the horizontal cord is 30N as shown. Find the weight of the object. [5]



(b) Consider the situation in the figure shown below. The uniform 0.6-kN beam is hinged at P. Find the tension in the tie rope and the components of the reaction force exerted by the hinge on the beam. Give your answers to two significant figures. [10]



(c) A force of 500N pushes on a box of 25kg as shown in the figure below.



Show that the coefficient of kinetic friction between the box and inclined plane is 0.41. [5]

[20 Marks]

5. (a) State the work-energy theorem. [2]

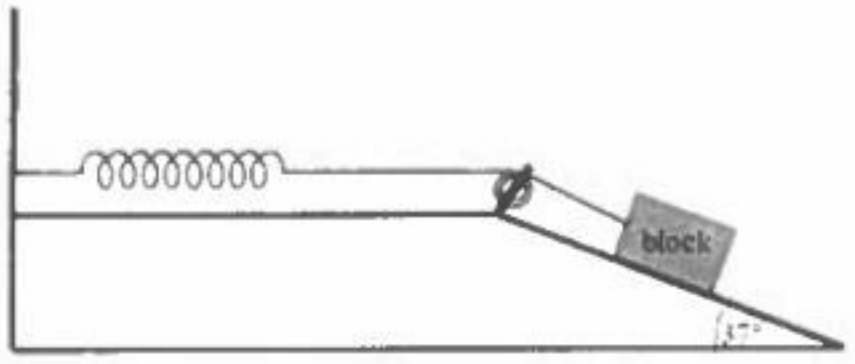
(b) In as much as friction force is nuisance, it is also useful. Discuss briefly:

(i) Any two situations where/when and how friction is useful. [4]

(ii) Any two problems which friction causes and how they are minimized. [4]

(c) State any two laws which govern friction force. [2]

(d) A block of mass 1000g on the rough incline is connected to a spring of force constant 100N/m is shown in the figure below.



If the spring has a negligible mass and pulley is frictionless, determine the coefficient of friction between the block and incline when the block is released from rest with the spring in the unstretched position and the block moves 10cm down the incline before coming to rest. [8]

[20 Marks]

6. (a) The position of a particle is given by the expression:

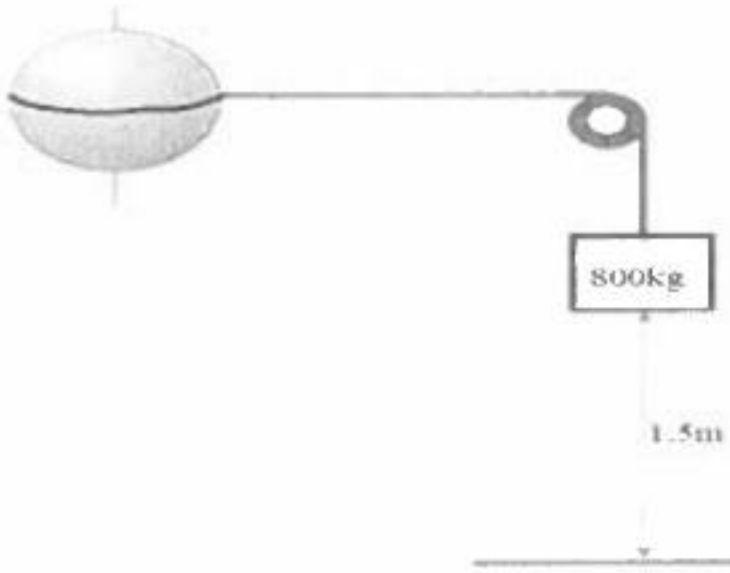
$$x(t) = 4\text{Cos } 3\pi t + \pi.$$

Where x is in meters and t is in seconds. For this motion, determine the:

(i) amplitude [1]

(ii) angular frequency and phase angle [2]

(b) The diagram below shows a solid sphere of mass 2.0kg and radius 30.0cm which is constrained to rotate about the vertical axis passing through the center of the sphere. A cord is wrapped around what would be the equator, passes over a pulley of negligible mass and attached to a mass of 800g that is allowed to fall through the height of 1.5m under the influence of gravity.



Find the,

(i) velocity of the hanging mass. [6]

(ii) angular momentum of the sphere. [3]

(c) A student small tied a stopper to the end of string of length 1.0 m and whirled in a vertical circle.

(i) What is the minimum speed that it must have at the highest point so that the string does not slacken? [4]

(ii) What is its speed at the lowest point if it has the above minimum speed at the highest point? [4]

[20 Marks]

7. (a) Discuss the difference between heat and temperature. [2]

(b) State the meaning of the following:

(i) Transmittance [1]

(ii) Blackbody [1]

(iii) Emissivity [1]

(c) Steam at 100°C is condensed to water and its temperature is lowered to 25°C. If 7.08×10^5J of energy is removed during the whole process, calculate the mass of steam that condensed into water. [6]

(d) A police officer arrives on a crime scene at 08.30 hours to investigate the death of a man whose mass is 75kg. Upon measuring the body temperature, an officer records 10°C. By taking the average normal body temperature of humans as 37°C and surface area $1.6m^2$, approximate the time at which the crime was committed. [9]

[20 Marks]

8. (a) With clear examples, explain the following thermodynamic terms;

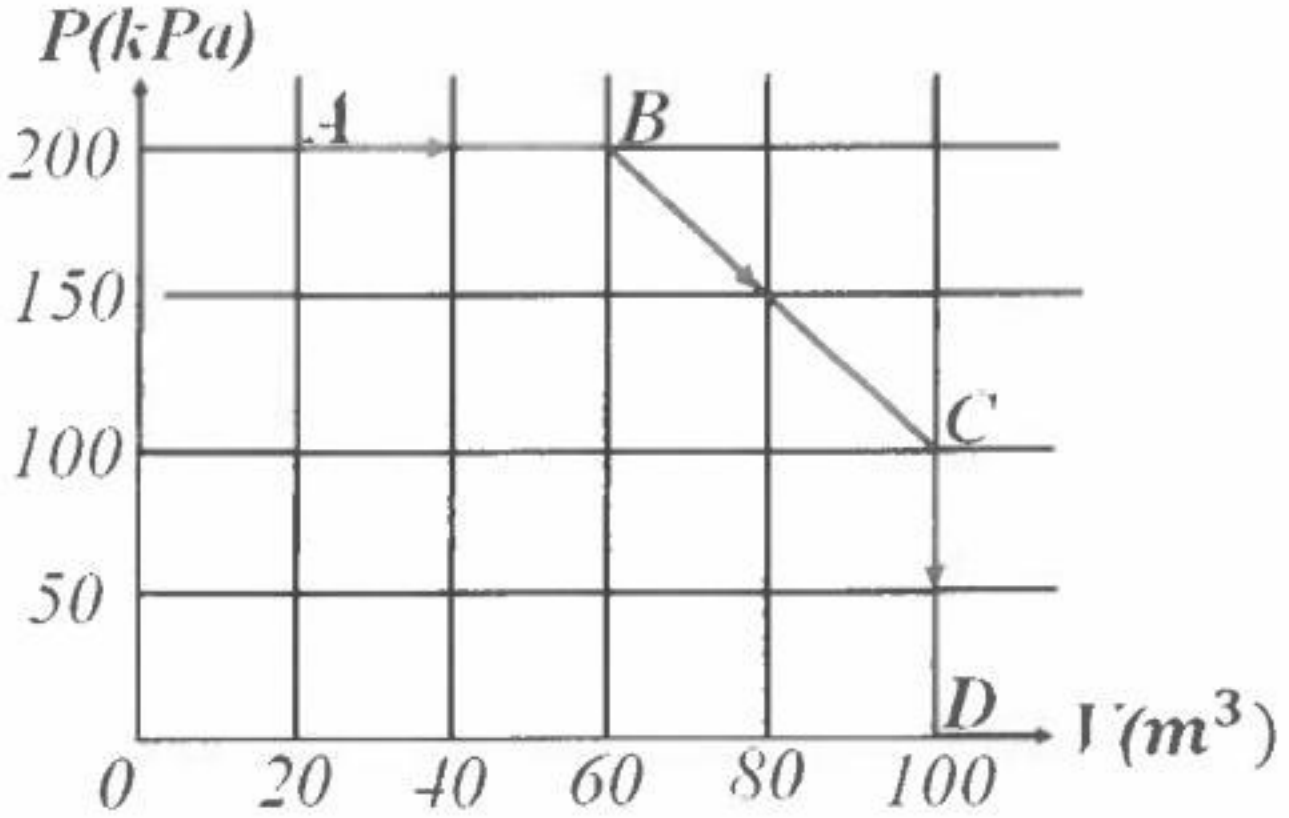
(i) Thermodynamic system [2]

(ii) Thermodynamic state [2]

(iii) Thermodynamic process [2]

(b) Briefly discuss the effect of increasing the temperature of thermodynamic system on its internal energy. [2]

(c)The figure below shows a thermodynamic system undergoing a number of thermodynamic processes from **A** to **D**.



(i) Identity the thermodynamic processes a system is undergoing. [3]

(ii) Calculate the total work done by this thermodynamic system. [6]

(iii) If the total energy supplied to this system during the whole process is 6.8×10^7J, what is its change in internal energy? [3]

[20 Marks]

The End. Best wishes!!!!!!

List of constants

Density of water ρ = 1000kg/m^3

Specific heat capacity of water = 4200J/kg°C

Specific heat capacity of human = 3600J/kg°C

Latent heant of vapourisation of water = 2.260 x 10^6J/kg

Latent heat of fusion of water = 3.34 x 10^3J/kg

Stefan – Boltzmann constant = 5.67 x 10^{-8}W/ m^{2}K^4

Emissivity of black body = 1

Emissivity of human = 0.8

Acceleration due gravity = 9.8m/s^2,

Speed of sound in air = 340m/s,

Speed of light in vacuum = 3.0 x 10^8m/s

Universal gravitational constant = 6.67 x 10^{-11}Nm^2/kg^2

Mass of the earth = 6.0 x 10^{24}kg

Radius of the earth = 6400km

Universal gas constant = 8.31J/mol.K

Atmospheric pressure = 1.01 x 10^5 Pa

1 Pascal = 1N/m^2

1 Cal = 4.18J

Equations

Uniformly accelerated motion:

$v = \frac{x}{t}$, $v = v_o + at$, $x = v_o t + \frac{1}{2}at^2$, $v^2 = v_o^2 + 2aS$, $v = v_o + at$

Projectile motion:

$v_x = v_o Cos\theta, \quad v_y = v_o Sin\theta - gt, \quad y = (v_o Sin\theta)t - \frac{1}{2}gt^2 \quad T = \frac{2v_o sin\theta}{g},$

$R = \frac{v_o^2 sin2\theta}{g}, y = (tan\theta)x - \left[\frac{gx^2}{2v_o^2 Cos^2\theta}\right]$

Force and motion:

$F = ma, \quad w = mg, \quad F_{AB} = -F_{BA}, \quad f = \mu F_N$

Energy:

$P.E = mgh, \quad K.E = \frac{1}{2}mv^2, \quad W = FxCos\theta, \quad P = \frac{W}{t} = FvCos\theta$

Linear Momentum:

$p = mv, \quad F\Delta t = \Delta mv$

Circular:

$T = \frac{2\pi r}{v}, \quad a_c = \frac{v^2}{r}, \quad F_c = \frac{mv^2}{r},$

Rotational and angular motion:

$\theta = \frac{S}{r} = \left(\frac{\omega_o + \omega_f}{2}\right)t, \ \theta = \omega_o t + \frac{1}{2}\alpha t^2, \quad \omega_f = \omega_o + \alpha t, \quad \omega = \frac{\theta}{t},$

$v = r\omega, \quad \omega_f^2 = \omega_o^2 + 2\alpha\theta, \quad \alpha = \frac{\Delta\omega}{\Delta t} = \frac{a_T}{r}, \quad I = \sum mr^2, \quad K.E = \frac{1}{2}I\omega^2$

$\tau = Fr = I\alpha, \quad W = r\theta, \quad P = \tau\omega, \quad L = I\omega$

Simple harmonic motion:

$F = -kx, \quad \omega = 2\pi f, \quad f = \frac{1}{2\pi}\sqrt{\frac{g}{L}}, \quad a = \omega^2 x, \quad P.E = \frac{1}{2}kx^2,$

$\frac{1}{2}kx^2 + \frac{1}{2}mv^2 = \frac{1}{2}kx_o^2, \quad \omega = \sqrt{\frac{k}{m}}, \quad f = \frac{1}{2}\sqrt{\frac{k}{m}}$

Moment of Inertia

Solid cylinder: $I = \frac{1}{2}MR^2$ Solid sphere: $I = \frac{2}{5}MR^2$ Thin spherical shell : $I = \frac{2}{3}MR^2$

Thermal Properties of matter:

$\frac{Q}{t} = \varepsilon\sigma A\Delta T^4,$ $\frac{Q}{\Delta t} = \frac{kA\Delta T}{\Delta L},$ $Q = mc\Delta T = nc\Delta T,$ $\Delta L = \alpha L\Delta T,$

$\Delta V = \gamma V\Delta T,$ $C_V = C_p - R,$ $PV = nRT,$ $P_1V_1^{\gamma} = P_2V_2^{\gamma},$ $W = P\Delta V$

Thermodynamic:

$Q = \Delta U + W,$ $\eta = 1 - \frac{T_2}{T_1} = \frac{work\ done}{input\ heat\ high\ temperature},$ $W = nRT.In\left(\frac{v}{v_o}\right)$

$C_V = C_p - R,$ $PV = nRT,$ $P_1V_1^{\gamma} = P_2V_2^{\gamma},$ $W = P\Delta V$

NS

2025

KAPASA MAKASA UNIVERSITY
SCHOOL OF APPLIED SCIENCES AND OPEN LEARNING

Course Title: Introduction to Mathematics
Coure Code: MA110
Date: 20/10/ 2025 14:00hrs
Duration: 3 Hours
Total Marks: 100

General Instructions to Candidate:

1. Answer questions as instructed.
2. No unauthorized materials are allowed.
3. No electronic devices are allowed unless specified.
4. Start **each** on a new page.
5. Omission of **essential** working will results in loss of marks
6. Write clearly and legibly

Exam Instructions

1. There are **seven** questions in this paper, each carrying equal marks.
2. Answer **any five** questions

1. (a) (i) Given that A, B and C are sets. Show that

$$A \cap (B \cup C) = (A \cap B) \cup (A \cap C) \quad [2]$$

(ii) Prove that $\sqrt{2}$ is an irrational number [4]

(b) (i) Simplify $\frac{(4x^2y)^2 \times \sqrt{9x^6y^2}}{(x^3y^2)^{-2}}$ [2]

(ii) Find the domain of the function,

$$f(x) = \frac{3x - 8}{x^2 - 9x + 20} \quad [4]$$

(c) Solve $x^3+4x^2-19x+14 = 0$ [8]

2. (a) Use partial fraction to evaluate [10]

$$\int \frac{2x^3 - 4x^2 - x - 3}{x^2 - 2x - 3} dx$$

(b) (i) Find x if $|2x+1| > 7$ [3]

(ii) Convert$10^x = 58$ to logarithmic form [1]

(c) If α and β are the roots of the quadratic equation $x^2 - 3x - 5 = 0$, find the quadratic equation that has the roots of $\alpha - 3$, $\beta - 3$ [6]

3. (a) (i) Obtain the first five terms in the expansion of $\frac{1}{1-x}$ [5]

(ii) Use the method of induction to show that if n is positive integer then [5]

$$1 + 2 + 3 + 4 + \cdots + n = \frac{n(n+1)}{2}$$

(b) If $e^x y = sinx$. Show that $\frac{d^2y}{dx^2}+2\frac{dy}{dx}+2y = 0$ [6]

(c) Find $\int \frac{1}{x^2-4} dx$ [4]

4. (a) (i) Show that $Z_1 = 2 + 3i$ is a root of the equation $Z^4-5Z^3+18Z^2-17Z+13 = 0$ and hence find the other remaining roots. [8]

(ii) Show that $\frac{1}{1+sin\theta} \equiv sec^2\theta - tan\theta sec\theta$ [4]

(b) Evaluate

(i) $cos75^o$ [2]

(ii) $tan15^o$ [2]

(c) Solve the equation $2log_8(x+2) = log_8(2x+19)$ [4]

5. (a) (i) Given that $A = \begin{bmatrix} 2 & -1 & -2 \\ -1 & 1 & 0 \\ -2 & 1 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 1 & 2 \\ 3 & 2 & 2 \\ 1 & 0 & 1 \end{bmatrix}$, evaluate AB [4]

(ii) By means of matrix method solve the system of simultaneous equations [8]

$$3x + y + 2z = 11$$
$$3x + 2y + 2z = 10$$
$$x + z = 5$$

(b) Find the value of the limit [4]

$$\lim_{x \to 2} \left[\frac{x^3 - x^2 - x - 2}{x - 2} \right]$$

(c) The sum of the first 6 terms of an arithmetic progression is 72 and the second term is seven times the fifth term. Find the first term and common difference [4]

6. (a) (i) Given that set $A = \{1, 2, 3, 4, 5\}$ and $B = \{4, 5, 6, 7\}$. Show that $(A - B) \cup A = A$ [2]

(ii) evaluate $\binom{7}{3}$ [2]

(b) By using De Moivre's theorem. Show that [8]

$$tan5x = \frac{5tanx - 10tan^3x + tan^5x}{1 - 10tan^2x + 5tan^4x}$$

(c) Find the middle term in the expansion of $\left(2ax - \frac{b}{x^2}\right)^{12}$ [8]

7. (a) Solve the equation $2^{3x+1} = 8$ [2]

(b) Solve $log_3 x = log_9(x+6)$ [8]

(c) The cubic polynomial $6x^3 + 7x^2 + ax + b$ has the remainder of 72 when divided by $(x-2)$ and is exactly divisible by $(x+1)$

(i) Calculate the values of a and b [4]

(ii) Show that $(2x-1)$ is also a factor of the polynomial and obtain the third factor [6]

SESSIONAL EXAMINATION

2025 ACADEMIC YEAR

PH 110 - INTRODUCTORY PHYSICS

31ST October, 2025

Time: 14:00 Hrs. – 17:00 Hrs.

DURATION: 3 HOURS

INSTRUCTIONS:

1. Write your Student Identity Number (SIN) on the answer booklet provided.
2. This paper has **EIGHT (8)** questions; Question one (1) is compulsory and attempt any other **FOUR (4)**.
3. Each question carries twenty (20) marks. Omission of essential working will result to loss of marks. Carefully assign ***S.I units*** to the appropriate physical quantities.
4. Begin each question on a new page in your answer booklet.
5. Credit will be given for clarity of expression and orderly layout of work.
6. Formulae and Physical constants that you may find useful have been provided on page 7 and 8.

Instruction(s): Attempt a total of five questions; question one is compulsory (20 Marks) and choose any other four (4).

1. (a) Clearly explain the concept of 'dimension analysis' and give three of its application. **[4]**
   (b) Given that the Cartesian coordinates of a point are $x = 3m$ and $y = 4m$, what are the polar coordinates of a point? **[3]**
   (c) The volume of a liquid flowing out per second of a pipe of length l and radius r is written by a student as:

$$V = \frac{\pi}{8}\frac{Pr^4}{\eta l}$$

Where P, is the pressure difference between the two ends of the pipe and η is the coefficient of viscosity (**Kg/ms**) of the liquid.
Prove that the equation is dimensionally consistent. **[4]**

(d) A unit of area, often used in measuring land areas, is the **hectare**, defined as 10^4 m^2. An open pit coal mine excavates 75 hectares of land, down to a depth of 26 m, each year. What volume of earth, in cubic kilometers, is removed during this time? **[5]**

(e) Kalonde Valerian is reading a treasure map's instructions that says to walk 200 m due east. Then it says to walk 150m **45°** north of west. What direction could Valerian walk to get to the treasure quicker? How far is the treasure away? **[4]**

[20 Marks]

2. (a) Explain the following terms used in motion:
   (i) Instantaneous velocity [2]
   (ii) Displacement [1]

   (b) A position-time graph for a particle moving along the x axis is shown in figure 1.1.
   (i) Find the instantaneous velocity at time $t = 2$ seconds **[3]**
   (ii) At what value of t is the velocity zero? [2]

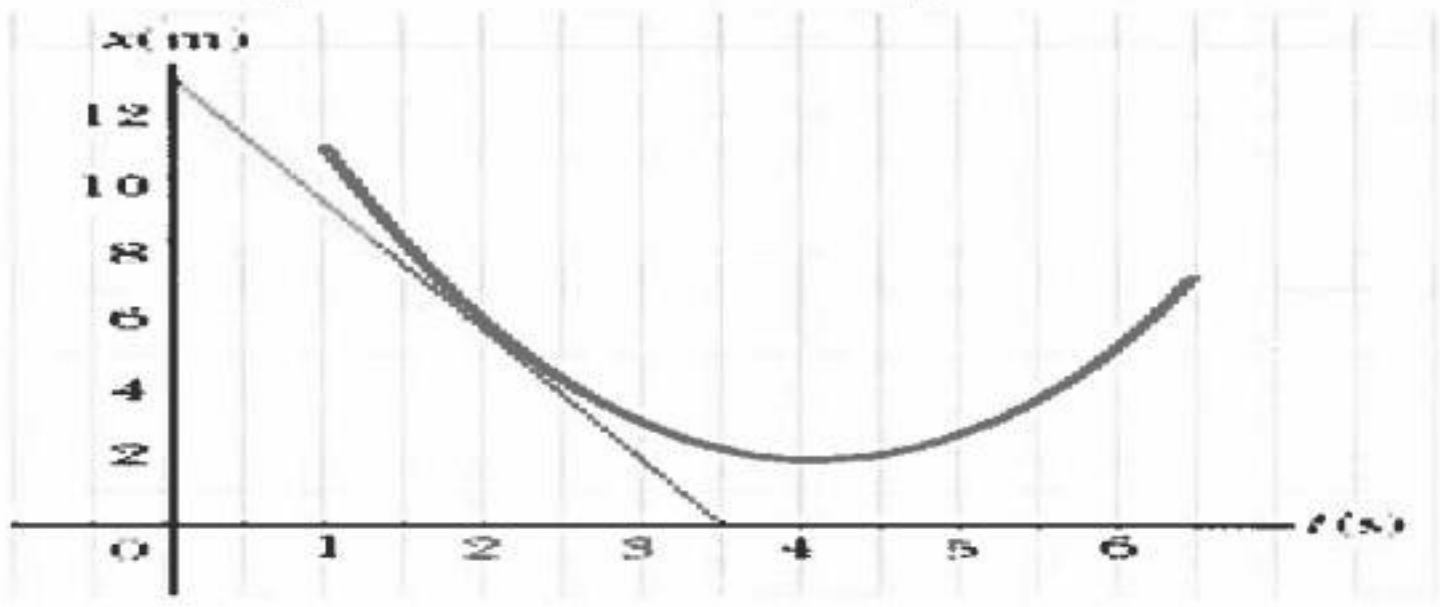


Figure 1.1. position-time graph

(c) A particle starts from a point O with an initial velocity of 2 m/s and travels along a straight line with uniform acceleration of 2 m/s^2. Two seconds later a second particle starts from rest at O and travels along the same line with an acceleration of 6 m/s^2. Find how far from O the second particle overtakes the first. **[12]**

[20 Marks]

3. (a) Distinguish between elastic collision and inelastic collision. **[2]**
(a) A 5-kg steel ball strikes a wall with a speed of 10 m/s at an angle $\theta = 60^\circ$ with the wall's surface (see figure 3.1). The ball bounces off with the same speed and angle and is in contact with the wall for 0.01 s.
(i) What is the change in momentum of the ball? **[5]**
(ii) What is the average force exerted on the ball by the wall? **[3]**

Figure 3.1. Motion Of a Ball Bouncing Off the Wall's Surface.

(c) A 20-kg box sits on an incline as shown in figure. 3.2. The coefficient of kinetic friction between box and incline is 0.30.
Find the acceleration of the box down the incline. **[10]**

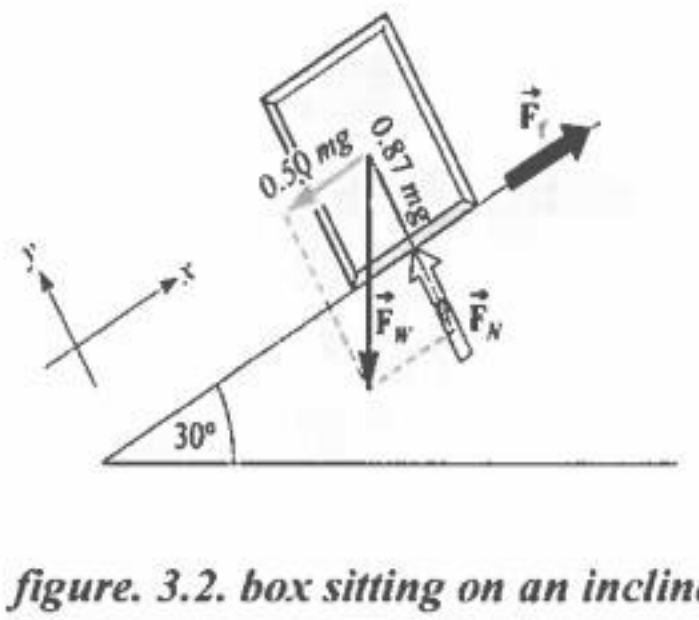


figure. 3.2. box sitting on an incline

[20 Marks]

4. (a) Distinguish between the following terms:
   (i) Linear acceleration and angular acceleration **[1]**
   (ii) Linear velocity and angular velocity. **[1]**

(b) The mass of Jupiter is $1.9\times10^{27}kg$ and that of the sun is $1.99\times10^{30}\,kg$. The mean distance of Jupiter from the sun is 7.8×10^{11}m. Calculate the gravitational force which the sun exerts on Jupiter, and the speed of Jupiter. **[10]**

(b) A flywheel of mass 500 kg and one meter diameter makes 500 r.p.m. Assuming the mass to be concentrated at the rim, calculate:

(i) the angular velocity of the wheel **[3]**
(ii) moment of inertia of the wheel **[3]**
(iii) energy of the flywheel **[2]**

[20 Marks]

5. (a) State the laws of friction. **[3]**
   (b) Discuss any three factors that affect the fluid friction. **[3]**
   (c) The figure below shows a body of mass 20kg sliding down on an incline.

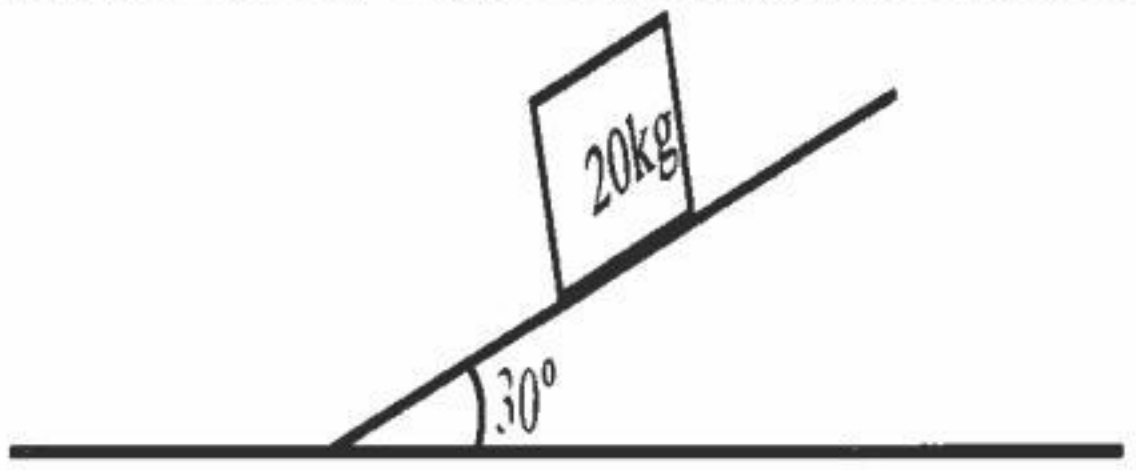


Figure 5.1. A box sliding down on an incline

If its acceleration is $2.5m/s^2$ down the incline, determine the coefficient of friction between the surfaces. **[5]**

(d) A uniform ladder **AB** has a length of 5.0m and mass 12.0kg leans against a frictionless wall as shown below in ***figure 5.2***. Determine the coefficient of friction between the concrete floor and wood holding the ladder from slipping. **[9]**

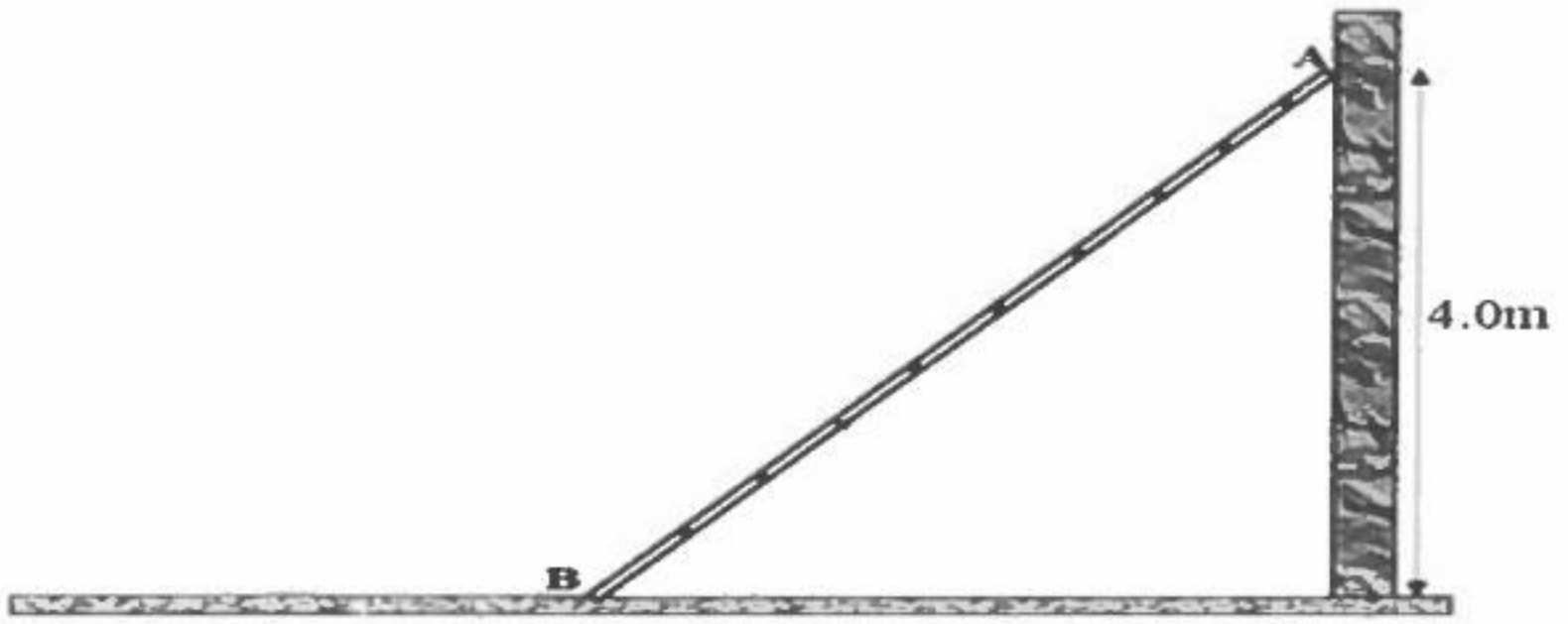


Figure 5.2. a ladder leaning against a frictionless wall

[20 Marks]

6. (a) Explain the meaning of work-cnergy theorem. **[2]**
   (b) A body shown is of mass 1400kg being pulled upward with a force of 10 000N on a ramp with an angle of elevation 10^o at a speed of 80km/h. Calculate the power needed by a body to reach the top if $\mu_k = 0.3$ between the surfaces.

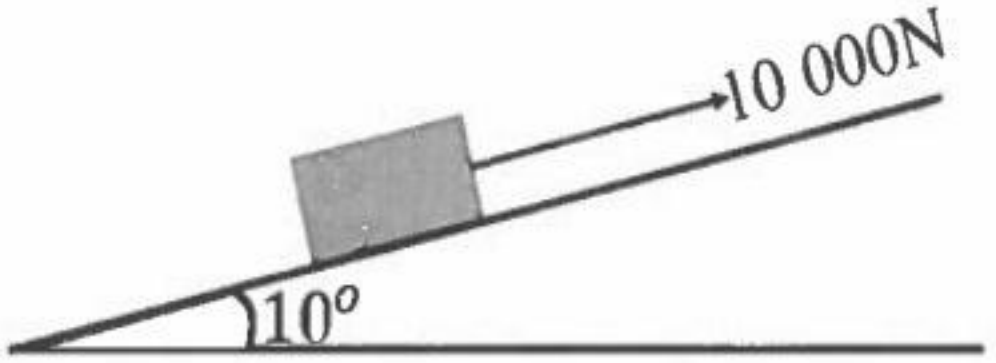


Figure 6.1. A box being pulled upwards by a force

[9]

(c) A cylindrical aluminium wire of length 25cm and radius 0.05cm is heated from the temperature of 25^oC to 85^oC. calculate,

(i) The rate at which heat energy is being conducted through this wire. **[4]**

(ii) The amount of heat energy which the wire will conducts after 5 minutes. **[2]**

(d) An aluminum calorimeter with mass 100g contains 250g of water. The calorimeter and water are in thermal equilibrium at 10°C. two metallic blocks are placed into the water. One is 50g piece of copper at 80°C, the other block has a mass of 70g and is originally at a temperature of 100°C. The entire system stabilizes at final temperature of 20 °C. Determine the specific heat capacity of the unknown sample. **[3]**

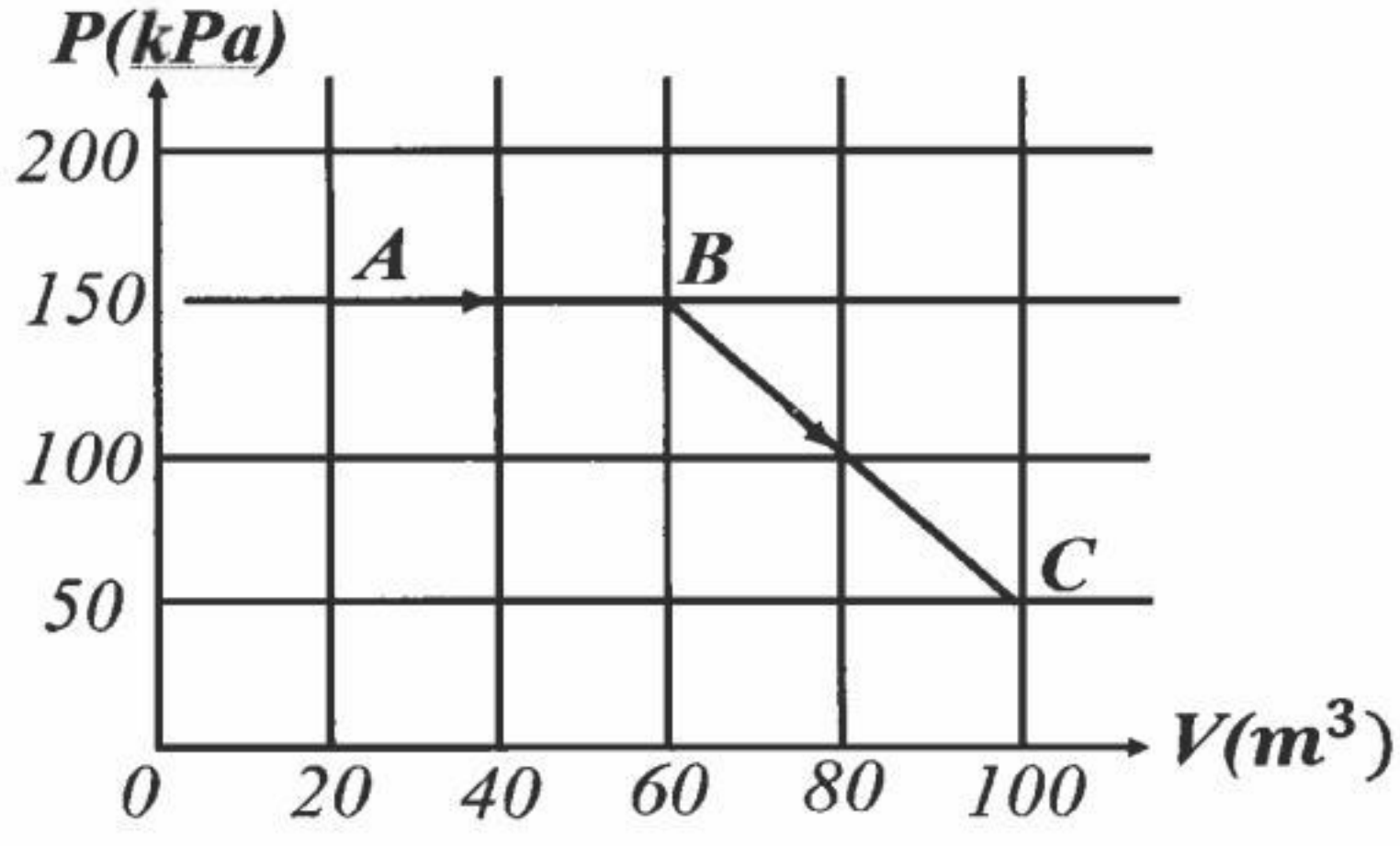
[20 Marks]

7. (i) Explain the following terms:
   (a) Stefan's laws of radiant heat emission **[3]**
   (b) Emissive power (e) **[1]**
   (c) Emissivity (ε) of a body. **[1]**

(iii) A patient in a examination room removes the clothes and the body temperature is 18 °C. Calculate the rate at which the patient is losing heat energy from the body. Take the body's surface area to be 1.5m^2. *(Refer to Appendix 1: Constants)* **[4]**

(iv) Calculate the amount of heat energy required to raise the temperature of 2 moles of CO_2 from 20°C to 50 °C at **Constant volume process** and at ***constant pressure process***. *(Refer to Appendix 1: Constants)* **[4]**

(v) The graph shown below is a ***PV*** curve for a thermodynamic system



For this thermodynamic system, calculate the work done by thermodynamic system in going from ***A*** through ***B*** to ***C***. **[7]**

[20 Marks]

8. The study that deals with the transformation of heat into work and vice – versa is called thermodynamics. Discuss the following terms used in thermodynamics:

(i)

(a) Adiabatic process **[2]**

(b) First law of thermodynamics **[2]**

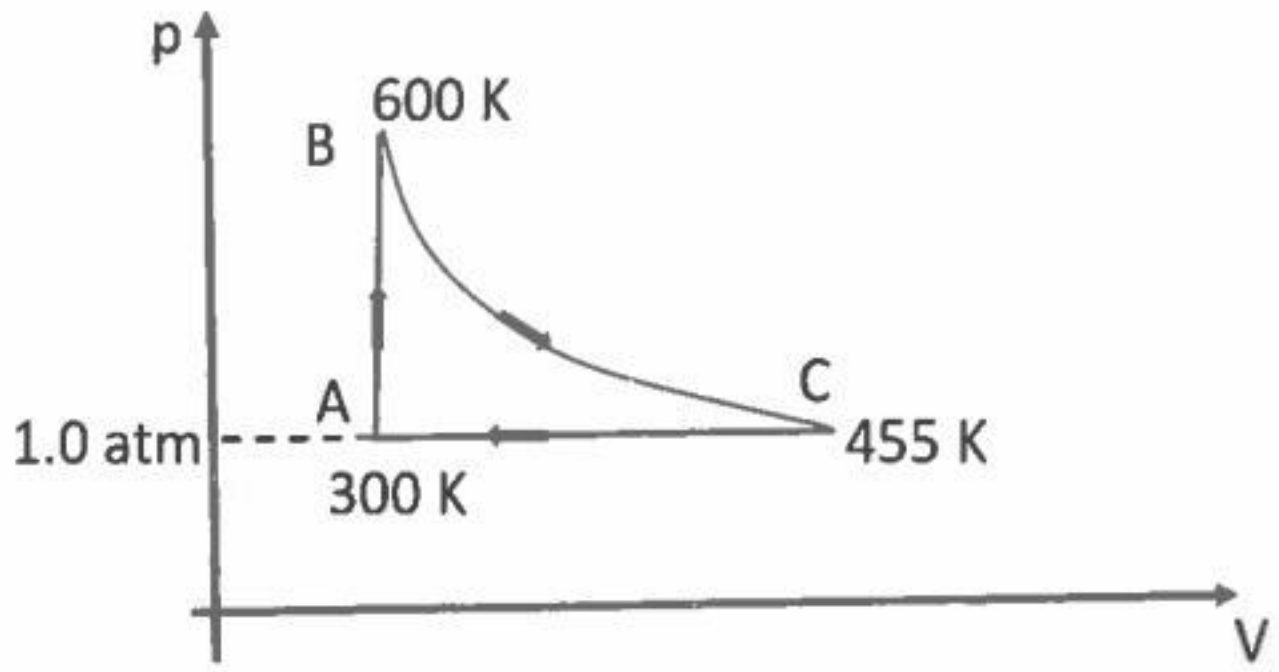
(ii) Give four (4) distinct features between the ***reversible*** and ***irreversible*** processes.**[4]**

(iii) The P-V diagram of 0.2 mol of a diatomic ideal gas is shown in figure. Process *BC* is adiabatic. The value of γ for this gas is 1.4.

(a) Find the pressure and volume at points *A*, *B* and *C*. **[3]**

(b) Calculate ΔQ, ΔW and ΔU for each of the three processes. **[7]**

(c) Find the thermal efficiency of the cycle. (Take 1 atm=1.0×10^5 N/m^2.) **[2]**



[20 Marks]

Appendix 1: List of constants

Density of water ρ = 1000kg/m^3
Specific heat capacity of water = 4200J/kg°C
Specific heat capacity of human = 3600J/kg°C
Latent heat of vaporization of water = 2.260 x 10^{6}J/kg
Latent heat of fusion of water = 3.34 x 10^{3}J/kg
Stefan – Boltzmann constant (σ)= 5.67 x 10^{-8} W/ m^{2}K^4
Emissivity of black body = 1
Emissivity of human = 0.8
Acceleration due gravity = 9.8m/s^2,
Speed of sound in air = 340m/s,
Speed of light in vacuum = 3.0 x 10^{8}m/s
Universal gravitational constant = 6.67 x 10^{-11}Nm^2/kg^2
Mass of the earth = 6.0 x 10^{24}kg
Radius of the earth = 6400km
Universal gas constant = 8.31J/mol.K
Atmospheric pressure = 1.01 x 10^5 Pa
1 Pascal = 1N/m^2
1 Cal = 4.18J

$k_{Al} = 88\frac{J}{m.s.K}$,

Use for CO_2, C_v=3.37R and C_p=4.37R

Al – 900 J/Kg/C
Cu – ~~385~~ 385 J/Kg
Radius of Jupiter

Equations

Uniformly accelerated motion:

$v = \frac{x}{t}$, $v = v_o + at$, $x = v_o t + \frac{1}{2}at^2$, $v^2 = v_o^2 + 2aS$, $v = v_o + at$

Projectile motion:

$v_x = v_o Cos\theta$, $v_y = v_o Sin\theta - gt$, $y = (v_o Sin\theta)t - \frac{1}{2}gt^2$ $T = \frac{2v_o sin\theta}{g}$,

$R = \frac{v_o^2 sin2\theta}{g}$, $y = (tan\theta)x - \left[\frac{gx^2}{2v_o^2 Cos^2\theta}\right]$

Force and motion:

$F = ma$, $w = mg$, $F_{AB} = -F_{BA}$, $f = \mu F_N$

Energy:

$P.E = mgh$, $K.E = \frac{1}{2}mv^2$, $W = FxCos\theta$, $P = \frac{W}{t} = FvCos\theta$

Linear Momentum:

$p = mv$, $F\Delta t = \Delta mv$

Circular:

$T = \frac{2\pi r}{v}$, $a_c = \frac{v^2}{r}$, $F_c = \frac{mv^2}{r}$,

Rotational and angular motion:

$\theta = \frac{S}{r} = \left(\frac{\omega_o + \omega_f}{2}\right)t$, $\theta = \omega_o t + \frac{1}{2}\alpha t^2$, $\omega_f = \omega_o + \alpha t$, $\omega = \frac{\theta}{t}$,

$v = r\omega$, $\omega_f^2 = \omega_o^2 + 2\alpha\theta$, $\alpha = \frac{\Delta\omega}{\Delta t} = \frac{a_T}{r}$, $I = \sum mr^2$, $K.E = \frac{1}{2}I\omega^2$

$\tau = Fr = I\alpha$, $W = r\theta$, $P = \tau\omega$, $L = I\omega$

Simple harmonic motion:

$F = -kx$, $\omega = 2\pi f$, $f = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$, $a = \omega^2 x$, $P.E = \frac{1}{2}kx^2$,

$\frac{1}{2}kx^2 + \frac{1}{2}mv^2 = \frac{1}{2}kx_o^2$, $\omega = \sqrt{\frac{k}{m}}$, $f = \frac{1}{2}\sqrt{\frac{k}{m}}$

Moment of Inertia

Solid cylinder: $I = \frac{1}{2}MR^2$ Solid sphere: $I = \frac{2}{5}MR^2$ Thin spherical shell : $I = \frac{2}{3}MR^2$

Thermal Properties of matter:

$\frac{Q}{t} = \varepsilon\sigma A\Delta T^4$, $\frac{Q}{\Delta t} = \frac{kA\Delta T}{\Delta L}$, $Q = mc\Delta T = nc\Delta T$, $\Delta L = \alpha L\Delta T$,

$\Delta V = \gamma V\Delta T$, $C_V = C_p - R$, $PV = nRT$, $P_1V_1^\gamma = P_2V_2^\gamma$, $W = P\Delta V$

Thermodynamic:

$Q = \Delta U + W$, $\eta = 1 - \frac{T_2}{T_1} = \frac{work\ done}{input\ heat\ high\ temperature}$, $W = nRT.In\left(\frac{v}{v_o}\right)$

$C_V = C_p - R$, $PV = nRT$, $P_1V_1^\gamma = P_2V_2^\gamma$, $W = P\Delta V$

KAPASA MAKASA UNIVERSITY

SCHOOL OF APPLIED SCIENCES

DEPARTMENT OF AGRICULTURE AND AQUATIC SCIENCES

2025 SESSIONAL EXAMINATION

23RD OCTOBER, 2025

14:00-17:00

BIOLOGY

NR 100

INSTRUCTIONS:

1. There are seven questions in total
2. Answer a Compulsory (CQ) in **Section A**
3. Answer any four (4) questions out of six in **Section B**
4. There are 100 marks allocated to this paper
5. Each question carries **20 marks**
6. Where possible, illustrate your answers
7. Time allowed: **Three 3 hours**
8. When answering follow further instructions in the answer book

SECTION A (COMPULSORY)

1. (a) Explain the functions of **any** five parts of a compound microscope. [5 marks]

(b) Describe how viruses affect the cells in the human body. [4 marks]

(c) Show two ways in which viruses are classified. [2 marks]

(d) Mention two diseases that are caused by retroviruses. [2 marks]

(e) Explain the concept of the 'Central dogma' in relation to gene expression. [4 marks]

(f) Give **three** characteristics of the 'genetic code'. [3 marks]

SECTION B (CHOOSE ANY 4 QUESTIONS)

2. (a) Describe the history of taxonomy with the emphasis on the works of Aristotle and Linnaeus.[10 marks]

(b) Describe the three domains of life. [3marks]

(c) Give three rules for binomial nomenclature as outlined in the international code of botanical nomenclature. [3marks]

(d) Describe a botanical key using any member of kingdom Plantae. [2 marks]

(e) Explain the concept of 'Binomial nomenclature'. [2 marks]

3. (a) Differentiate Chromosomes from DNA. [2 marks]

(b) Explain the concepts of co-dominance and incomplete dominance. [2 marks]

(c) A man who has normal genes for haemophilia marries a woman has haemophilia. Using the alleles X^B and X^b, predict the first filial generation using a genetic diagram. [4marks]

(d) Explain the law of independent assortment in relation Gregor Mendel's laws on inheritance. [2 marks]

(e) Describe the structure and function of a nucleotide. [4 marks]

(f) Describe the Primary, Secondary and tertiary levels of protein structure. [6 marks]

4. (a) Describe the stages of mitosis with the aid of diagrams.[10 marks]

(b) Explain the importance of mitosis in living organisms. [10 marks]

5. (a) Describe the stages of the Calvin cycle with well labelled diagrams.[10 marks]

(b) Briefly explain the electron transport chain and glycolysis stages of respiration. [10 marks]

6. (a) Describe the dark and light stages of photosynthesis. [10 marks]

(b) Explain the factors that affect the rate of photosynthesis. [5 marks]

(c) Show the structure of a chloroplast with the aid of a diagram. [5 marks]

7. (a) Describe the biotic and abiotic components of the ecosystem with examples. [10 marks]

(b) Define the term 'evolution' and explain the adaptations that primitive plants developed to survive on land as they evolved and many years ago. [6 marks]

(c) Briefly explain the major groups of plants. [4 marks]

END OF THE EXAMINATION

KAPASA MAKASA UNIVERSITY

SCHOOL OF APPLIED SCIENCES AND OPEN LEARNING

Course Title: General Chemistry

Course Code: CH110

Date: 27th October, 2025

Total Marks: 100 **Duration: 3 HRS**

General Instructions to Candidates:

- Answer questions as instructed.
- No unauthorized materials are allowed
- No electronic devices are allowed unless specified.
- Start **each** answer on a new page.
- Write clearly and legibly.

Exam Instructions:

1. There are (**TWO**) Sections in this paper and a total of **SEVEN** questions. Section A is compulsory and you are required to answer any **FOUR** questions from section B.
2. All questions carry equal marks.
3. Answer every new question on a fresh page in the answer booklet. Adhere to the **numbering format** that appears in each question.
4. Read a question completely before attempting it, you are reminded of the need for **good English** and **clear presentation**.
5. Show key steps in your working to support your answers.
6. Table of **physical constants** and **periodic table** of chemical elements are on page 6 and 7.

THERE ARE EIGHT (8) PRINTED PAGES IN THIS QUESTION BOOKLET

SECTION A: COMPULSORY

Question 1: Stoichiometry (20 marks)

a) i) Write a balanced chemical equation for the complete combustion of propane, C_3H_8, in oxygen. [2]

ii) Calculate the mass of CO_2 produced when 20.0 g of propane (C_3H_8) is completely combusted. [4]

b) Ammonia is prepared by the Haber process:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g).$$

i) If 56.0 g of nitrogen reacts with 12.0 g of hydrogen, determine the limiting reagent.[4]

ii) Calculate the percentage yield if 28.0 g of NH_3 is obtained. [4]

c) A compound is found to contain the following percentage composition by mass:

Carbon (C): 54.5%

Hydrogen (H): 9.1%

Oxygen (O): 36.4%

The relative molecular mass (Mr) of the compound is 88 g/mol.

i) Determine the empirical formula of the compound. [3]

ii) Determine the molecular formula of the compound. [3]

SECTION B: CHOOSE FOUR QUESTIONS ONLY

Question 2: Reactions in Solution (20 marks)

a) Identify the species oxidized and reduced in the following half-reactions: [6]

i) $Cr^{2+} \rightarrow Cr^{3+}$

ii) $ClO_3^- \rightarrow Cl^-$

iii) $Fe^{2+} \rightarrow Fe^{3+}$

b) Identify the oxidizing and reducing agents in: [4]

i) $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$

ii) $2H_2O_2 \rightarrow 2H_2O + O_2$

c) Aqueous barium chloride ($BaCl_2$) reacts with aqueous sodium sulfate (Na_2SO_4) to form a precipitate and other aqueous product. Write: [6]

i) The balanced molecular equation

ii) The complete ionic equation

iii) The net ionic equation

d) One litre of solution is prepared by dissolving 146 g of Na_2CO_3 in water. If 200 mL of this solution is diluted to 600 mL, determine the molarity of the resulting solution. [4]

Question 3: Electrochemistry (20 marks)

a) A galvanic cell composed of Zn^{2+}/Zn and Cu^{2+}/Cu half-cells. Sketch the galvanic cell for this system. [4]

i)Write the reduction and oxidation half reactions. [2]

ii) Write the overall balanced reaction and the standard notation of the cell. [3]

iii) Using standard reduction electrode potentials, calculate the standard emf of this cell:

$Zn^{2+} + 2e^- \rightarrow Zn$ ($E^\circ = -0.76$ V), $Cu^{2+} + 2e^- \rightarrow Cu$ ($E^\circ = +0.34$ V). [2]

iv) Calculate the equilibrium constant (K) and ΔG° for the cell reaction. Predict the spontaneity of the reaction. [5]

b) Balance the following redox reaction in basic medium: [4]

$$MnO_4^-{}_{(aq)} + SO_3^{2-}{}_{(aq)} \rightarrow MnO_{2\,(s)} + SO_4^{2-}{}_{(aq)}$$

Question 4: Acids and Bases (20 marks)

a) Define a Bronsted–Lowry acid and base. [2]

b) Identify the Bronsted-Lowry acid and the Bronsted-Lowry base in this chemical equation.

$$C_6H_5OH + NH_2^- \rightarrow C_6H_5O^- + NH_3$$ [2]

c) Indicate whether solutions with each of the following ions concentrations are neutral, acidic or basic:

i. $[H^+] = 4.0 \times 10^{-9}$ M

ii. $[OH^-] = 1.0 \times 10^{-7}$ M

iii. $[OH^-] = 7.0 \times 10^{-13}$ M [3]

d) Calculate the pH of a 0.001 M HCl solution. [3]

e) A weak acid, HA, has Ka = 1.0×10^{-5}. Calculate the pH of a 0.10 M HA solution. [5]

f) Calculate the pH of a solution prepared by mixing 2.0 mL of a strong acid solution of pH 3.00 and 3.0 mL of a strong base of pH 10.00. [5]

Question 5: Gases (20 marks)

a) State Boyle's law and Charles' law. [4]

b) A sample of nitrogen gas has a volume of 2.50 L at 25 °C and 1.00 atm. What will be its volume at 0 °C and 2.00 atm? [3]

c) State Graham's law of diffusion and calculate the molar mass of gas X, if an unknown gas X effuses 1.50 times faster than carbon dioxide (CO_2). [3]

d) A 12.0 L vessel at 300 K contains a mixture of H_2, N_2, and CO_2 with partial pressures: $P(H_2) = 0.200$ atm, $P(N_2) = 0.450$ atm, $P(CO_2) = 0.350$ atm. Calculate

i) the total pressure [2]

ii) the mass of each gas in the container [6]

e) Explain why real gases deviate from ideal behavior at high pressure and low temperature. [2]

Question 6: Chemical Equilibrium (20 marks)

a) Write the expression for the equilibrium constant, Kc, for: $N_2O_4(g) \rightleftharpoons 2NO_2(g)$. [2]

b) If 0.040 mol of N_2O_4 is placed in a 1.0 L container and the equilibrium concentration of NO_2 is found to be 0.020 M, calculate the value of Kc. [6]

c) State Le Chatelier's principle and explain how increasing pressure affects the equilibrium of the Haber process (synthesis of Ammonia). [4]

d) The equilibrium constant for the reaction:

$$2H_{2(g)} + CO_{(g)} \rightleftharpoons CH_3OH_{(g)}$$

Is 1.6×10^{-2} at a certain temperature. If there are 1.17×10^{-2} mol of H_2 and 3.46×10^{-3} mol of CH_3OH at equilibrium in a 5.6 L flask. What is the equilibrium concentrations of the species in the system? [4]

e) Distinguish between homogeneous and heterogeneous equilibria with an example of each. [4]

Question 7: Thermodynamics (20 marks)

a) State the first law of thermodynamics. [2]

b) Calculate the change in internal energy (ΔU) for a system in which 500 J of heat is absorbed and 150 J of work is done on the system. [3]

c) Calculate ΔG for a reaction where $\Delta H = -120$ kJ, $\Delta S = -200$ J/K at 298 K. State whether the reaction is spontaneous. [3]

d)State Hess's law. Diborane (B_2H_6 (g)) is a highly reactive Boron hydride which was considered as a possible rocket for the US space program. Calculate ΔH° for the synthesis of diborane from its elements B and H using the following data:

$$2\,B(s) + 3\,H_2(g) \rightarrow B_2H_6(g) \qquad \Delta H^\circ = ? \qquad [5]$$

Reaction	ΔH° (kJ)
$2B_{(s)} + \frac{3}{2}O_{2(g)} \rightarrow B_2O_{3\,(s)}$	-1273.0
$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}$	-285.8
$B_2H_{6\,(g)} + 3\,O_{2(g)} \rightarrow B_2O_{3\,(s)} + 3H_2O_{(l)}$	-2035

e) The combustion of methane is represented by the following balanced equation:

$$CH_{4\,(g)} + 2O_{2\,(g)} \rightarrow CO_{2\,(g)} + 2H_2O_{(l)}$$

At 298 K, the standard molar entropies (S°) of the substance are:

Substance	S° ($J.mol^{-1}K^{-1}$)
$CH_{4\,(g)}$	186.3
$O_{2\,(g)}$	205.0
$CO_{2(g)}$	213.6
$H_2O_{(l)}$	69.9

Calculate the standard entropy change (ΔS°) for the reaction. [5]

Fundamental Constants		
Constant	**Symbol**	**Value**
Planks constant	H	$6.63 \times 10^{-34} J.s$
Faraday constant	F	96500 C/mol. e^-
Avogadro's number	N_A	6.02×10^{23} mol^{-1}
speed of light	c	3.00×10^8 m/s
Rydberg constant	A or R_H	$2.18 \times 10^{-18} J$
Atomic mass unit	amu	1.660554×10^{-27} Kg
Gas constant	R	$8.314\ JK^{-1}mol^{-1}$ 8.314×10^{-2} $L.bar.K^{-1}.mol^{-1}$ $0.0821\ L.atm.\ K^{-1}.mol^{-1}$
<u>Masses</u> proton neutron	 Mp Mn	 1.00728 amu 1.008665 amu
Ion-Product Constant	K_w	1.0×10^{-14}
1 atm = 760 torr = $1.01325 \times 10^5 Nm^{-2}$ = 1.01325×10^5 Pa		

The Periodic Table of the Elements

1 **H** Hydrogen 1.00794																	2 **He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012182											5 **B** Boron 10.811	6 **C** Carbon 12.0107	7 **N** Nitrogen 14.00674	8 **O** Oxygen 15.9994	9 **F** Fluorine 18.9984032	10 **Ne** Neon 20.1797
11 **Na** Sodium 22.989770	12 **Mg** Magnesium 24.3050											13 **Al** Aluminum 26.981538	14 **Si** Silicon 28.0855	15 **P** Phosphorus 30.973761	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.4527	18 **Ar** Argon 39.948
19 **K** Potassium 39.0983	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.955910	22 **Ti** Titanium 47.867	23 **V** Vanadium 50.9415	24 **Cr** Chromium 51.9961	25 **Mn** Manganese 54.938049	26 **Fe** Iron 55.845	27 **Co** Cobalt 58.933200	28 **Ni** Nickel 58.6934	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.39	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.61	33 **As** Arsenic 74.92160	34 **Se** Selenium 78.96	35 **Br** Bromine 79.904	36 **Kr** Krypton 83.80
37 **Rb** Rubidium 85.4678	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.90585	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.90638	42 **Mo** Molybdenum 95.94	43 **Tc** Technetium (98)	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.90550	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.8682	48 **Cd** Cadmium 112.411	49 **In** Indium 114.818	50 **Sn** Tin 118.710	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.60	53 **I** Iodine 126.90447	54 **Xe** Xenon 131.29
55 **Cs** Cesium 132.90545	56 **Ba** Barium 137.327	57 **La** Lanthanum 138.9055	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.9479	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.217	78 **Pt** Platinum 195.078	79 **Au** Gold 196.96655	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.3833	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.98038	84 **Po** Polonium (209)	85 **At** Astatine (210)	86 **Rn** Radon (222)
87 **Fr** Francium (223)	88 **Ra** Radium (226)	89 **Ac** Actinium (227)	104 **Rf** Rutherfordium (261)	105 **Db** Dubnium (262)	106 **Sg** Seaborgium (263)	107 **Bh** Bohrium (262)	108 **Hs** Hassium (265)	109 **Mt** Meitnerium (266)	110 (269)	111 (272)	112 (277)	113	114				

58 **Ce** Cerium 140.116	59 **Pr** Praseodymium 140.90765	60 **Nd** Neodymium 144.24	61 **Pm** Promethium (145)	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.964	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.92534	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.93032	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.93421	70 **Yb** Ytterbium 173.04	71 **Lu** Lutetium 174.967
90 **Th** Thorium 232.0381	91 **Pa** Protactinium 231.03588	92 **U** Uranium 238.0289	93 **Np** Neptunium (237)	94 **Pu** Plutonium (244)	95 **Am** Americium (243)	96 **Cm** Curium (247)	97 **Bk** Berkelium (247)	98 **Cf** Californium (251)	99 **Es** Einsteinium (252)	100 **Fm** Fermium (257)	101 **Md** Mendelevium (258)	102 **No** Nobelium (259)	103 **Lr** Lawrencium (262)

KAPASA MAKASA UNIVERSITY

SCHOOL OF APPLIED SCIENCES AND OPEN LEARNING

Course Title: General Chemistry

Course Code: CH110

Date: 24th November, 2025

Total Marks: 100 **Duration: 3 HRS**

General Instructions to Candidates:

- Answer questions as instructed.
- No unauthorized materials are allowed
- No electronic devices are allowed unless specified.
- Start **each** answer on a new page.
- Write clearly and legibly.

Exam Instructions:

1. There are (**TWO**) Sections in this paper and a total of **SEVEN** questions. Section A is compulsory and you are required to answer any **FOUR** questions from section B.
2. All questions carry equal marks.
3. Answer every new question on a fresh page in the answer booklet. Adhere to the **numbering format** that appears in each question.
4. Read a question completely before attempting it, you are reminded of the need for **good English** and **clear presentation**.
5. Show key steps in your working to support your answers.
6. Table of **physical constants** and **periodic table** of chemical elements are on page 6 and 7.

THERE ARE EIGHT (8) PRINTED PAGES IN THIS QUESTION BOOKLET

SECTION A: COMPULSORY

Question 1: NUCLEAR REACTIONS (20 marks)

a) Define the following terms
   i. Nuclear fission ii. Nuclear fusion [2]

b) A sample of 100 g has half-life of 5 years.
   i. How much is left after 5 years. [2]
   ii. How much is left after 2 half-lives or after 10 years. [3]
   iii. How much is left after 1 half-life. [2]
   iv. The half-life of Molybedenum-99 is 67.0 hrs. How much of the 1.000-mg sample of Molybdenum-99 remains after 335 hrs? [3]

c) The most stable nucleus in terms of binding energy per nucleon is ^{56}Fe. If the atomic mass of ^{56}Fe is 55.9349 amu, calculate the binding energy per nucleon for ^{56}Fe. [5]

d) Justify why nuclear chemistry is studied in fisheries and aquaculture, Sustainable Agriculture and Animal Science programmes. [3]

$$\left(\frac{N_0}{N_t}\right) = \left(\frac{0.963}{t_{1/2}}\right) t$$

$$\ln\left(\frac{10}{N_t}\right) = \left(\frac{0.963}{5}\right) t$$

SECTION B: CHOOSE FOUR QUESTIONS ONLY

Question 2: Thermodynamics (20 marks)

a) State the second law of thermodynamics. [2]

b) A system releases 350 J of heat to the surroundings while 120 J of work is done on the system. Calculate the change in internal energy (ΔU) for the system. [3]

c) Using Hess's law. Nitrogen dioxide (NO_2) can be converted to nitric acid in several industrial processes. Using the ddata below, determine $\Delta H°$ for the reaction:

$3NO_2\,(g) + H_2O\,(l) \rightarrow 2HNO_3(aq) + NO\,(g)$ [5]

Reaction	$\Delta H°$ (kJ)
$NO_{(g)} + \frac{1}{2} O_{2(g)} \rightarrow NO_{2\,(g)}$	-57
$H_{2(g)} + \frac{1}{2} O_{2(g)} \rightarrow H_2O_{(l)}$	-286
$2NO_{(g)} + 3O_{2(g)} + H_2O_{(l)} \rightarrow 2HNO_3(aq)$	-826

d) Explain why enthalpy change cannot be measured directly during a reaction and how calorimetry helps determine it experimentally. [2]

e) Discuss two factors other than temperature that influence whether a chemical reaction reaches equilibrium quickly or slowly in natural systems such as soils, water bodies, or animal physiology. [2]

f) The standard molar entropies (S°) of several substances at 298 K are listed below:

- $S^\circ\,(CO_2\,(g)) = 214\ J.mol^{-1}.K^{-1}$
- $S^\circ\,(O_2\,(g)) = 205\ J.mol^{-1}.K^{-1}$
- $S^\circ\,(C\ (graphite)) = 6\ J.mol^{-1}.K^{-1}$

Using this data, calculate the standard entropy change of formation, $\Delta S^\circ\,(f)$ for:

$C\ (graphite) + O_2\,(g) \rightarrow CO_2\,(g)$ [5]

Explain whether the formation of carbon dioxide from its elements leads to an increase or decrease in entropy and why. [1]

Question 3: Acids and Bases (20 marks)

a) Write an equilibrium equation for the reaction of NH_3 and H_2O, and label each of the conjugate acids and bases. [4]

b) calculate the mass of sodium acetate that must be added to 500.0 mL of 0.200 M acetic acid to form a pH = 5.00 buffer solution. [5]

c) Write chemical equations to show the behavior of each of the following solutions in water and calculate their pH:

i. 0.001 M NaOH solution.
ii. 0.05 M HNO_3 [6]

e) A weak acid, HA, has Ka = 1.0×10^{-9}. Calculate the pH of a 0.20 M HA solution [5]

Question 4: Electrochemistry (20 marks)

a) A galvanic cell composed of Mg^{2+}/Mg and Cu^{2+}/Cu half-cells. Sketch the galvanic cell for this system. Show the direction of electron flow, the direction of ion migration through the porous disk, identify the cathode and anode reactions, give the overall balanced reaction and give the standard notation of the cell, assuming that all the concentrations are 1.0 M. Calculate the standard EMF (E°) for the cell. [12]

ii) Calculate the cell potential at 1.0 M for all species in the redox reaction given in (a)[4]

b) Balance the following redox reaction in acidic medium: [4]

$$MnO_{4\,(aq)}^{-} + CH_2O_{(g)} \rightarrow HCHO_{2\,(l)} + Mn^{2+}_{(aq)}$$

Question 5: CHEMICAL BONDING (20 marks)

a) Define a dative bond and give an illustrative example of its formation. [2]

b) For each molecule given below, write its Lewis structure, molecular structure (including bond angles), draw and state the hybridization of the central atom. What is the molecule's overall polarity?

i. CF_4 ii. PF_5 iii. SF_6 [15]

c) Write a Lewis structure for a carbonate ion, including resonance structures. [3]

Question 6: Chemical Equilibrium (20 marks)

a) Write the expression for the equilibrium constant, Kc, for: $N_2O_4(g) \rightleftharpoons 2NO_2(g)$. [2]

b) The equilibrium constant for the reaction:

$$2H_{2\,(g)} + CO_{(g)} \rightleftharpoons CH_3OH_{(g)}$$

Is 1.6×10^{-2} at a certain temperature. If there are 1.17×10^{-2} mol of H_2 and 3.46×10^{-3} mol of CH_3OH at equilibrium in a 5.6 L flask. What is the equilibrium concentrations of the species in the system? [4]

c) State Le Chatelier's principle. [1]

d) State if possible, what happens to the equilibrium position in each of the following cases: [8]

$$N_{2\,(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$$

i. Heat is added.

ii. Nitrogen is added and the volume is reduced.

iii. Ammonia is taken out and a catalyst is added.

iv. Nitrogen and ammonia are both added.

e) Define homogeneous and heterogeneous equilibria with an example for each. [4]

f) In your field of study, just why chemical equilibria is important. [1]

Question 7: Reactions in Solution (20 marks)

a) A redox reaction is defined as a reaction in which oxidation and reduction take place simultaneously. Identify the following changes as either oxidation or reduction: [6]

i) BiO_3^- to Bi^{3+}

ii) N_2O_4 to N_2O

iii) SO_2 to SO_3

b) Identify the oxidizing and reducing agents in each of the following reactions: [4]

i) $I_2O_5 + 5CO \rightarrow 5CO_2 + I_2$

ii) $H_2O_2 + 2Fe^{2+} + 2H^+ \rightarrow 2H_2O + 2Fe^{3+}$

c) Aqueous Sodium chloride, NaCl, reacts with aqueous lead nitrate, Pb $(NO_3)_2$, to form a precipitate and other aqueous product. Write: [6]

i) The balanced molecular equation

ii) The complete ionic equation

iii) The net ionic equation

d). A student at Kapasa Makasa University needs to prepare a 250 mL of a 0.020 M Potassium Permangate ($KMnO_4$) solution for a water quality experiment. The only available stock solution has a concentration of 0.10 M. [4]

i) Calculate the volume of the stock solution needed to prepare the diluted solution.

ii) Describe the procedure the student should follow to prepare this solution accurately using a volumetric flask.

Fundamental Constants		
Constant	**Symbol**	**Value**
Planks constant	H	6.63×10^{-34} J.s
Faraday constant	F	96500 C/mol. e^-
Avogadro's number	N_A	6.02×10^{23} mol^{-1}
speed of light	c	3.00×10^8 m/s
Rydberg constant	A or R_H	2.18×10^{-18} J
Atomic mass unit	amu	1.660554×10^{-27} Kg
Gas constant	R	8.314 $JK^{-1}mol^{-1}$ 8.314×10^{-2} L.bar.K^{-1}.mol^{-1} 0.0821 L.atm. K^{-1}.mol^{-1}
<u>Masses</u> proton neutron	 Mp Mn	 1.00728 amu 1.008665 amu
Ion-Product Constant	K_w	1.0×10^{-14}
1 atm = 760 torr = $1.01325 \times 10^5 Nm^{-2}$ = 1.01325×10^5 Pa		

KAPASA MAKASA UNIVERSITY

SCHOOL OF APPLIED SCIENCES

DEPARTMENT OF AGRICULTURE AND AQUATIC SCIENCES

2025 SESSIONAL EXAMINATION

30TH OCTOBER, 2025

14:00-17:00

COMMUNICATION SKILLS

NR 120

INSTRUCTIONS:

1. There are seven questions in total
2. Answer a Compulsory (CQ) in **Section A**
3. Answer any four (4) questions out of six in **Section B**
4. There are 100 marks allocated to this paper
5. Each question carries **20 marks**
6. Time allowed: **Three 3 hours**
7. When answering follow further instructions in the answer book

SECTION A (Compulsory)

1. (a) What is communication? [1]

   (b) List any six (6) elements of the communication process and define them. [12]

   (c) In summary form, state five (5) reasons why we communicate. [5]

   (d) Define a barrier to effective human communication. [1]

   (e) Name a communication barrier which is associated with language problems. [1]

SECTION B (CHOOSE ANY 4 QUESTIONS)

2. With clear examples, explain in detail nonverbal communication by highlighting its definition, importance and types. [20]

3. Describe the library with its organisation in terms of groups of books, main sections, and clearly show why it is important to students in learning institutions. [20]

4. (a) Demonstrate how a good writer can write an attractive essay by following the stages of the writing process. [15]

   (b) What is plagiarism? [1]

   (c) Use the following jumbled information to write four (4) references in the Harvard system.

   (i) London, 1988, McMillan, Culling, J.B., Town and Country Planning in Britain. [1]

   (ii) Urban and Rural Settlements, New York, Carter, H., Longman, 1990. [1]

   (iii) Palgrave Publishers, Urban Economics: A Global Perspective, 2000, London, Balchin, P.N. and Chen, J. [1]

   (iv) Word Formation Processes, Journal of Linguistics, Mwenya, C. and Kaunda, J., pp. 120-145, (4), vol. 2, 2019. [1]

5. (a) Assuming that the policies have been established already, discuss how an effective meeting should be conducted by highlighting all important elements involved in it. [15]

(b) Identify any five (5) policies which should be established in the first meeting. [5]

6. With clear examples, discuss in detail job interview and its basic steps. [20]

7. Define entrepreneurship, and explain in detail entrepreneurial process. [20]

END OF EXAMINATION