UNIVERSITY OF AGRICULTURE, ABEOKUTA
2003/2004 SECOND SEMESTER EXAMINATION
DEPARTMENT OF CHEMISTRY

CHM 104: INTRODUCTORY INORGANIC CHEMISTRY TIME: - -1HR.

1. There are three types of carbides ----, --- and ---

(a) Metallic, Salt like, and ionic
(b) Interstitial, Metallic and ionic
(c) Covalent, interstitial and Salt like
(d) Ionic, electrovalent and Metallic

2. Diamond is colourless and utilizes---------- hybrid orbitals to form bond.

(a). sp^2 (b) s (c) sp (d) sp^3

3. Graphite forms a ------sheet like polymeric structure.

(a) Two-dimensional (b) Five-dimensional.
(c) Four-dimensional (d) Three-dimensional

4. Carbondioxide gas (CO_2) is detected by its action on lime water and Baryta water which are represented as ---------- and ----------

(a) CaOH and $Ba(OH)_2$
(b) BaOH and CaOH
(c) $Ca(OH)_2$ and $BaCO_3$
(d) $Ca(OH)_2$ and $Ba(OH)_2$

5. The oxides of carbon differ from other elements because they contain multiple bonds between C and O.

(a). $\sigma\pi - p\pi$ (b) $p\pi - p\pi$
(c) $p\pi - \pi\pi$ (d) $\pi\pi - p\pi$

6. Carbonmonoxide is a poisonous gas, sparingly soluble in water and formed by the following equation.----------

(a) $HCOOH_2 + HSO_3 \rightarrow CO + H_2O$
(b) $H_2COO + HSO_3 \rightarrow CO + H_2O$
(c) $HCOOH + H_2SO_4 \rightarrow CO + H_2O$
(d) $H_2COOH + HSO_4 \rightarrow CO + H_2O$

7. The tetrahalides are tetrahedral, volatile and covalent except ------ and -------

(a) SnF_4 and PbF_4
(b) PbF_4 and SnF_2
(c) SnF_3 and PbF_3
(d) PbI_4 and SnF_4

8. Carbon differs from the other elements in its limitation to a coordination number of four because there are no------- in the second shell.

(a) f-orbital (b) d-ortbital.
(c) s-orbital (d) p-orbital

9. The electronic structure of lead (Pb) is ------

(a) $\{Ar\}3d^{10}4s^24p^2$
(b) $\{Kr\}\ 4d^{15}\ 5s^1\ 5p^3$
(c) $\{Xe\}.4f^{14}5d^{10}6s^26p^2$
(d) $\{Kr\}\ 1d^{10}5s^25p^2$

10. The alkaline earth elements burn in nitrogen and form nitrides as----------

(a) M_2N_3 (b) M_3N_2 (c) M_1N_3
(d) M_2N_2

11. All metals combine with the halogens at an appropriate temperature forming halides.

(a) M_2X_2 (b) M_3X_2 (c) XM_2
(d) MX_2

12. Lithium aluminium hydride is --------

(a) A redox agent
(b) A strong oxidizing agent
(c) A strong reducing agent
(d) All of the above

13. The solubility of the sulphate in water decreases down the group as follows.

(a) Be>Sr>Mg>Ca>Ba
(b) Be>Ba>Sr>Mg>Ca
(c). Be>Ca>>Sr>Mg>Ba
(d) Be>Mg>>Ca>Sr>Ba

14. The hydrated energies of the ions are four or five times greater than the group I elements because of their -------- and ------

(a) Smaller size and decreased charge
(b) Bigger size and decreased charge.
(c) Smaller size and increased charge
(d) Bigger size and increased charge

15. Alkali metals replace hydrogen in organic acids forming salts such as --- and --------

(a). CH_2COONa and $C_6H_6.COOK$
(b) CH_2CONa and $C_6H_5.COOK$
(c). $CHCOONa$ and $C_3H_5.COOK$
(d). CH_3COONa and $C_6H_5.COOK$

16. When the metals of group I elements are burnt in air lithium and sodium form ---------- and ---------

(a) Li_2O and NaO (b) Li_2O and Na_2O.
(c) Li_2O and Na_2O_2 (d) LiO and NaO

17. -----metals are typically soft, highly reactive, univalent and forms colourless ionic compounds

(a) Group II (b) Group I.
(c) Group IV (d) Group III

18. An artificially produced radioactive isotope decomposes according to the first order rate law with a half-life period of 270 min. How long will it take for 60% of the sample to disappear?

(a) 5.95hrs (b) 4.5hrs. (c) 0.95hrs (d) 5.4hrs

19. The decomposition of a compound follows first order rate law with a rate constant equal to 5.37×10^{-3}hr. In what time will 80% of the sample disintegrate completely.

(a) 500 hrs (b) 25hrs. (c) 50hrs (d) 5 hrs

20. When the nucleus of a $^{209}_{83}Bi$ atom captures neutron and the product undergoes beta decay, the final product is

(a) $^{210}_{84}Po$ (b) $^{209}_{82}Pb$ (c) $^{209}_{83}Bi$ (d) $^{210}_{83}Bi$

21. Identify the unknown in equations 21-24

$^{40}_{19}K \rightarrow$ ------ + $^{0}_{-1}e$

(a) $^{40}_{18}Ar$ (b) $^{40}_{20}Ca$ (c) $^{41}_{19}K$
(d) None of the above

22. $^{35}_{17}Cl$ (n, ---) $^{36}_{17}Cl$

(a) γ (b) $^{1}_{1}H$ (c) α (d) $^{1}_{0}n$

23. $^{173}_{78}Pt \rightarrow ^{173}_{76}Os$ + -----

(a) $^{1}_{0}n$ (b) $^{2}_{1}H$ (c) $^{0}_{1}e$ (d) $^{4}_{2}He$

24. $^{14}_{7}N$ (-----, α) $^{12}_{6}C$

(a) $^{1}_{1}H$ (b) $^{2}_{1}H$ (c) $^{1}_{0}n$ (d) $^{4}_{2}He$

25. The half life of $^{13}_{7}N$ is 10.1min.

Starting with 1000 atoms of $^{13}_{7}N$, how many atoms would remain after 1hr?.

(a) 1 atom (b) 16 atoms (c) 162 atoms
(d) 2 atoms

26. When nuclear fission occurs,
(a) A great deal of energy is gained
(b) A great deal of energy is released.
(c) Electricity is generated
(d) α particles are emitted

27. The compound $ZnSO_4$ is white because
(a) $ZnSO_4$ compound is naturally white
(b) It is not possible to promote electrons within the d-orbitals in Zn^{2+} as it is full.
(c) electrons are easily promoted in d-orbitals of Zn^{2+}
(d) It is not possible to promote electrons within the d orbitals in Zn^{2+} as it is empty.

28. Transition metals form a large number of complexes because of

(a) the possession of catalytic ability
(b). the presence of completely filled orbitals
(c) the presence of vacant orbitals which can accept electrons from donors
(d). None of the above.

29. A piece of wood is found to have a $^{14}_{6}C$ total carbon ratio 0.560 times that in a living plant. Calculate the age of the wood given that the half-life of carbon is 55 70 years.

(a) 4833yrs (b) 8433yrs. (c) 2400yrs (d) 4200yrs

30. The loss of Alpha particle by a nucleus

(a) Produces no effect
(b) Increases its mass number by 4 and decreases the atomic number by 2.
(c) decreases its mass number by 2 and the atomic number by 4.
(d) decreases its mass number by 4 and its atomic number by 2

31. The dropping of an electron from a higher quantum level into that vacated by the captured electron results in the emission of :

(a) γ --rays (b). α --rays (c) β-rays (d) x-rays

32. The transition metals are paramagnetic due to:

(a). the presence of unpaired electrons in their ions
(b) the presence of completely filled d-orbitals
(c). the ability to form both covalent and metallic bonds
(d). the ability to attract iron filings

33. In Haber process of manufacture of Ammonia, Iron (Fe) is able to catalyse the reaction because

(a) It has vacant d-orbitals
(b) It can form ionic compounds with oxygen
(c). It is a metal (d) It can form metallic bond

34. The bond angle in one of these molecules is reduced by the presence of lone pair of electron(s) on the central atom.

(a) $BeCl_2$ (b) H_2O (c) SiH (d) CH_4

35. What is the unit of paramagnetism in Phosphorus
(a) 4 (b) 0 (c) 3 (d) 2

36. Which of these statements is false?
(a) Atomic radius increases across a period
(b) Effective nuclear charge increases across a period.
(c) Atomic radius decreases across a period.
(d) Atomic radius increases down a group

37. Calculate the maximum number of electrons in the orbital that has the quantum numbers n=2,

(a) 10 (b) 6 (c) 8 (d) 28

38. What is the maximum number of electrons in the orbital that has the quantum numbers n=3; l=0, m=0

(a) 10 (b) 14. (c) 2 (d) 6

39. Identify the element with an excited state electronic configuration of $1s^2\ 2s^2\ 2p^5\ 3s^1$
(a) Neon (b). Chlorine (c) Helium
(d) Fluorine

40. Predict the shape and bond angle of SF_6
(a) Octahedral & 60^o
(b) Octahedral & 90^o
(c) Bipyramidal & 90^o
(d) Hexagonal & 60^o

41. Arrange the following elements in the order of decreasing first ionization energies. Na, Mg, Al and Si.

(a). Si>Mg.>Al>Na (b) Si<Mg<Al<Na
(c) Na>Al>Mg>Si (d) Na<Al<Mg<Si

42. Which of these is a d-block element?
(a) Ar (b) Ca (c) Co (d) P

43. The electronic configuration of Cu is

(a) [Ne] $4s^1\ 3d^{10}$ (b) [Ar] $4s^2\ 3d^9$
(c) [Ne] $4s^2\ 3d^9$ (d) [Ar] $4s^1\ 3d^{10}$

44. The electronic configuration for the alkali metal without 4p electrons is

(a). [Ne] $4s^2$ (b) [Ar] $4s^2\ 3d^2$
(c) [Ar] $4s^1$ (d) [Ar] $4s^2$

45. An anion is formed when

(a) an atom gains electron(s)
(b) an atom gains neutron (s)
(c) an atom loses electron (s)
(d) an atom gains proton (s)

46. ---------- is the energy required to remove an electron from its atom or (ion) in the gas phase

(a). Bonding energy (b) Ionization energy
(c) Atomisation energy (d) Exothermic

CHM104

UNIVERSITY OF AGRICULTURE, ABEOKUTA,
CHEMISTRY DEPARTMENT
CHM 104 CAT
Instruction: Answer all. Time allowed 30mins.

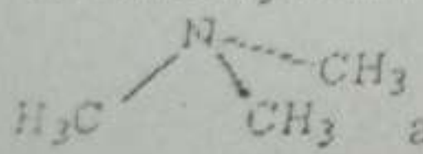
1. $SiCl_4$, PCl_5, SiF_6^{2-} and PCl_6^- are compounds which can be hydrolyzed by water to give strongly acidic solutions. which of these molecules possess the sp^3d hybrid orbital type?
(a) $SiCl_4$ (b) PCl_5 (c) PCl_6^- (d) SiF_6^{2-}

2. Elemental analysis of a chloride of phosphorus gave 23.4% ^{31}P and 76.6% of ^{35}Cl. By determining the molecular formulae of this compound, suggest the type of hybridization present in the molecule.(Note, E F = M F)
(a) sp^3d (b) sp^2 (c) sp^3 (d) sp

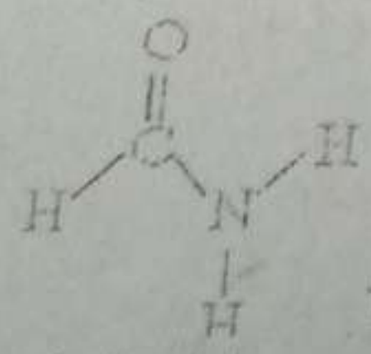
3. An example of physical means of separating an ore from unwanted rocky material is
<a> Froth flotation <b> Decantation <c> Sedimentation <d> Bath coagulation

4. Which type of hybridization is present in SF_6?
<a> sp^3 <b> sp^3d <c> sp^3d^2 <d> sp

5. Trimethylamine is a pyramidal molecule



and formamide is a planar



molecule The hybridization of nitrogen in both is
<a> sp^2, sp^2 <b> sp^3, sp^3 <c> sp^2, sp <d> sp^3, sp^3

6. Why is limestone added to the blast furnace during extraction of iron?
<a> it helps to reduce the ore at high temperature
<b> it helps to convert some of the iron ore to wrought iron
<c> it helps to convert silicon dioxide present in the ore to slag
<d> It purifies the iron

7. In the compound $H_2C=CH-C\equiv CH$, Which of the following represents the given mode of hybridization from left to right?
<a> $sp^1 - sp^3 - sp^2 - sp^2$ <b> $sp^3 - sp^3 - sp - sp$ <c> $sp^2 - sp^2 - sp - sp$
<d> $sp^2 - sp^2 - sp^2 - sp^2$

8. $^{232}_{90}Th$ emits a total of six alpha-particles and four beta-particles in its natural decay sequence. What is the atomic number, mass number and symbol of the final product.
A. $^{208}_{78}Pt$ B. $^{208}_{82}Pb$ C. $^{212}_{84}Po$
D. $^{208}_{74}W$

9. Choose the One statement that is true about gamma radiation;
A. They exert strong ionizing effect during collision
B. It can be diffracted by the lattice of a crystal
C. It is markedly deflected towards a positive plate in an electrostatic field
D. It has a relatively small mass.

10 Nucleons are
A. Electrons + Neutrons B. Protons + Electrons C. Protons+ Neutrons D. Protons+ Electrons +Neutrons

11. Calculate the energy released when 0.0303×10^{-3}kg of mass is lost in a nuclear reactor.($c=3 \times 10^8 ms^{-1}$)
A. 4.5×10^{14}J B. 4.5×10^{12}J
C. 2.7×10^{12}J D. 2.7×10^{16}J

12. One of the following statements is not true about Group IV elements on descending the group;
A The 2-valent state becomes more stable relative to 4-valent state.
B The nature of the dioxides changes from acidic to amphoteric

UNIVERSITY OF AGRICULTURE, ABEOKUTA

DEPARTMENT OF CHEMISTRY

COLLEGE OF NATURAL SCIENCES

B.Sc. CHEMISTRY SECOND SEMESTER EXAMINATION

CHM 102: Introductory Organic Chemistry Option A Time: 60 minutes

Instruction: Attempt all the question and shade appropriate space in the OMR provided with HB pencil

1. In sucrose, the carbon 1 of α - D - Glucopyranose bond to C -2 of D- Fructose pyranose by which bond?
(A) β - 1, 2 – Glucosidic bond, (B) α – 1, 2 - Glucosidic bond (C) β - 3, 4 – Glucosidic bond (D) α – 3, 4 - Glucosidic bond

2. The three important polysaccharides that are made of glucose units are?
(A) starch, glycogen and cellulose (B) maltose, sucrose and starch (C) glycogen, starch and monosaccharide (D) cellulose, sucrose and starch.

3. ---------- is the most widely distributed plant skeletal polysaccharides?
(A) monosaccharide (B) glucose (C) disaccharides (D) cellulose

4. Amino sugars are denoted by the presence of which group?
(A) ammonium group (B) ketone group (C) amine group (D) aldehyde group

5. The name given to cyclic structure of monosaccharide is called?
(A) Chirality (B) Harworth projection (C) Fischer projection (D) Dextro and laevo projection

6. In aldose, the anomeric carbon is at carbon one, while in fructose and ketone, the anomeric carbon is at carbon----? (A) 1 (B) 2 (C) 3 (C) 4

7. Treating an aldehyde or a ketone with one molecule of alcohol will yield what? (A) sugar (B) aldeketone (C) glucose (D) hemiacetal.

8. Amino acids are compounds whose chemistry is built on what?
(A) hydroxyl and amine (B) carboxylic acid and hydroxide (C) amine and carboxylic acid (D) alcohol and amine.

9. Which of these structures is the Zwitterian form of an Alpha amino acid?
(A) $RC(NH_3^+)HCOO^-$ (B) $RC(NH_2)HCOOH$ (C) $RC(NH)HCOOH$ (D) $RC(N_2H_3^+)HCOOH$

10. What is the simplest amino acid is called?
(A) aminobasic (B) aminoacidic (C) amino acetic acid (D) amino asphatic acid

11. Among the common 20 amino acids, how many have non- polar side chains?
(A) 4 (B) 6 (C) 5 (D) 9

12. Among the common 20 amino acids, how many have polar side chains?
(A) 5 (B) 4 (C) 9 (D) 6

13. Among the common 20 amino acids, how many have acidic side chains?
(A) 4 (B) 5 (C) 9 (D) 3

14. Among the common 20 amino acids, how many have basic side chains?
(A) 4 (B) 5 (C) 3 (D) 9

15. ----- and -------- are amino acids that are predominantly found in the liver and urea cycle
(A) aspartic acid and alanine (B) citrulline and ornithine (C) serine and praline (D) arginine and tyrosine

16. Which of these amino acids is found in the brain at high concentration?
(A) 1- amino butanoic acid (B) 2- amino butanoic acid (C) 3- amino butanoic acid (D) 4- amino butanoic acid

17. 'GABA' is another name for which amino acids?
(A) 2- amino butanoic acid (B) 4- amino butanoic acid (C) 2, 4- diamino butanoic acid (D) 1- amino butanoic acid.

18. ---------- is used as a component in antifreeze because of its has a high solubility in water,
(A) propan-1,2-diol (B) ethelene-1,2-diol (C) Ethane-1,2-diol (D) butanol.

19. Fermentation ceases when the ethanol content of the fermentation process reaches about 14% (v/v), because
(A) equilibrium is established at 14% (v/v) (B) ethanol kills the yeast at high concentration (C) ethanol degrade at 14% (v/v) (D) none of the above

natin is a solution of ---------- dissolved in
ith some methanol added.
tanone (B) methanol (C) methanal (D) aldehye

all amounts of methanol are added to ethanol to
hyl alcohol (B) methylated spirit (C)
hrinm (D) spirit

e boiling points of the alcohols tend to be higher
ner organic compounds of similar molecular mass
e: (A) they are miscible with water (B) of their
to form H bond
y are soluble in polar solvent (D) they are alkanols

ie presence of -OH and R groups on alcohol
s respectively on alcohols
ility to dissolve ionic and organic covalent
ounds (B) hydrogen and covalent bond
olar and non-polar compound (D) high boiling
rties

Whisky or brandy may contain about ----------
ol. (A) 30% (B) 70% (C) 40% (D) 60%.

rganic compound A reacted with sodium dichromate
ve another organic product B. B reacted with another
nic compound C, in a reversible reaction catalyzed
cid to give a sweet smelling compound D. use the
ve information to answer questions 14 – 17.

C belongs to the family of
alkanone (B) alkanol (C) aldehyde (D) ketones

Compound A is likely to be:
an aldehyde (B) a ketone (C) a carboxylic acid (D)
matic compound

The functional present in B is
).C=O (B) RCOOH (C) RCHO (D) ROH

. The name of the process that yielded D is
) acid catalyzed process (B) acidification (C)
ponification (D) esterification

. A carbonyl compound X has been found by analysis
have the molecular formula C_3H_6O the following are
rrect about X if it give a positive test with Fehling
agent except
A) contains oxidizing group (B) CHO is present in X
X is a reducing sugar (D) X is an alkanone

30. Amines tend to be more basic than ammonia
because
(A) alkyl groups confer an inductive effect on its
structure (B) it react with acid to produce salt and water
(C) it contains NH_2 groups (D) none of the above

31. An amino acid exists in solution in
(A) bi polar form (B) zwitterionic form (C) ionized
form (D) zwitterionic form in equilibrium with its
intact form.

32. Keratin is ---------- protein type of (A) primary
(B) secondary (C) fibrous (D) globular

33. The following are examples of primary amines
except (A) $CH_3CH_2NH_2$ (B) $CH_3CH_2CH_2NH_2$
(C) $H_2NCH_2CH_2CH_2NH_2$ (D) $CH_3CHNH_2CH_3$

34. Which of the following is true for mono cyclic
saccharide with an hemiacetal (or hemiketal) on its
terminal
(A) will reduce Cu^{2+} to Cu^{+} (B) give blue black
colouration with iodine (C) will burn in air to produce
carbon monoxide (D) none of the options above.

Y is a carbohydrate, which give a negative result with
Benedict's reagent. When warmed with hydrochloric
acid, the resulting solution gives a positive test with
both Fehling and Benedict's reagent. Use the
information to answer the following questions.

35. The function of hydrochloric acid in the above
process is
(A) oxidation of hemiketal group (B) cracking of
glucose linkage (C) hydrolysis glycosidic linkage (D)
breaking of carbonyl bond

36. Y is likely to be
(A) glucose (B) fructose (C) monosachariide (D)
polysachridde

37. Carbon atom in its ground state has ----------
unpaired electrons
(A) 4 (B) 6 (C) 2 (D) 0

38. Carbon atom has ---------- unpaired electrons in
its excited state
(A) 4 (B) 2 (C) 1 (D) 0

39. How many similar orbitals are formed during SP^2
hybridization
(A) 4 (B) 10 (C) 3 (D) 0

40. How many p-orbitals unaffected during SP hybridization
(A) 0 (B) 2 (C) 4 (D) 6

41. Which of the allotropes of carbon is non-crystalline
(A) diamond (B) graphite (C) fullerene (D) amorphous carbon

42. Which of the following is the recently discovered exotic allotrope of carbon
(A) amorphous carbon (B) graphite (C) fullerene (D) diamond

43. Which of the allotropes represents application in research of nanomaterials
(A) fullerene (B) bukyballs (C) fullerene and bukyballs (D) none of the above

44. Which of the following scientists discovered fullerene and buckyballs carbons
(A) Richard Buckminster Fuller (B) Richard Brickyballs (C) Richard Fullerene (D) Richard Smith

45. How many carbons are contained in buckyballs
(A) C_{20} (B) C_{30} (C) C_{60} (D) C_{100}

46. In diamond, how are carbon bonded
(A) tetrahedrally to four others (B) tetrahedrally to five others (C) hexagonally (D) none of the above

47. Which of the following allotrope(s) of carbon contain fused hexagonal carbon rings
(A) graphite (B) diamond (C) fullerene (D) graphite and fullerene

48. The highest energy arrangement of electrons in an atom is called
(A) electronic state configuration (B) excited state configuration (C) ionic state configuration (D) ground state configuration

49. The ground state electronic configuration of carbon can be represented as
(A) $1s^2\ 2s^1\ 2p^2_x\ 2p^1_y\ 2p^2_z$ (B) $1s^2\ 2s^2\ 2p^2_x\ 2p^1_y$ (C) $1s^2\ 2s^2\ 2p^1_x\ 2p^1_y$ (D) $1s^1\ 2s^1\ 2p^2_x\ 2p^2_y$

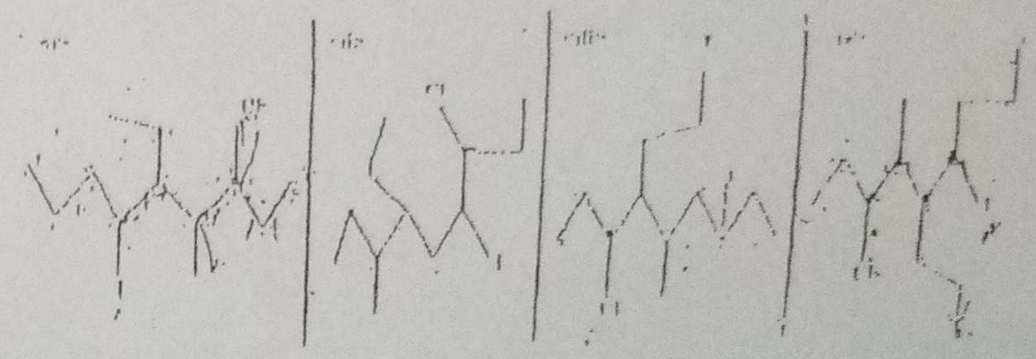
50. The imaginary layer around the nucleus occupied by electrons is called (A) ground state (B) shell (C) energy level (D) orbital

51. The following statements refer to different types of overlapping by molecular orbitals. In which case is a sigma bond not formed?
(A) two s orbitals (B) two linearly opposed orbitals (C) two laterally opposed p orbitals (D) two sp³ orbitals

52. What forms do carbon takes at normal pressure?
(A) sp (B) graphite (C) sp^2 (D) diamond

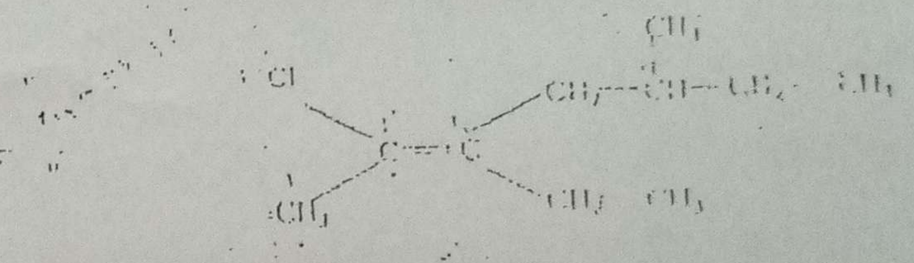
53. Which of the following account for the energetic stability of graphite over diamond at room temperature
(A) delocalization of one of the outer electrons (B) hexagonal packings (C) formation of π-cloud (D) delocalization of one of the outer electrons and formation of π-cloud

54. The structural formula of the compound 3-Chloro-6-Iodo-4-methyl-5-propylnonane is:



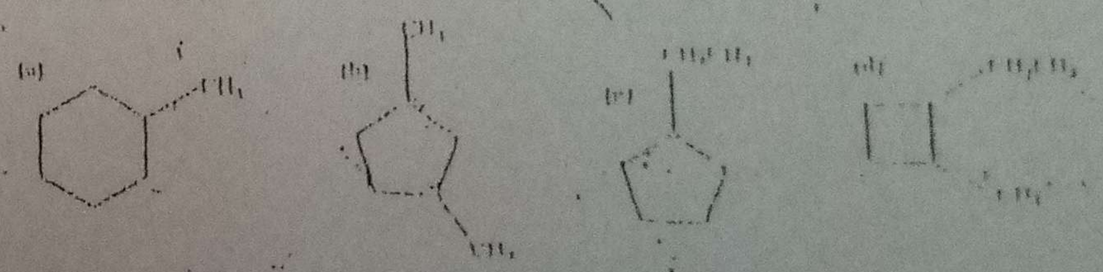
(A) (i) (B) (ii) (C) (iii) (D) (iv)

55. Name the compound below and specify its configuration by the *E-Z* system.



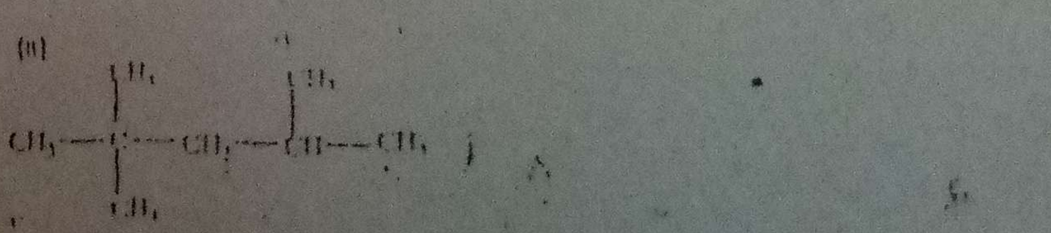
(A) E-2-chloro-3-ethyl-5-methyl-2-heptene (B) Z-2-chloro-3-ethyl-5-methyl-2-heptene (C) E-5-methyl-2-chloro-3-ethyl-2-heptene (D) Z-2-chloro-3-ethyl-5-methyl-2-heptene

56. The following are cycloalkanes of the molecular formula C_7H_{14}. Which of them can exhibit *cis-trans* isomerism.



(A) a & b (B) b & c (C) b & d (D) a, b, c & d

57. Arrange the following compounds in order of increasing boiling point



(A) a,b,c (B) a,c,b (C) b,a,c (D) c,b,a

FEDERAL UNIVERSITY OF AGRICULTURE, ABEOKUTA

DEPARTMENT OF MATHEMATICS

2018/2019 Second Semester Examination .

MTS 104: Mechanics

Time Allowed : 2 Hours.

Instruction: Answer any 4 Questions.

1(a). Aparticle is projected with a speed u and at an angle of elevation α from a point O. Show that at time t after projection, the position vector of the particle relative to O is r, where $r = (ucos\alpha)ti + [(usin\alpha)t - \frac{1}{2}gt^2]j$, i and j are unit vector directed horizontal and vertically upwards respectively.

(b). Given that $u = 40ms^{-1}$ and that the particle strikes a target A on the same horizontal level as O, where $OA = 60m$. Find the least possible time, to the nearest tenth of a second that elapses before the particle hits the target. $(g = 10ms^{-2})$.

(c). A running man has 3/4 the kinetic energy of that of a body whose mass is one-third of the man. The man speed up by $5m/s$ so as to have the same kinetic energy as that of the body. Find the original speed of the man.

2(a). A particle is projeected up a plane with an initial speed of $50m/s$ from a point O in a plane inclined 45^0 to the horizontal. The plane containing the path passes through the line of greatest slope of the inclined plane. Find (i) the maximum range of the particle (ii) the time of flight of the maximum range.

(b). A simple pendulum making small oscillation is released from a position where it makes an angle α with the vertical. Show that the complete period is $\frac{2\pi v}{g\alpha}$ wher v is the maximum speed.

3(a). A tripod consists of three light rigid legs AL, BL and CL which are freely pinned at their base points A,B,C and at their apex L. The position vectors of the points A,B,C and L with respect to some origin are $2i-j-3k$, $3i+2j+2k$, $j+k$ and $2i+j+3k$ respectively, where k points vertically upward. The tripod supports a camera of weight $2N$ at L. Calculate the magnitude of the resultant forces on the legs of the tripod.

(b). A body of mass $50kg$ is projected up an inclined plane of 47^0 with an initial speed of $5m/s$. The coefficient of the friction is 0.25. Calculate (i) How far up the slope it travels before coming to rest (ii) How long it takes to reach the highest point (iii) How much longer it takes to return to its starting point (iv) How fast its traveling when it gets there.

4(a). A spacecraft at a distance $r_0 = 2R_E$ from the center of the earth is moving outwards with initial velocity $v_0\sqrt{2gR_E/3}$. Determine its velocity as a function of its distance from the centre of the earth.

(b). A rocket booster is traveling straight up when it suddenly starts rotating counter clockwise at $0.25rev/s$. The range safety officer destroys it $2s$ later. The booster mass is $m = 90Mg$, its thrust is $T = 1.0MN$ and it is moving upwards at $10m/s$ when it starts rotating. If aerodynamic forces are neglected. What is the booster's velocity at the time it is destroyed?

5(a). The Apollo CSM(A) attempts to dock with the sayus capsule (B). Their masses are $m_a = 18Mg$ and $m_b = 6.6Mg$. The sayus is stationary relative to reference frame and the CSM approaches with velocity $v_a = (0.2i + 0.03j - 0.02k)m/s$. (i) If the first attempts at docking is succesful, what is the velocity of the center of mass of the combined vehicles afterwards? (ii). If the attempt is successful and the coefficient of the restitution

of the resulting impact is $e = 0.95$, what are the velocities of the spacecraft after the impact?

6(a). When an earth satelite is at perigee, the magnitude of its velocity is $v_a = 700m/s$ and its distance from the center of the earth is $r_a = 10000km$. What are the magnitude of its velocity v_b and its distance r_b from the earth at apogee. The radius of the earth is $R_E = 6370km$.

(b). Two bodies having masses of $6kg$ and $15kg$ and traveling along the same straight line level path have respectively velocities of $12m/s$ right to left and $6m/s$ left to right, when they collide. The coefficient of restriction is $e = -0.85$. Calculate the two final velocities and the energy loss due to the collision.

17·5 = 34

FEDERAL UNIVERSITY OF AGRICULTURE, ABEOKUTA
DEPARTMENT OF MATHEMATICS
2017/2018 BSc. DEGREE SECOND SEMESTER EXAMINATIONS
COURSE: MTS 104 (MECHANICS)
TIME ALLOWED: 2 HOURS , 30 MINUTES
INSTRUCTION : ANSWER ANY FOUR (4) QUESTIONS

(a) $ABCDEF$ is a regular hexagon and O is its centre. Forces $1, 2, 3, 4, P$ and Q Newtons act on O in the direction OA, OB, OC, OD and OF respectively. If the six forces are in equilibrium, find the values of P and Q.

(b) One end of a string $0.5m$ long is fixed to point A and the other end is fastened to a small object of weight $8N$. The object is pulled aside by a horizontal force until it is $0.3m$ from the vertical through A. Find the magnitude of the tension in the string and the horizontal force.

(a) Distinguish between the following pairs:

(i) A resultant force and an equilibrant force

(ii) Torgue and Work

(b) A uniform plank AB of weight $100N$ and length $4m$ lies on a horizontal roof perpendicular to the edge of the roof and overhanging by $1.5m$. *If a load of* $200N$ is to be attached to the overhanging end A, what force must be applied to the opposite end B just to prevent the plank from overturning?

(c) Let P and Q be given forces acting on points A and B respectively. With the aid of a suitable diagram each, find the magnitude of the resultant forces when

(i) P and Q are like parallel forces

(ii) P and Q are unlike parallel forces.

(a) Define Simple Harmonic Motion.

(b) One end A of a light elastic string of natural length l and Young's modulus of elasticity λ is fixed. To the other end is attached a particle of mass m and the assembly hangs freely under gravity. The particle is pulled down a further distance p and released.

(i) Show that initially, the motion of the particle is simple harmonic.

(ii) Determine its centre of oscillation.

4. (a) A projectile is fired from the edge of a $300m$ cliff with an initial velocity of $360m/s$ at an angle of 30 degrees with the horizontal. Neglecting air resistance, find

(i) the horizontal distance from the gun to the point where the projectile strikes the ground.

(i) the greatest elevation above the ground reached by the projectile

(b) Define the following:

(i) Coplanar forces

(ii) Concurrent forces

5. (a) Let F be a constant force which acts on a body such that it makes an angle θ with the horizontal. Let the body be displaced through a distance s.

(i) Represent the above graphically

(ii) Resolve F componentwise

(iii) What is the work done by the force in displacing the body through distance s?

(iv) What is the work done if a force $F = (6i + 4j)N$ is applied over a particle which displaces it from its origin to the point $R = (3i - 2j)$ metres?

(b) State and prove the energy-work Theorem

(c) (i) A spring of spring constant $(4 \times 10^3)N/m$ is stretched initially by $4cm$ from the unstretched position. What is the work required to stretched it further by another $4cm$?

(ii) Define power? Hence calculate the instantaneous power applied to a particle that moves with velocity $V = (10i - 6j + 10k)ms^{-1}$ under the influence of a constant force $F = (20i + 20j + 20k)N$.

(a) A sail controller at a seaport observes two ships A and B simultaneously, their position vectors being $(10i+20j+5k)Km$ and $(-20j-10j+3k)Km$ respectively relative to the tower. Ship A is sailing with a constant velocity of $(-20i-50j)Kmhr^{-1}$ and ship B is sailing with a constant velocity of $(150i+250j+60k)Kmhr^{-1}$. Find:

(i) The velocity of ship A relative to ship B

(ii) The position vector of ship A relative to ship B at t minutes after the ships are observed.

(b) Forces P and Q inclined at an angle of 60 degrees act on a particle of mass $2.5Kg$. P has a magnitude of $5N$ and Q has a magnitude of $8N$. Find the acceleration of the particle.

FEDERAL UNIVERSITY OF AGRICULTURE, ABEOKUTA

DEPARTMENT OF MATHEMATICS

2016/2017 Second Semester Examination .

MTS 104-Mechanics, February 2018, Time: $2\frac{1}{2}$hours

Instruction: Answer any TWO questions in each section

SECTION A

1(a) A body is moving in a straight line with constant acceleration. One second after passing a point A it is $10m$ from A. In the next second it travels a further $14m$. Find the (i) velocity on passing A, (ii) the acceleration, (iii) velocity after traveling $100m$ from A, (iv) the time taken to cover this distance.

(b) Sharon, is diving into a swimming pool. During her flight she may be modelled as a particle. Her initial velocity is $1.8m/s$ at an angle 30^0 above the horizontal and initial position $3.1m$ above the water. Air resistance may be neglected. Find (i) the greatest height above the water that reaches during her dive. (ii) Show that the time t, in secs that it takes sharon to to reach the water is given by $4t^2 - 9t - 3.1 = 0$ and solve the equation to find t.

(c) An object is projected straight upwards with an initial velocity u. If T is the time taken to return to the point of projection and H is the greatest height and g is the acceleration due to gravity. Show that (i) $T = \frac{2u}{g}$ (ii) $H = \frac{u^2}{2g}$

2. (a) Two particles are projected vertically upward from exactly the same point on the ground at $2s$ interval. How high above the ground do the meet if the both start with an initial velocity $12m/s$. Take $g = 10m/s^2$

(b) A car is rounding a bend of radius $100m$ which is banked at an angle of 10^0 to the horizontal. At what speed must the car travel to ensure it has no tendency to slip side way ?.

(c) A particle moves around the curve $r = 2(1 + sin\theta)$ with constant angular velocity w. Find the radial and transverse component of the velocity and acceleration of the particle at a time t in terms of w and θ.

3(a) A car of mass $900kg$ produces power of $45kw$ when moving at a constant speed. It experiences a resistance of $1700N$. (i) What is its speed ? (ii) If the

Car comes to a downhill stretch inclined at 2^0 to the horizontal. What is its maximum speed downhill, if the power and resistance remain unchanged ?

(b) The combined mass of a Cyclist and her bicycle is 65kg. She accelerated from rest to $8m/s$ in $80m$ along a horizontal road. (i) Calculate the work done by the net force in accelerating the cyclist and her bicycle (ii) Calculate the net forward force.

(c) A bullet of $25kg$ is fixed at a wooden barrier $3cm$ thick. When it hits the barrier it is traveling at $200m/s$. The barrier exerts a constant resistive force of $5000N$ on the bullet. (i) Does the bullet pass through the barrier and if so with what speed does it emerge, is energy conserved in this situation ?

SECTION B

4(ai) Define the term Simple Harmonic motion

(ii) With the aid of a diagram, considering the motion of a block of mass M attached to one end of a spring, the other of which is fixed , derive the equation *for Simple harmonic motion*

(iii) What is the name given to any system that obeys an equation of the form derived in (ii) above

(b) At time $t = 0$, the position of the mass of a harmonic oscillator is observed to be $x(0)$ and ist velocity is $v(0)$. From the the equation below, Determine the displacement and celocity at the given time and evaluate the complete solution

$$x = X_0 cos(w_0 t + \phi)$$

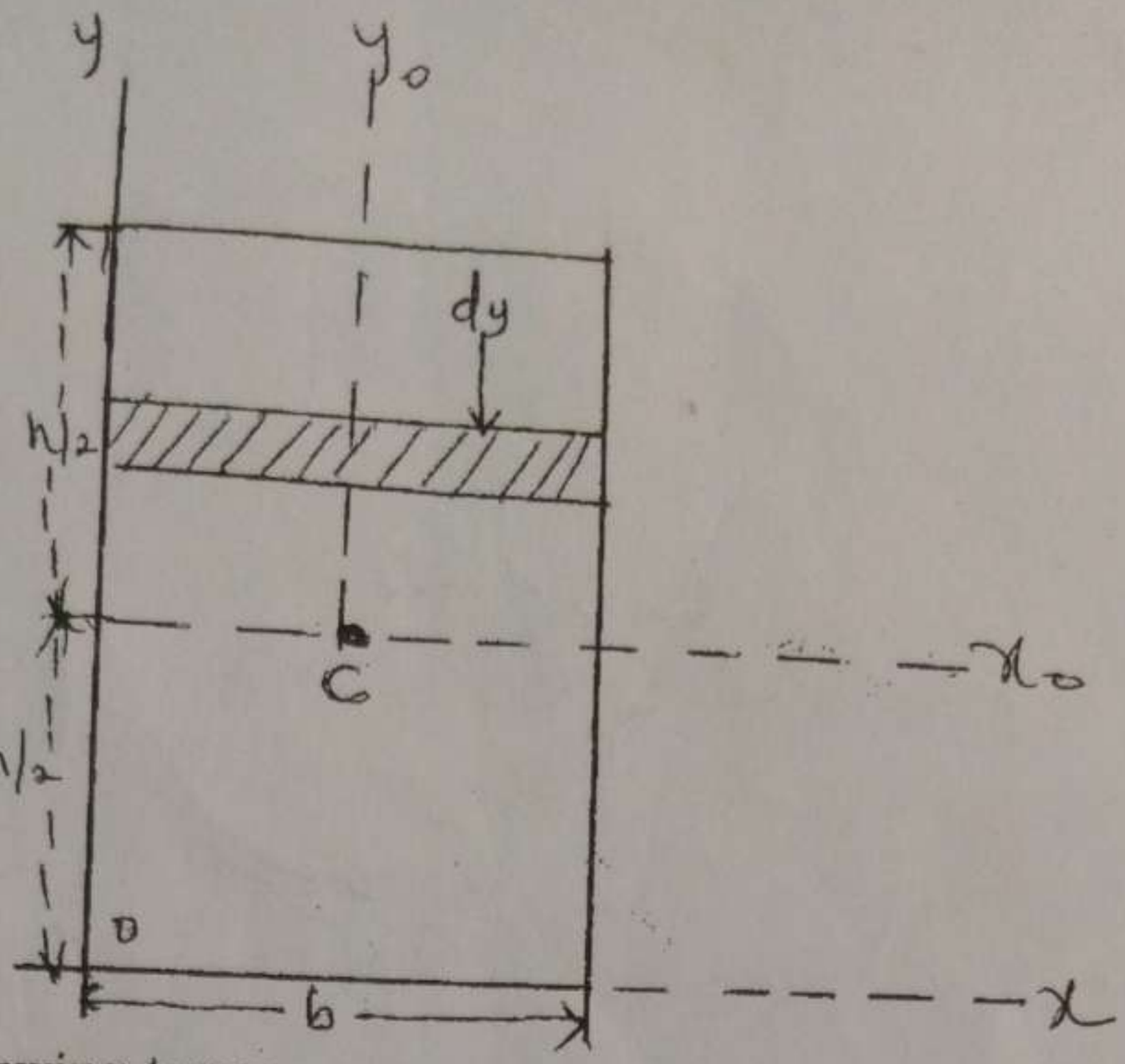
where the (quantity $w_0 t + \phi$ is the plane of the oscillation at time t and ϕ is the plane constant)

5(a) Write short note on the following

(i) Moment of Inertia (ii) Centroid (iii) Perpendicular Axis Theorem (iv) Parallel Axis Theorem

(b) In the Diagram below, determine the moments of inertia of the rectangular area about the centroidal x_0 and y_0 axes, the centroidal polar axis z_0 through C, the x-axis and the polar axis z through O

$V_2 = U \cos\theta$

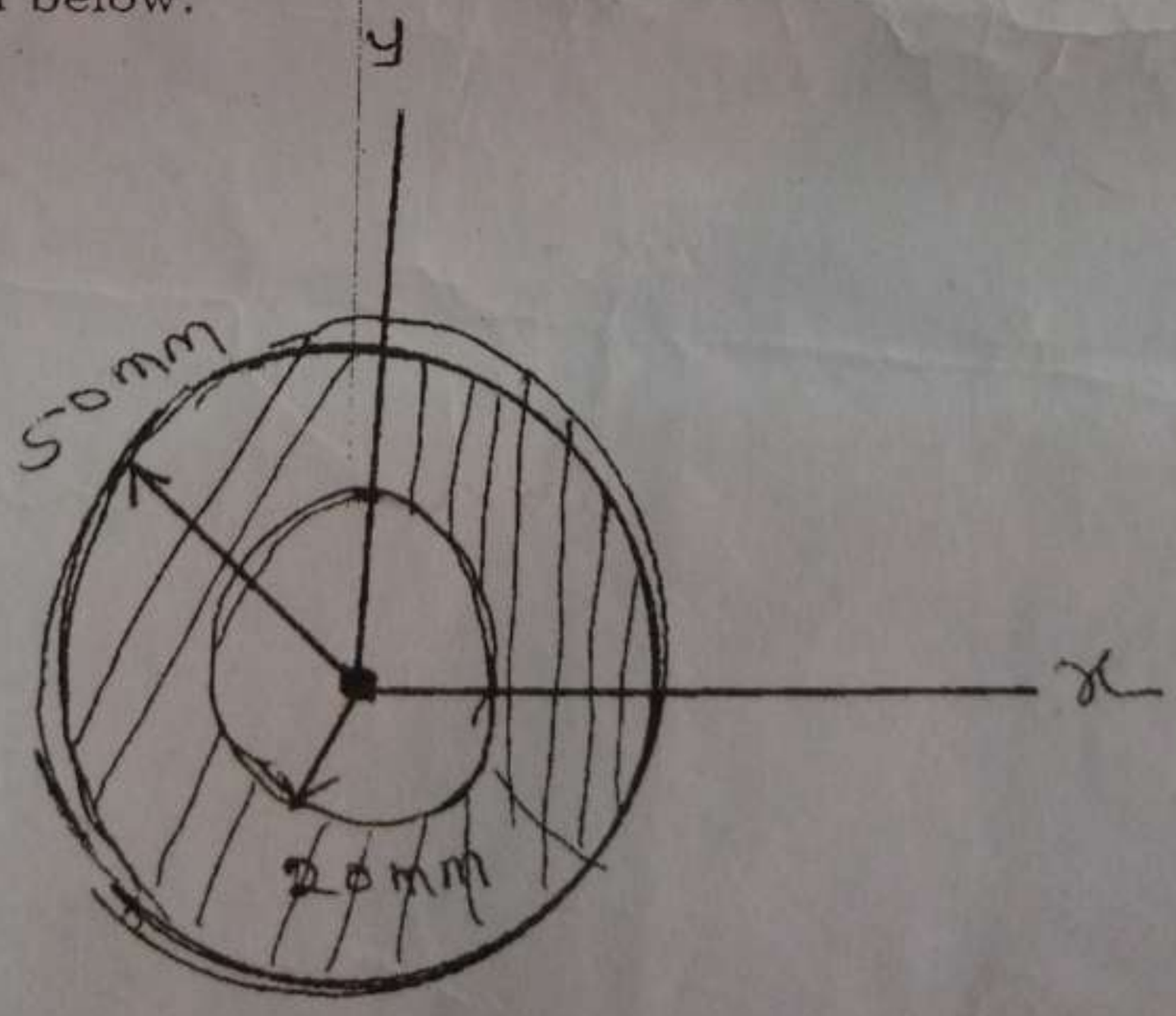


6(a) Define the following terms

(i) Momentum (ii) Impulse (iii) Coefficient of restitution

(b) A particle of mass m impacts a smooth wall at $4um/s$ at angle of 30^0 to the vertical. The particle rebounds with a speed ku at 90^0 to the original direction and in the same plane as the impact trajectory. What is (i) the value of the constant K? (ii) the coefficient of restitution between the wall and the particle? (iii) the magnitude of the impulse of the wall on the particle

(c) Determine the moment of inertia of the Cross hatched region about the x-axis in the diagram below.



FEDERAL UNIVERSITY OF AGRICULTURE, ABEOKUTA
COLLEGE OF PHYSICAL SCIENCES
DEPARTMENT OF STATISTICS
2018/2019 SECOND SEMESTER EXAMINATION
ATTEMPT ANY FOUR

Course Code: STS 102, Course Title: Introduction to Statistics (2 Units)

Time Allowed: 2hours

QUESTION ONE

a. Define Statistics
b. Differentiate between Primary and Secondary data
c. Given the following data, represent on Pie chart

Metal	Specific Heat Capacity (J/kg.C)
Berylium	96
Cadmium	230
Copper	387
Iron	448
Gold	129

QUESTION TWO

a. Define measures of Location
b. Given the table below, find by calculation (using appropriate expressions)

Mark	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
Frequency	8	10	14	26	20	16	4	2

i. Mean
ii. Median
iii. Mode
iv. Middle Quartile
v. 7^{th} Decile
vi. 64^{th} Percentile

QUESTION THREE

a. Define Random Variable
b. Give two types of random variables.
c. Differentiate between Probability mass function and Probability density function
d. Given that $f(x)=\begin{cases}3x^c & 0<x<1\\ 0 & elsewhere\end{cases}$ is a probability density function

(i) Find c
(ii) Find E(x)
(iii) Find Var(x)

QUESTION FOUR

a. Define the following terms:
   i. A trial
   ii. An Experiment
   iii. An Event
   iv. An Outcome
   v. Sample Space

b. Give three conceptual approaches to the definition of probability

c. A die is thrown twice, let x be the number that turns up on the first and y on the second die. Find the probability of:-
   i. $A = \{(x,y): (x,y) \in S, x = y\}$
   ii. $B = \{(x,y): (x,y) \in S, x \leq y\}$
   iii. $C = \{(x,y): (x,y) \in S, (x-y) = 2\}$
   iv. $D = \{(x,y): (x,y) \in S, |x-y| < 2\}$

QUESTION FIVE

a. Explain the terms Regression and Correlation

b. List four assumptions of Regression model

c. Given the table below,
   (i) Compute the regression estimates of Y on X
   (ii) Find the product moment correlation coefficient between X and Y, and interpret your result

X	59	47	52	60	67	48	44	58	76	58
Y	61	42	50	58	67	45	39	57	71	53

QUESTION SIX

a. *Define the following terms*
   (i) Mutually exclusive
   (ii) Independence events
   (iii) Conditional Probability

b. State and proof Bayes Theorem.

c. Bolts of the same kind are produced in a manufacturing outfit by three machines A, B and C. Machine A produces 40%, 10% of its output were defective, out of 36% of the total output produced by machine B, 8% were defective while 6% of the remainder produced by machine C were also defective. A bolt is selected at random from a large container in which all the total output is store, determine the probability that
   (i) the bolt is defective
   (ii) the defective bolt is produced by machine C