PART I

1. Which State of Nigeria is known as the "Food Basket of the Nation"?

   - A ☐ Kogi
   - B ☑ Benue
   - C ☐ Kwara
   - D ☐ Zamfara
   - E ☐ Ondo

2. What does the acronym EFCC stands for?

   - A ☐ Engineering and Financial Crimes Commission
   - B ☐ Economic and Financial Commission for Crimes
   - C ☐ Economic and Financial Commission against Crimes
   - D ☑ Economic and Financial Crimes Commission
   - E ☐ Economic and Financial Crimes Corporation

3. Free Markets.......

   - A ☐ Are markets where commodities are free
   - B ☐ Are markets where commodities are very cheap
   - C ☑ Allow prices to be determined purely by the forces of demand and supply
   - D ☐ Allow only the rich to purchase commodities
   - E ☐ Are market for everybody

4. All major engineering projects must be preceded by

   - A ☐ Environmental Impact Assessment
   - B ☐ Energy use Assessment
   - C ☐ Energy Input Assessment
   - D ☐ Environmental Input Assessment
   - E ☐ Reliability Studies

5. Planning Process includes all the following except

   - A ☐ Establishing a goal
   - B ☑ Managerial Grid
   - C ☐ Forecasting
   - D ☐ Budgeting
   - E ☐ Critical path analysis

6. The obligation of an officer to prosecute an assigned task to the best of his/her knowledge and to which he/she is answerable is

   - A ☐ Authority
   - B ☐ Responsibility
   - C ☐ Delegation
   - D ☑ Power
   - E ☐ Government

7. If the ice in Antarctica were to melt, sea level worldwide will rise by

   - A ☐ 1 meter
   - B ☐ 2.5 meters
   - C ☐ 0.5 meters
   - D ☐ 5.0 meters
   - E ☐ 12.0 meters

8. Who does not belong in the following list?

   - A ☐ Orhan Pamuk
   - B ☐ Joseph Stiglitz
   - C ☐ Dario Fo
   - D ☐ Wole Soyinka
   - E ☐ Saul Bellow

9. The five founding members of OPEC were

   - A ☐ Algeria, Iran, Saudi Arabia, Venezuela, Nigeria
   - B ☐ Angola, Nigeria, Saudi Arabia, Iran, U.A.E.
   - C ☑ Kuwait, Iran, Iraq, Venezuela, Saudi Arabia
   - D ☐ Saudi Arabia, Iran, Iraq, Venezuela
   - E ☐ Qatar, U.A.E. Iran, Iraq, Saudi Arabia

10. If the letters RAPIS are rearranged it will give the name of a

    - A ☑ City
    - B ☐ State
    - C ☐ Ocean
    - D ☐ Animal
    - E ☐ Country

11. Which one makes the best comparison, ICAFE is to 93165 as FACED is to

    A. ☑ 61354 ✓ 61354
    B. ☐ 31654
    C. ☐ 61453
    D. ☐ 41356
    E. ☐ 63145

12. Which one is most different from others?

    A. ☐ Horse
    B. ☑ Kangaroo
    C. ☐ Zebra
    D. ☐ Deer
    E. ☐ Donkey

13. Water is to a cup as letter is to

    A. ☑ Envelope
    B. ☐ Stamp
    C. ☐ Book
    D. ☐ Pen
    E. ☐ Mail

14. A fish has a head 9cm long. The tail of the fish is equal to the size of the head plus one-half the size of the body. The body is the size of the head plus tail. How long is the fish?

    A. ☐ 27cm
    B. ☐ 63cm
    C. ☐ 54cm
    D. ☐ 72cm
    E. ☐ 81cm

15. During the Trans-Atlantic Slave Trade that lasted from the 15th - 19th Century approximately ....persons were taken from Africa to the Americas.

    A. ☐ 20,000,000
    B. ☐ 7,000,000
    C. ☐ 11,000,000
    D. ☐ 1,000,000
    E. ☐ 25,000,000

16. Which is the odd one out?

    A. ☐ Kalahari
    B. ☐ Atacama
    C. ☐ Arizona-Sonora
    D. ☐ Atherton Tableland
    E. ☐ Gobi

17. Summer and Winter solstice are characterized by

    A. ☐ The sun is closest to the equator
    B. ☐ The sun is furthest from the North or South of the equator
    C. ☐ The sun and the moon are aligned vertically
    D. ☐ The sun and the moon are aligned horizontally
    E. ☐ None of the above

18. The most polluted city in the world is

    A. ☐ Lagos
    B. ☐ Linfen
    C. ☐ Sao Paulo
    D. ☐ Caracas
    E. ☐ Calcutta

19. The Nigerian Armed Forces Remembrance Day is celebrated on

    A. ☐ 29th July
    B. ☐ 27th August
    C. ☑ 15th January
    D. ☐ 1st October
    E. ☐ 11th November

20. The three players shortlisted for CAF player of the Year Award for 2006 are

    A. ☐ Kanu, Drogba, Essien
    B. ☐ Kanu, Martins, Drogba
    C. ☐ Essien, Drogba, Eto'o
    D. ☐ Aiyegbeni, Eto'o, Essien
    E. ☐ Martins, Kanu, Essien

21. The acronym LASER stands for

A ☐ Light Amplification by Simulated Emission of Radiation
B ☐ Localized Aggregation of Small Emission Rythms
C ☐ Locally Accessed Sampling of Emitted Radiation
D ☐ Local Amplification of Simplified Emitted Radons
E ☐ Local Access to small and Enclosed Radiation.

22. One complete day i.e. 24 hours is realized by

A ☐ A complete revolution of the Earth around the sun
B ☐ A complete revolution of the Sun around the Earth
C ☐ A complete revolution of the Earth around its vertical axis
D ☐ A complete revolution of the Earth around its horizontal axis
E ☐ A complete revolution of the moon around the Earth.

23. Anorexic people do not do this

A ☐ Exercise
B ☐ Sleep
C ☐ Eat
D ☐ Drink
E ☐ Sing

24. How many counts are required for a person to be defeated in a wrestling bout?

A ☐ 10
B ☐ 5
C ☐ 3
D ☐ 6
E ☐ 7

25. Nigeria was made of how many states in 1989?

A ☐ 19
B ☐ 21
C ☐ 30
D ☐ 36
E ☐ 33

26. The two largest continents in the world are

A ☐ Asia and North America
B ☐ Europe and Africa
C ☐ South America and Europe
D ☐ North America and South America
E ☐ Asia and Africa

27. The largest planet in the Universe is

A ☐ Venus
B ☐ Jupiter
C ☐ Saturn
D ☐ Uranus
E ☐ None of the above

28. Orville and Wilbur Wright flew the first plane in

A ☐ 1912
B ☐ 1882
C ☐ 1902
D ☐ 1892
E ☐ 1922

29. Which of the following is a non-renewable resource?

A ☐ Fisheries
B ☐ Wildlife
C ☐ Range
D ☐ Water
E ☐ None of the above

30. Respectively, isohyets and isobars are lines joining place of equal .... and ....

A ☐ Humidity and Temperature
B ☐ Radiation and Rainfall
C ☐ Air Pressure and Humidity
D ☐ Rainfall and Air Pressure
E ☐ Temperature and Radiation

31. A surface is a .... dimensional object

A □ Zero
B ☑ One
C □ Two
D □ Three
E □ Four

32. Which one of these is not an organ of the United Nations Organization?

A □ ILO
B □ OAU
C □ World Bank
D ☑ NEP
E □ FAO

33. The United States of America was once a colony of

A □ India
B □ Portugal
C □ Spain
D ☑ Britain
E □ France

34. The Black Shield on the Coat of Arms of Nigeria stands for

A □ Crude Oil
B □ Pride
C □ Unity
D ☑ Agriculture
E □ Race of the Citizens

35. The smallest country in the world is

A □ Cape Verde Island
B □ Qatar
C □ Mongolia
D ☑ Vatican
E □ Comoro Island

36. The Secretary General of the United Nations is

A □ Jan Pronk
B □ Louise Fresco
C □ Kofi Annan
D □ John Liman
E ☑ Ban Ki-Moon

37. Sam Mbakwe Airport is located in

A □ Owerri
B □ Enugu
C □ Awka
D □ Onitsha
E □ Abakaliki

38. Cable News Network popularly known as CNN was founded by

A □ Reese Schonfeld
B □ Time Warner
C □ Inonathen Klein
D □ Ted Turner
E □ Jimmy Jackson

39. Which of these 7 wonders of the world is still standing today?

A □ Temple of Artemis
B □ The Pyramids of Egypt
C □ The statue of Zeus
D □ The Hanging Garden of Babylon
E □ The Colossus of Rhodes

40. What is a compost?

A ☑ Decayed organic material
B □ Mailing Instruction
C □ Asignage
D □ A type of House
E □ An open Field

Handwritten notes:

Head – pride & dignity
Eagle – Strength
Greenway – Nature Niger & Benue
Cactus Spectabilies – Beauty of Nig
Motto: Unity & faith, peace & progress
Shield – fertile soil of Nig.

41. When did Nigeria record the peak level of production of 2.25 million barrels of oil/day?

- A ☐ 2005
- B ☐ 2002
- C ☐ 1985
- D ☐ 1979
- E ☐ 1998

42. When was the first shipment of 200,000 barrels of oil from the deep offshore Banga Field made?

- A ☐ 2001
- B ☐ 2005
- C ☐ 2004
- D ☐ 2006
- E ☐ 1998

43. Find the difference between the values of six in 12687 and in 21867

- A ☐ 9180
- B ☐ 660
- C ☐ 620
- D ☐ 540
- E ☐ 0

44. Which of these is not one of human senses?

- A ☐ Snell
- B ☐ Taste
- C ☐ Instinct
- D ☐ Hearing
- E ☐ Feeling

45. API means

- A ☐ African Petroleum Industry
- B ☐ American Petroleum Institute
- C ☐ Asian Petroleum Institute
- D ☐ African Petroleum Institute
- E ☐ American Petroleum Industry

46. The N1000.00 (One thousand naira) note has the pictures of

- A ☐ Vincent and Sanusi
- B ☐ Cirona and Isong
- C ☐ Mai-Bornu and Ogwumah
- D ☐ Ahmed and Vincent
- E ☐ Mai-Bornu and Isong

47. The last Presidential election in Nigeria was held on

- A ☐ 19th April 2003
- B ☐ 29th May 2003
- C ☐ 12th May 2003
- D ☐ 12th April 2003
- E ☐ 2nd May 2003

48. In automatic light controlled traffic intersection the timing of the amber is dependent on

- A ☐ Width of the road
- B ☐ The driver's perception time
- C ☐ The hourly traffic volume
- D ☐ Design speed of the road
- E ☐ All of the above

49. If X> Y and Z are positive numbers, which of the following relationships is not true

- A ☐ XZ> YZ
- B ☐ Z-X>Z-Y
- C ☐ X+Z>Y+Z
- D ☐ X/Z> Y/Z
- E ☐ None of the above

50. The importance of petroleum is not only as fuel and lubricant but also as a raw material for the production of the following

- A ☐ Naphta
- B ☐ Dyes
- C ☐ Asphalt
- D ☐ All of the above
- E ☐ None of the above

PART II

Part II

SECTION A: MATERIALS ENGINEERING

1. Maintenance is an important aspect of petroleum production in the oil industry. Describe the essential components of the maintenance of drilling equipment.

2. The lifespan of any gas pipeline depends principally on the maintenance scheme designed for such a system. Corrosion monitoring and inspection is one of the ways of detecting pipeline failure and recommending a control measure. Discuss the various aspects of corrosion monitoring of gas pipelines that you know.

3. Welding of unstabilized stainless steels with relative high carbon content often lead to "sensitization" and "weld decay". Describe how these phenomena arise.

4. Heat treatment is an important aspect of production engineering that is often neglected. Briefly describe the type of heat treatment that will be necessary for the production of a crank shaft with excellent structural integrity.

5. The factors affecting the selection of engineering materials cannot be viewed in isolation from one another. Discuss.

SECTION B: GAS PIPELINE ECONOMICS AND ENGINEERING: GAS ENGINEERING AND MANAGEMENT: HYDROCARBON ENTERPRISE

1. Discuss the rising profile of natural gas in the global energy mix.

2. Discuss the prospects and challenges of the proposed trans-Nigeria gas pipeline.

3. Discuss the problems of petroleum products distribution and marketing in Nigeria and suggest practical solutions to the problems you have highlighted.

4. Briefly discuss the role of the organization of Petroleum Exporting Countries (OPEC) in the global petroleum industry.

SECTION C: DRILLING AND WELL ENGINEERING: OIL AND GAS ENGINEERING: RESERVOIR ENGINEERING: PETROLEUM ENGINEERING

1. Discuss the role of a drilling engineer in the oil industry.

2. Discuss the role of Science, Engineering and Technology in oil and gas exploration and development.

3. Write an essay on the impact of directional drilling technique on the oil industry.

4. Discuss the characteristics and functions of drilling fluids.

SECTION D: REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM

1. Assess critically how an overseas scholarship award in your field of interest by the PTDF shall contribute to the goals and aspirations of the agency?

2. With appropriate examples, examine how remote sensing OR GIS has benefited from (and also contributed to) the development of any four (named) inter-relational scientific and/or technical disciplines.

3. Discuss the application of GIS and Remote Sensing to the recently concluded Census exercise in Nigeria.

4. Discuss how the analysis of remotely sensed data can aid formulation of a national policy on Agriculture.

SECTION E: INDUSTRIAL HEALTH AND SAFTEY AND ENVIRONMENTAL ENGINEERING

1. Using specific examples and illustrations assess carefully the impact of the Niger Delta wetland on the dominant industry in the region.

2. Environmental Impact Assessment of geo-resources projects should address adequately the health, economy, culture and safety of both project staff and the host communities. Examine this statement critically.

3. Write a proposal to the Chairman of your Local Government suggesting the adaptation of waste recycling measures to reduce environmental impact.

4. Write a reasoned essay on the prevention and monitoring of industrial accidents.

SECTION F: PETROLEUM GEOSCIENCES

1. Discuss the evidence for the inorganic origin of Petroleum

2. Write an essay on fifty years of oil and gas exploration and production in Nigeria

3. Assess the relevance of Subsurface Geology in Petroleum Exploration

4. Discuss the role of clay minerals in petroleum generation and migration.

SECTION G: GEOPHYSICS

1. Write an essay on the applications of geophysics in Forensic Science.

2. Persistent pavement failure is the bane of Nigerian highways. Discuss the relevance of geological/geophysical investigation in road failure investigation.

3. Geophysics is an effective tool in environmental impact assessment. Discuss.

4. Discuss the relevance of geophysics in subsurface investigation and imaging.

SECTION H: ENGINEERING GEOLOGY/HYDROGEOLOGY

1. Discuss the role of an Engineering Geologist in the feasibility study of a proposed new capital city.

2. Write an essay on geological/engineering geological investigation of highway road failure in a typical basement complex environment.

3. Discuss the various factors influencing the groundwater yield of water well sited in basement and sedimentary environment.

4. Write a proposal on the investigation of the impact of an ancient waste dump site located in a basement complex environment on the quality of the groundwater.

SECTION I: FACILITY ENGINEERING

1. Discuss the various classes of pumps and the basic operational principle of centrifugal pumps.

2. Discuss in detail, the various resources needed for the proper maintenance of facilities.

3. To date, many states and local governments in Nigeria have set up Mass Transit Organizations/Corporations. Discuss these organizations vis-à-vis the private operators, by highlighting the advantages and disadvantages; problems, etc of both methods. Make recommendations for the improvement of government owned transport companies.

4. Discuss the factors influencing the design and installation of a central air-conditioning system.

SECTION J: COMPUTER INFORMATION ENGINEERING

1. An important requirement of any information management system is to protect information against improper disclosure or modification. Describe in detail, three mutually supportive technologies used to achieve this goal.

2. One of the most notable trends in Information Technology today is the availability of affordable micros with powerful processors, large amounts of memory and the capacity to add boards that control sophisticated input/output devices. Discuss the potential business opportunities this trend might create.

3. Discuss the major advances that have been made in the last decade in research and development of systems that can understand spoken language.

4. With appropriate examples, describe the stages involved in Software Development Life Cycle.

5. Write an essay on the historical development of Microprocessor Technology.

SECTION K: SCIENCE

1. Discuss how Silicon has affected man.

2. Discuss how industries have affected the Nigerian ecosystems.

3. Write an essay on nanotechnology.

4. Should Nigeria embark on Space Science? Discuss.

Part III

SECTION L: PROCESS ENGINEERING

1. Briefly provide an analysis of what might be the impediment to rapid progress in the exploitation and development of the Nigerian bituminous sands while also providing possible ameliorative policy options.

2. Describe the present overall nature/status of one industry with highly intensive process engineering components in Nigeria and analyze the main processing sequence(s) of an important component aspect of the chosen industry.

3. Briefly write on the benefits and disadvantages of the Nigerian government's policy on privatization.

4. Briefly discuss the present and potential usefulness of the combination of satellite technology and information and communication technology to socioeconomic development.

PART III

SECTION A: MATERIALS ENGINEERING

1. State four precautions which should be taken to protect the eyes and skin of the welder and other workers exposed to radiation from arc welding operations.

2. Outline the four basic requirements for satisfactory welding.

3. List the various techniques employed for checking the structural integrity of pipelines without necessarily destroying them.

4. From the information given below list the correct order for the brazing sequence that should be carried out in the repair of a leaking copper or brass pipe.

   A. Brick in an enclosure to confine the heat
   B. Clean the mating surfaces with a file, emery cloth and hydrofluoric acid
   C. Wire patch securely in place
   D. Shape the copper patch to fit
   E. Heat with an acetylene torch but do not burn patch or piping.

5. Provide a list of the three fundamental physical laws and the names of their corresponding mathematical relations (equations) which, with the exception of relativistic and nuclear phenomena, apply to each and every flow independently of the nature of the fluid under consideration.

6. Water flows through a pipeline 60 m long at a velocity of 1.8 ms^{-1} when the pressure between the inlet and outlet ends is 25 kNm^{-2}. What increase of pressure difference is required to accelerate the water in the pipe at the rate of 0.02ms^{-2}? Neglect elasticity effects.

7. A horizontal pipe 15 cm in diameter and 4 m long is buried in the earth at a depth of 20 cm. The pipe-wall temperature is 75°C and the earth surface temperature is 5°C. Assuming that the thermal conductivity of the earth is 0.8 W/m.°C, calculate the heat lost by the pipe, given that the shape factor S of the arrangement is given by the equation:

$$S = \frac{2\pi L}{\text{Cosh}^{-1}(D/r)} \qquad \text{Sin } D < 3r$$

8. What is the composition of a water based drilling mud?

9. What are the five primary purposes of drilling mud in well engineering?

10. Discuss the merits and demerits of crushers.

SECTION B: GAS PIPELINE ECONOMICS AND ENGINEERING; GAS ENGINEERING AND MANAGEMENT: HYDROCARBON ENTERPRISE

1. A gas (comprising mainly methane) was passed through a turbo-expander. The pressure dropped from 800 psia to 200 psia. If the initial temperature of the gas was 60°F and each gas sample weighed 100lb, what was the outlet temperature?

2. Given the following cash flow for a small project:

Year 0	Year 1	Year 2	Year 3
-N2350000	N1000000	N1000000	N1000000

Calculate the net present value (NPV) of the project using 15% per annum discount rate.

3. 7.5 lb mole of ethane gas at 218 °F occupies a volume of 430 cu ft. Calculate the vapour pressure exerted by the ethane if it behaves as an ideal gas.

4. A marginal field operator has a 4 years lease on a pipeline facility at one million naira per month to the operator, how much should he offer to pay for the facility?

5. Estimate the API gravity of a sample of Bonny light crude oil having specific gravity (at 60/60) of 0.78 (water = 1.0).

6. 2.5 Bscf of natural gas has been produced by a Company from its gas field. Gas initially in place was estimated as 14.2 Bscf while recovery factor was established at 85%. If gas sells for N6.50/Mscf, how much revenue should the Company still expect from the field?

7. A pipeline discharges product into a storage tank. The tank has a height of 18.5 m and is filled with product of specific gravity 0.825. Estimate the pressure at the bottom of the tank.

8. An independent oil marketer purchases 25,000 tonnes of kerosene each year from a single supplier. At the moment the company obtains supplies in batch size of 800 tonnes. The cost of kerosene is N1600.00 per tonne. The cost of ordering a new batch from the supplier is N3200.00 and the cost of holding one tonne in stock due to certain logistic problems is N400 per annum plus an interest equal to 15% of the purchase price of the kerosene. Calculate the economic order quantity and the number of orders placed per year.

9. A pump delivers PMS of specific gravity of 0.72 at 150 M³/hr. If the viscosity of the PMS is 0.85 Centistokes and the pipeline diameter is 0.304 m estimate the Reynolds number of the flow system.

10. If the calorific value of natural gas is 54 MJ/kg, how much of the fuel do we need to burn in one hour to run a 100 KW power plant?

1. Given the following data for a simple Ramp well, estimate the along hole depth (ah.ss) expected to be drilled.

   Kick off depth = 900 ft. Target Depth = 8000 ft.ss. Target Drift = 1200 ft.
   Build up rate = 2 $\frac{1}{2}$ °/100 ft.

2. A well is to be cemented with a 50-50 pozzolan cement containing 4 per cent bentonite by weight of the mixture and mixed with a 6.25 gal of water per sack. The specific gravity of the cement is 3.14; of pozzolan, 2.46; and of bentonite, 2.65. Calculate the pounds of pozzolan per sack of the mixture.

3. A flowing well with 4000 ft of tubing in the hole exhibits a casing head pressure of 600 psig when the production rate is 100 b/d, and 350 psig when the production rate is 200 b/d. What is the productivity index of this well?

4. 10.5 lb/gal drilling fluid contains bentonite and fresh water. What is the volume percentage clay in the fluid if the density of the fresh water is 8.33 lb/gal and the specific gravity of bentonite is 2.45?

5. An oil well is producing at 1000 bbls/day. It has a productivity index of 5 stb/psi. What is the flowing bottom hole pressure if the static reservoir pressure is 3000 psia?

6. A well has a bottom hole temperature of 230 °F at 12,000 ft. Mean surface temperature is 80 °F. What is the temperature at 8000 ft?

7. 5.2 MMstb of oil has been produced from a reservoir. If the initial oil in place is given as 56 MMstb and recovery factor is 57%. Estimate the reserves.

8. The oil-water contact (OWC) of an oil reservoir was established at 8050 ft.ss. What is the capillary pressure in the oil zone 20 ft above the OWC if the reservoir oil density is 0.68 g/cc? Assume density of water is 62.4 psi/ft.

9. Given the following planimeter reading obtained for a reservoir, estimate the initial oil in place using the trapezoidal rule. Assume that porosity = 0.29, Swi = 0.23, Boi = 1.1098 rb/stb. Oil-Water contact is at -7200 ft.ss.

Contour (ft.ss)	Area (acres)
-7000	2.5
-7050	318.6
-7100	485.1
-7150	586.4
- 7200	801.5

10. A gas lift valve has bellows pressure of 850 psi at well conditions. The spring effect is 150 psi, while the tubing pressure opposite the valve is 260 psi. Calculate the valve spread given a port/bellows area ratio of 0.10.

SECTION D: REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM

1. List any five (5) sources of data for planning, management and development of Nigeria's geo-based resources presently. Examine the adequacy (or otherwise) of the most important of the sources to you.

2. How can remotely sensed images be adopted to monitor ocean bottoms around oil production areas in Nigeria.

3. Provide an integrated analysis of spatial and attribute data in geo information technological environment.

4. Discuss briefly the different types of spatial referencing systems.

5. Draw an illustrative diagram showing the components of a standard Radar Sensing System.

6. How has the internet aided our understanding of spatio-temporal characteristics of petroleum resources?

7. Compare and contrast (i) Nigeria-Sat and Euro-Sat (ii) SAR and RAR.

8. Use the diagram of a typical electromagnetic spectrum to depict the relationship between wavelengths and remote sensing systems.

9. Examine the significance of buffering in spatial data analysis.

10. Discuss the output media for remotely sensed and GIS products.

SECTION E: INDUSTRIAL HEALTH AND SAFTEY: ENVIRONMENTAL ENGINEERING

1. Provide a list of any five significant industrial safety regulatory agencies in your state currently. Discuss the activities of the most prominent of them.

2. Of what significance is weather in oil pollution abatement in Nigeria?

3. What are the health implications of CO_2-induced climate change over Nigeria?

4. Justify why urban waste management in Nigeria is yet to be solved using standard landfill sites.

5. Appraise the magnitude, causes and geographical distribution of oil pipeline fire incidences in Nigeria over the last century.

6. What are the basic industrial safety and health considerations of DPR's Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN) of 2002?

7. What mechanical methods can be used to remove spilled oil around oil wells and flowstations?

8. List and define the steps involved in the conduct of EIA in Nigeria.

9. Why are the Atlantic coastlines less susceptible to natural disasters than the Indian Ocean?

10. How have foreign multinational companies contributed to industrial safety, health and georesources development in Nigeria?

SECTION F: PETROLEUM GEOSCIENCES

In questions 1 - 3, choose the correct option to complete the statement.

1. Shales can act: (i) As source and reservoir rock for gas (ii) Only as source for gas (iii) Only as source for oil (iv) Only as reservoir for gas (v) Only as seal for oil.

2. Type III kerogen can: (i) Generate oil (ii) Generate oil and Gas (iii) Be described as hydrogen rich and oxygen poor (iv) Be described as fusain (v) Be sourced from algal mat.

3. Surface occurences of petroleum in Nigeria are: (i) Oil and bituminous shales (ii) Mud volcanoes (iii) Bituminous san dykes (iv) Disseminated deposits (v) Oil shales.

4. Authigenic clays can occur in sandstone reservoir rocks as:
    (i)............................... (ii)...............................
    (iii).............................. (iv)...............................

5. Distinguish between a simple cratonic basin and a cratonic extentional basin in terms of: (i) Dominant tectonics and basin shape (ii) Hydrocarbon potential (iii) Exploration strategy (iv) Typical examples.

6. Two traps A and B contain oil, generated from a single source rock. The oil in reservoir A has been altered (biodegraded) while that in B has been subjected to higher temperature due to increased depth of burial. Complete the Table below with reasonable values.

Parameter/Element	Oil A	Oil B
% S	3 - 4	....
% N	0.1	....
% O	....	1.5
API Gravity	20 - 30	....

7. Elemental analysis of a source rock sample shows the following composition:

H	15%
C	30%
O	40%
Ash	15%

    Characterize the organic matter in the sample using a Van Krevelen Diagram.

8. Reservoir sandstones of the Agbada Formation in the Niger Delta are described as undercompacted or weakly consolidated. What is the cause of this and how does it affect hydrocarbon production in the Niger Delta?

9. Briefly describe the genetic classification of oil field waters.

10. What do you understand by "Gas hydrate"?

SECTION G: GEOPHYSICS

1. What determines an electrode array in electrical resistivity method? Compare and contrast the Wenner and dipole dipole arrays.

2. An air-fill cavity within limestone can be delineated using the gravity and or magnetic method. Why is this so? Sketch the typical gravity anomaly over such geological feature.

3. Although the Self Potential (SP) geophysical method is designed for mapping of massive conductive sulphide mineralization, it has found useful applications in engineering site investigation and geothermal study. Give a comprehensive list of these applications.

4. An IP survey was carried out over a suspected N-S trending massive sulphide mineralization. Sketch the expected IP anomaly curve along a profile normal to the strike of the mineralized zone.

5. The table below represents the results of a frequency domain IP survey of a Precambrian Shield area for mineral deposit.
   For each measurement station calculate the Percentage Frequency
      (i)   Effect (PFE) and Metal Conduction Factor (MCF).
      (ii)   Plot the IP (PFE and MCF) against station position on separate graph paper and interpret accordingly.

Station Position (m)	0	20	40	60	80	100	120	140
$\rho_{dc}(\Omega m)$	101.5	86.2	72.8	49.8	44.0	95.8	114.9	120.7
$\rho_{ac}(\Omega m)$	100.9	85.2	70.1	46.6	41.4	91.7	114.1	120.1

6. Why are the electrical methods of geophysical prospecting particularly suited to hydrogeological investigations? Describe other geophysical methods that could equally be used stating the reasons why they are applicable.

7. Calculate the depth of electromagnetic fields with frequencies of 500 Hz and 2000kHz in:
   (a) wet sandstone with a conductivity of $10^{-1}Sm^{-1}$
   (b) massive limestone with a conductivity of $2.5 \times 10^{-4}Sm^{-1}$
   (c) granite with a conductivity of $10^{-6}Sm^{-1}$ (note $\mu_o = 4\pi \times 10^{-7}$).
   (d) How does the depth of penetration of electromagnetic field vary with frequency of prospecting?

8. Graphite creates one of the major interpretation pitfalls in the application of the electrical methods in the search for conductive metallic sulphide ores. How can this pitfall be resolved and what characteristic property of graphite is the most crucial?

9. A seismic wave is incident normally on a reflector with a reflection coefficient R of 0.01. What proportion of the incident energy is transmitted? What is the acoustic impedance contrast across the reflector like?

10. A single-ended refraction profile designed to determine the depth to an underlying horizontal refractor reveals a top layer velocity of 3.0 kms^{-1} and a refractor velocity of 5.0 kms^{-1}. The cross over distance is found to be 500 m. Derive the relevant equation and determine the refractor depth.

SECTION H: ENGINEERING GEOLOGY/HYDROGEOLOGY

1. What constitute the water resources of a nation?

2. Differentiate between primary and secondary porosity. What are the factors responsible for the development of secondary porosity in basement and sedimentary terrains?

3. A prospective landfill site must meet some hydrogeological and engineering geological selection criteria. Name any five of these criteria. What do you consider as the relevance of geophysical method(s) in landfill site investigation?

4. Write short notes on the following:
   - (a) Well-graded Soil
   - (b) Uniformly graded Soil
   - (c) Poorly or Gap graded soil
   - (d) Uniformity Coefficient

5. What are the aquifer units that are characteristic of an area underlain by basement complex rocks? What determines the storage capacity of such aquifer units?

6. Discuss the hydrogeological and engineering geological impact of excessive groundwater withdrawal in a typical coastal area such as the Victoria Island of Lagos.

7. Write short notes on the following:
   - (i) Consistency Limit
   - (ii) Liquid Limit
   - (iii) Plastic Limit
   - (iv) Plasticity Index

8. A sample of soil weighing 60 kg had a volume of $0.0366m^3$. When dried in an oven, its weight was reduced to 54.4 kg. The specific gravity of the soil was found to be 2.65. From the above stated data, calculate the following:
   - (a) Bulk Density
   - (b) Dry Density
   - (c) Percentage Moisture Content and
   - (d) Saturated Density.

9. A constant head permeameter test was conducted for approximately four minutes. The following results were obtained: the water collected during the duration of the test was 300 ml; the head difference in the manometers was 50 mm; the distance between the manometer tubes was 100 mm, which is also the same as the diameter of the sample chamber. Determine the coefficient of the hydraulic conductivity of the sample in ms^{-1}.

10. After one day of pumping a confined aquifer, the drawdown in an observation well at a distance of 97.5 m is 0.6 m and the drawdown in an observation well at a distance of 33.5 m is 1.1 m. If the pumping rate is $5.43 \times 10^3 \ m^3 \ day^{-1}$, find the storage coefficient of the aquifer.

SECTION I: FACILITY ENGINEERING

1. Two ships leave the same port at the same time, one sailing due northeast at 6 knots/hr and the other sailing due north at 10 knots/hr. Determine the distance between the two ships after sailing for 3 hr.

2. Given that

   $5x + 2y + 4z = 4$
   $3x - y + 2z = -11$
   $7x - 3y - 3z = 8$

   Determine x, y, and z.

3. A hangar door weighs 1200 kg and is supported on two rollers (Figure 1). The rollers have rusted, causing the door to slide along the track when moved. The door needs to be opened in an emergency by a materials handling equipment pushing horizontally at P. Determine the maximum distance d that will not cause roller A to leave the track, assuming the coefficient of friction between the rollers and the track to be 0.40.
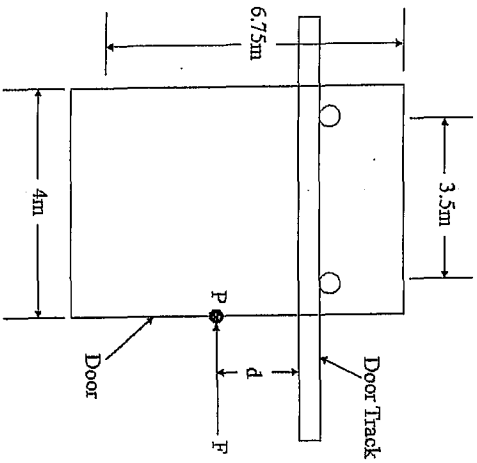

Figure 1: Hangar door on track

4. A circular disc of uniform density has a hole cut out of it, as shown in Figure 2. Determine the centre of mass of the disc.

5. A body moves so that the x-component of acceleration is given by the equation 6-t m/s^2 and the y-component of acceleration is given by 6+t m/s^2. Given that the initial x- and y-components of the velocity are both 2 m/s, determine the speed of the body at the end of 2 sec.
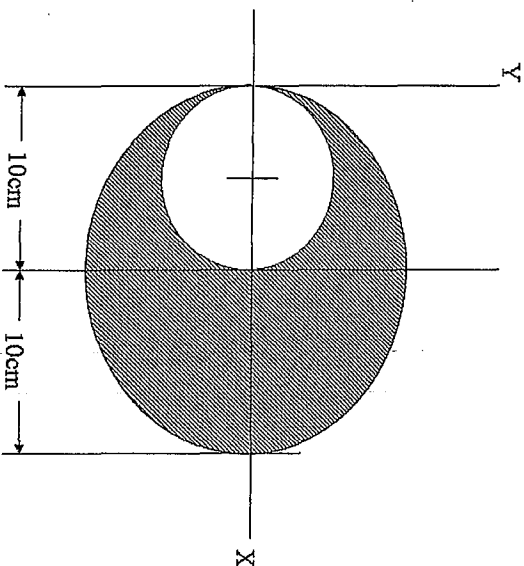

Figure 2: Circular disc with hole

6. Two 3-N masses are connected by a massless string hanging over a smooth frictionless peg. A third 3-N mass is added to one of the masses and the system is then released. Determine the increase in the force on the peg.

7. Two concentric cylinders of length L are loaded between rigid smooth plates as shown in Figure 3 below. The inner cylinder is copper and the outer cylinder is steel. Determine the stress in the copper cylinder given that:

   E_s = modulus of elasticity of steel
   E_c = modulus of elasticity of copper
   A_s = cross-sectional area of steel cylinder

A_c = cross-sectional area of copper cylinder
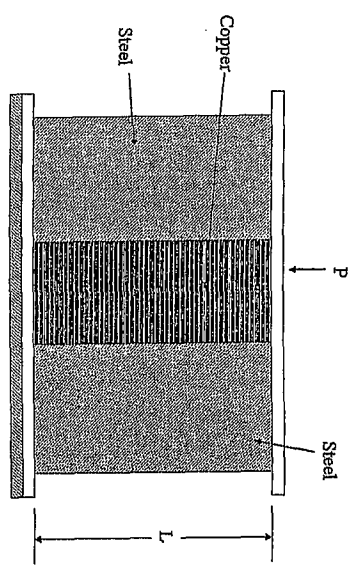
P = total applied load = $P_s + P_c$

Figure 3: Two concentric cylinders

8. A 15-cm I.D. pipe discharges water at an elevation 10 m below the surface of water in a reservoir. If the total head loss to the point of discharge is 5 m, determine the discharge rate in m^3/hr.

9. A 2-m diameter pipe has a depth of flow of 1.8 m. Determine the hydraulic radius for the depth of flow.

10. One end of a copper bar of cross-sectional area 4 cm^2 and length 80 cm is kept in steam at 1 atm. pressure. The other end is in contact with melting ice. The sides of the copper rod are insulated. Given that the thermal conductivity of copper is k = 420 J/m-sec^oC, and the specific latent heat of ice is 335 kJ/kg, determine the quantity of ice melted in 10 min.

SECTION J: COMPUTING INFORMATION ENGINEERING

1. Define the term "Artificial Intelligence" (5)

2. List FOUR major function of an operating system (5)

3. Perform the following subtraction using Twos complement notation:
   (i) $50_{10} - 30_{10}$ (ii) $111_2 - 01_2$ (iii) $01_2 - 111_2$

4. Determine the maximum memory capacity of an 8- bit microcomputer with 24bit address lines and hence determine the address of the last location in the memory. Express your answer in Hexadecimal.

5. Perform the following conversion
   (i) $30_{10} = (?)_2$ (ii) $350_{10} = (?)_{BCD}$ (iii) $45.65_{10} = (?)_2$

6. Distinguish carefully between "Database" and "Data warehouse" (5)

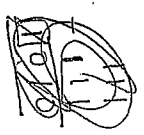7. Describe THREE Metrics used to qualify how reliable a computer is (5)

8. Define the term "Software Process". (5)

9. Give the full meaning of the following acronyms:
   (i) ASCII (ii) EBCDIC (iii) RAM (iv) BPS (v) UML (5)

10. Given a 2HD Diskette with the following specification:
    Number of tracks = 50
    Number of sectors/track = 15
    Maximum number of bytes/sector = 256
    Determine the memory capacity of the diskette. Express your answer in bits.

SECTION K: SCIENCE

1. In the case of an infinitesimal reversible process of stretching a wire, fibre or band, the change in the internal energy may be expressed by the equation given below:

   $$du = Tds + FdL.$$

   Where F is the force on the wire and L is the length.
   By suitable transformations, develop 3 other energy functions with different independent variables.

2. When rubber is unstretched, X-ray diffraction indicates an amorphous structure, whereas a crystalline structure is found upon isothermal stretching.
   Is $(\delta S/\delta F)_T$ positive or negative and why?

3. Interpret $\vec{A} \cdot (\vec{B} \times \vec{C})$ geometrically.

4. A force field in two dimensions is given by the vector $F(x,y) = 3x^2y\,\hat{i} + xy\hat{j}$.
   Evaluate the work done by this force field on a particle moved along the following path in the x-y plane.

   $$(0,0) \rightarrow (0,1) \rightarrow (1,1)$$

   along straight line segment and

5. Show that $(0,0) \rightarrow (1,1)$ along parabola $y = X^2$ points in the plane are denoted by (x,y).

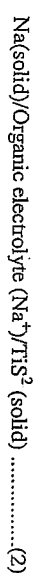6. The energy of a neutron is related to its de Broglie wavelength λ
   (i) Give the energy relation
   (ii) If the Mass of the neutron is $m_n = 1.675 \times 10^{-24}$ gm and it has an energy
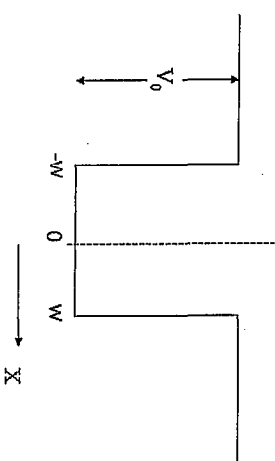
   $E \approx 0.08$ e V. What will be the value of λ

7. In a typical experiment for the measurement of the thickness of a grown SiO_2 film, the thickness of SiO_2 was estimated to be $270\,\overset{0}{A}$. Knowing that the refractive index of SiO_2 is 1.48, what is the value of $\Delta\lambda$? If in place of SiO_2 one had Si_3N_4 which has a refractive index of 1.97, for the same $\Delta\lambda$ calculate above, what will be the estimated thickness of Si_3N_4?

8. For a slab which is 0.3µm thick the measured absorbance at the wavelength of 300nm is 0.005632. What value of absorption coefficient does this correspond to?

9. A researcher is interested in comparing proposals for two solid state rechargeable batteries shown below. One of the criteria he wants to use is the emf developed, how is the emf related to ΔG of the electrode reactions. Where ΔG is the change in the Gibb's free energy.

   $$Na(liquid)/Na - \beta Al_2O_3/S \cdots\cdots (1)$$

   $$Na(solid)/Organic\ electrolyte\ (Na^+)/TiS^2\ (solid) \cdots\cdots (2)$$

10. With the aid of the given diagram, which represents a potential well in which an electron moves in one dimension

   Set up the appropriate boundary value problem that you will solve to obtain information on the motion of the electron in this potential well. (Hint: Set up the boundary conditions and appropriate equation of motion).

SECTION I: PROCESS ENGINEERING

1. An orifice meter having a diameter of 0.0566 m is installed in a 0.154 m diameter pipe through which oil having a density of 878 kg/m³ and a viscosity of 41cp is flowing. The measured pressure difference across the orifice is 93.2KN/m². Using the orifice equation calculate the volumetric flow rate in m³/sec.

Note: Orife equation is

$$V_2 = \frac{C_0}{\left[1-\left(\frac{D_2}{D_1}\right)^4\right]^{\frac{1}{2}}} * \left[\frac{2(P_1-P_2)}{\rho}\right]$$

Assume Co = 0.61

2. It is desired to use a centrifugal fan operating at an efficiency of 60 % to send 0.5663 kg/sec of air into a process. This quantity of air, which at rest and at a density of ρ_1 = 0.940kg/m³ enters the fan suction at a pressure of Pt = 741.7 mm Hg. It is discharged at a pressure of 769.6mmHg and a velocity of 45.7m/sec. Using the mechanical-energy balance equation, calculate the brake-Kw power needed.

Notes: (1) Mechanical-energy balance equation

$$Z_1 g + \frac{V_1^2}{2} + \frac{P_1}{\rho_1} - W_s = Z_2 g + \frac{V_1^2}{2} + \frac{P_2}{\rho_2} + \Sigma F$$

$$(\Sigma F = 0) \text{ and } Brake-Kw = \frac{-W_s^2 m}{\varsigma * 1000}$$

(2) 760 mmHg = 1 atm = 1.01325 N/m.

3. (i) Rich Cow's milk at 4.4°C is being pumped into a heat exchanger at the rate of 4536kg/hr and heated to 54.4°C using hot water as the heating medium. How much heat is supplied by the heat exchanger?

Note: average heat capacity of rich cow's milk is 3.85KJ/kg.°K

(ii) The purge stream from a given processing unit is composed of the following (and at the associated partial pressures):
.CH₄ (75mmHg) .N₂ (595mmHg)
.CO (50mmHg) .O₂ (26mmHg)

Calculate the mole fraction of CH₄ in the purge stream.

4. The power plant of a ship is designed for an outlet temperature of 7000K and sea water to provide cooling in the condenser. The ship regularly sails from Scotland (where the average sea-water temperature is 10°C) to the mediterania (sea-water temperature = 20°C). Assuming that power requirement W is the same throughout each voyage, estimate the increase in fuel consumption on a typical trip from Scotland to Mediterania.

Note:

(1) Thermal Efficiency/Conversion Ratio

$$\frac{W}{Q} = 1 - \left[\frac{T_{min}}{T_{max}}\right]$$

(2) Fuel consumption is proportional to heat supply.

5. Crude oil is pumped from an inlet pressure of 100KN/m² to an outlet pressure of 500KN/m². Given that the specific volume of a particular crude oil remains constant at 0.000lm³/kg and ignoring any changes in potential and kinetic energy, calculate the specific work input required by the pump.

6. A heat pump requires 2Kw of work to deliver 10Kw of heat to a building. How much heat is absorbed from outside the building and what is the co-efficient of performance of the heat pump?

7. Crude oil is pumped at a rate of 15.0kg/sec from a well 220 meters deep to a storage tank 20 meters above ground level. Calculate the attendant rate of increase of potential energy.

8. Steam at the rate of 500 kg/hr is used o drive a turbine. The steam enters the turbine at 44atm and at a linear velocity of 60 meters/sec and leaves at a point 5 meters below the turbine inlet at atmospheric pressure and a velocity of 360 meters/sec. The turbine delivers shaft work at a rate of 700Kw while the heat loss from the turbine estimated to be 104Kcal/hr. Calculate the enthalpy change per kg of steam associated with the process.

Note: 1. 500kg/hr of steam = 0.139kg/sec
2. 1kg.meter/sec² = 1N; 1 Joule = 1N.meter.
1 Joule = 0.239 x 10⁻³Kcal.

9. A power station burns 100 metric tons of a fossil fuel per hour. The heating value of the fuel is 7.76 X 10⁶ Joules/kg and the overall plant efficiency is 30%. What is the rated output of the plant?

10. The bottom of a crude oil storage tank leaks at a rate given by:

$$Q = 0.61S(2g\Delta P/\rho)^{\frac{1}{2}}$$

Where:

Q = rate of leakage, m^3/sec
S = cross-sectional area of the leak = $0.93 \times 10^{-6} m^2$
ΔP = driving pressure across leak, N/m^2
ρ = fluid density = 0.86 kg/m^3
g = 9.80m/sec^2

If the crude oil level in the tank is 40 m above the bottom, what is the rate of leakage in m^3/day?