National Exams December 2015

98-Pet-B3, Oil and Gas Evaluation and Economics

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.

2. This is a CLOSED BOOK EXAM.

3. Only and Approved Casio or Sharp non-programmable and non-communicating calculator is permitted.

4. The exam consists of a mix of short answer and multiple choice questions which cover general areas of knowledge about evaluation of oil and gas properties, and two spreadsheet questions to indicate a knowledge of basic economic evaluations related to future value and cash flow.

5. Distribution of marks for the four response areas: a) Short answer (7 questions worth 5 marks each, total 35); Multiple Choice (10 questions worth 4 marks each, total 40); Future Value (complete table total 5%); Cash Flow (complete table total 20%)

6. Short answer questions require written response of 2-3 sentences or a short list of response, please write clearly. Ten questions are provided, but only 7 are required, indicate the responses you want graded with an (*) beside the 7 responses, otherwise responses will be marked in the order they appear. If a formula is required it will be provided.

7. Multiple Choice. Circle the best answer on the sheet or list question numbers and letter responses separately.

8. Future Value complete the table to show the future value of the asset in each year.

9. Cash Flow complete the table all formulas required are provided as well as criteria for passing hurdle rate.

(35 marks)

Short Answer Questions – **ANSWER ONLY 7 OF THE 10 QUESTIONS** (5% each – Total 35%). If you answer more select the 7 you want to count with an (*).

1. List and generally describe four new types of unconventional gas resources being developed. (1 for each right; 1 extra for all four)

2. Describe three reasons why there are few consistent numbers for international oil and gas reserves estimates? (1.5 point each + 0.5 for getting all three)

3. What two countries are most affected by "Freehold Leases"? How are freehold leases different in the two countries? (1.5 for each country, 2 for the explanation of the difference)

4. Describe the four main historic energy transitions which have caused oil prices to peak and describe why transitions cause prices to spike? (1 for each transition + 1 for reason)

5. Using the formula and information provided below calculate the oil resource in place for a conventional reservoir. (5 marks)

   $N = VR \times \Phi \times 1/B_o \times (1-S_w)$

   N = oil in place (m^3)

   Area of the reservoir – 40 km2

   Average pay thickness – 20 m

   Porosity – 10%

   Formation volume factor – 0.9 m^3/stm^3)

   Water saturation – 15%

6. List 3 oil quality factors which affect crude prices and why these make heavy oil prices lower than light oil. (1 point each factor + 2 for explanation)

7. Explain 3 ways in which Steam-Oil-Ratio (SOR) might impact capital costs for thermal oil sands or heavy oil project. (1.5 for each reason + 0.5 for 3)

8. Give at least two reasons why CO_2 Enhanced Oil Recovery (EOR) may more attractive in the U.S. than in Alberta, Canada.

9. Describe tornado and spider diagrams that are two useful tools for displaying economic sensitivities. (2.5 each)

10. Describe the three classifications of conventional gas reserves based on the condition of the gas in the reservoir? (1.5 for each, 0.5 for all three)

(40 marks)

Multiple Choice Questions – ANSWER All QUESTIONS (4% each – Total 40%) Circle the letter representing the correct answer.

1. The role of property evaluation is to........... (Complete the sentence)
    a. To set an economic value on an oil and gas property
    b. To determine the size of the reserves in a given reservoir
    c. To determine the next best energy sources to develop
    d. To facilitate turning resources into reserves
    e. To calculate the after tax benefits of developing a property

2. What region contains most of the World's proved conventional gas reserves?
   a. Middle East
   b. Asia Pacific
   c. North America
   d. Europe and Eurasia
   e. None of the above

3. Which country is not an exporter of hydrocarbon resources?
   a. Russia
   b. Australia
   c. Japan
   d. Nigeria
   e. Brasil

4. Which is the best description of "effective oil in place" for the oilsands?
   a. Only the in-situ bitumen which might be heated
   b. Only the bitumen in deposits over 10 m thick
   c. Bitumen deposits which have some recovery assigned to them
   d. All bitumen which is in thick zones which cannot be mined
   e. Amount of production which can be produced at a SOR < 5

5. Why aren't traditional economic calculations including projections of inflation, exchange rates, time value of money and taxes not used as much today as they were in the past?
   a. Not required to prioritize projects
   b. Detailed financial information is too proprietary to share widely
   c. Oil and gas prices are changing too quickly
   d. Very difficult to get agreement on future economic environment
   e. All of the above

6. What factors are caused global natural gas prices to diverge in the last 3-4 years?
   a. Lack of gas pipelines and LNG terminals on the west coast of North America
   b. Development of shale gas resources in North America
   c. Shutdown of nuclear reactors in Japan
   d. Economic downturn
   e. All of the above

7. What are the most numerous sources of CO_2 used for EOR in the U.S.?
   a. Refineries and ethanol plants
   b. Natural CO_2 reservoirs and refineries
   c. Fertilizer plants and gas plants
   d. Power plants and coal gasification plants
   e. Natural CO_2 reservoirs and gas plants

8. What are the two main GHG emissions from upstream oil and gas operations?
   a. Nitrogen and carbon dioxide
   b. Hydrogen sulphide and ethane
   c. Carbon dioxide and methane
   d. Sulphur dioxide and methane
   e. None of the above

9. What term below means the same as "Associated Gas"?
   a. Gas that is dissolved in oil
   b. Gas that is adsorbed onto coal or shale
   c. Gas that is contained in a gas cap
   d. Free gas found in a gas hydrate deposit
   e. None of the above

10. Which of the following is not a capital cost category for oil and gas production?
   a. Lease facility costs
   b. Drilling and completion costs
   c. Land acquisition costs
   d. Central gas plant processing fees
   e. Flowline and gathering system costs

(5 marks)

Complete the Future Value Table below to determine the minimum sales price for the asset to realize the desired Hurdle Rate at the time it is to be sold in the next 10 years. (5% - .5% for each correct column; 3% for correct answer)

Problem Statement

Company buys a shale gas property for $50,000,000
In years 3, 6 and 9 they undertake drilling projects each cost $10,000,000 of additional investment in those years
Desired Hurdle Rate for Sale after 10 years is 15% (Ignoring inflation and taxes)
What is the value the property must have to achieve the hurdle rate?

Year	Investment (k$)	Cumulative Investment (k$)	Cumulative Expected Value (k$)	Value added for end of Year @ 15% (k$)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Minimum to meet Hurdle Rate $ - k$

Column

1 Year of investment at start of year --> sometimes shown as time zero
2 Annual investment at start of each year
3 Cumulative Investment = total af inputs without interest
4 Expected value at the start of each year = Expected Value at start of previous year + return earned at tend of previous year
5 Return at end of current year = Cumulative Expected Value * Hurdle rate/100

(20 marks)

Complete the Cash Flow Table below (20% - 1 mark for each correct column, 3 marks for payout, 3 marks for ROI, 3 marks for hurdle rate yes or no) **See description of columns on last page**

Cash Flow for Oil

(Ignoring Taxes and Inflation)

Problem Statement:

Shale oil well cost to drill, fracture and tie-in = $10,000,000
Working Interest = 50%
Gross Production = Average 500 barrels of oil per day (BOPD) in year 1 declining by 30%/yr
Royalty rate = 5%
Oil Price = $50 in year one increasing by $10/yr
OPEX = 15% of Capital in year 1, increasing by 10% per yr
Hurdle Rate = 10%

NB Show all values to the nearest k$ (thousand dollars)

1. Show cash flows for this investment for the WI owner for initial 4 years
2. Does the investment meet the Hurdle Rate with these assumptions? Yes or No
3. What is the return on investment for the initial capital investment?
4. **What is the approximate payout?**

1	2	3	4	5	6	7	8	9	10	11	12
Year	Annual Gross Production (bbls)	Working Interest Share (bbls)	Royalty Interest (bbls)	Net Production (bbls)	Oil Price ($/bbl)	Production Revenue (k$)	Capital Costs CAPEX (k$)	Operating Expenses OPEX (k$)	Net Production Income (k$)	Cumulative Net Income (k$)	Hurdle Rate = NPV @ 10% (k$)
1											
2											
3											
4											
Totals											

Economic Indicators

Payout — Years: ____

Return on Investment (ROI) = (cum income)/(total investment) — ROI = ____

Colums 12-1: $P=F*(1/(1+i)^{(n-1)})$ = Discounted value of future revenue F, at a discount rate of I, after n periods

Hurdle Rate Condition Met when **(12) > (8)**

Is the Hurdle Rate Met for this investment? ____ Yes or No

Explanation of Columns for the Conventional Oil Spreadsheet

Columns:

2	Annual Gross Production = Production measured at the wellhead
3	Working Interest Share = Producers share of operating interest in the well production = (2)*(Working Interest)
4	Royalty Interest = Production that is paid to the owner of the mineral rights = (3)*Royalty Rate
5	Net Production = Producers share of the production from the well = (3) - (4)
6	Oil Price = Price of oil expected in a forecast or actual average received over the year
7	Production Revenue = Revenue from oil sales = (5) * (6)
8	Capital Costs = Producers share of capital expenditures in the year = Total capital * WI
9	Operating Expenses = Producers share of operating costs in the Year = Total operating * WI
10	Net Production Revenue = Net revenue received by the producer = (7) - (8) - (9)
11	Cumulative Net Revenue = Running balance of revenues vs. Investment
12	Net Present Value $P=F*(1/(1+i)^{(n-1)})$ = Discounted value of future revenue F, at a discount rate of I, after n periods

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Marking Scheme

Short answer questions – 35 marks total, 5 marks each for 7 out of 10 questions.

- Breakdown of grading varies with the question and is shown on the exam sheet.

Multiple Choice – 40 marks total, 4 marks for each of 10 questions

Future Value Calculation – 5 marks

- Marks are given by correct column (4 x 0.5 marks) as well as 3 marks for the correct overall answer

Cash Flow Calculation – 20 marks

- Marks are given by correct column (11 x 1 mark) as well as 3 marks for correctly indicating payout term (<X years); 3 marks for calculation of return on investment; 3 marks for determining if the defined hurdle rate conditions are met