



PETE 693—WELL STIMULATION, Spring 2014
Instructor: Dr. Dare Awoleke

PART A—Final exam, Friday, 9th May, 2014

Duration: 8:00—9:00am

Instructions

- **Closed book. Closed notes.**
- **Write your answers in this booklet. You might want to use a pencil just in case of erasures.**
- **You need writing material and a simple calculator.**



8. **(1 point)**What is the most important parameter we can get from a minifrac?

Sandstone and carbonate acidizing (40 points)

9. **(1 point)**An acid treatment is called 'matrix' treatment because it is injected at pressures _____ the parting pressure of the formation.
10. **(1 point)**Which one(s) of the following reactions can result in the formation of insoluble precipitates
- Calcium carbonate and HF
 - Calcium carbonate and HCl
 - Quartz and HCl
 - Quartz and HF
11. **(1 point)**The gravimetric dissolving power of 100% HCl is 1.37 lbmCaCO₃/lbm HCl. What is the gravimetric dissolving power of 3% HCl?
12. **(3 points)**Mention 3 factors you think can affect the rate of acid reaction with minerals.
13. **(1 point)**Why does HF react faster with clay than with quartz?
14. **(2 points)**In sandstone acidizing, the acid is transported to the mineral surfaces by _____ and _____
15. **(2 points)**If you had a choice, would you shut in a well after pumping a sandstone acid treatment or would you flow it back immediately. Give your reasons.
16. **(3 points)**How would you decide on an acid choice in sandstone acidizing?



17. **(2 points)** You pump an acid system into a core during a coreflood. After pumping the acid, for the same flow rate, the pressure drop across the core increased by 100%. Would you recommend your company pump this acid system? Give your reasons.
18. **(1 point)** In the 2-mineral model, the minerals are lumped into _____ and _____ minerals.
19. **(1 point)** Successful acid treatments in sandstones treat _____ (shallow, deep) and _____ (mild, severe) formation damage.
20. **(1 point)** You suspect the reservoir is plugged with calcium carbonate particles. What acid would you recommend to remove this source of impairment.
21. **(1 point)** Sandstone acid treatments increase _____. Because of this, _____ increases too and we get increased productivity.
22. **(1 point)** In an injection well, what is the mathematical relationship between tubing head pressure, bottomhole pressure, hydrostatic and frictional pressure.
23. **(1 point)** What did Paccaloni recommend regarding injection rate?
24. **(1 point)** What did the Zhu and Hill model for skin factor evolution during sandstone acidizing account for?
25. **(1 point)** What is diversion?
26. **(1 point)** Suggest a situation where you would recommend the use of buoyant ball sealers?



27. **(1 point)**What are the constituents of foam?
28. **(1 point)**Wormholes form when _____ (large,small) pores grow at a rate substantially higher than the rate at which _____ (large, small) pores grow.
29. **(2 points)**Use a graph to illustrate the relationship between the PVbt and interstitial velocity in carbonate acidizing.
30. **(3 points)**If injection rate is 2 barrels per minute, what is the interstitial velocity (ft/min) at the wellbore if $r_w = 0.328\text{ft}$, $h = 50\text{ft}$ and porosity=0.2.
31. **(2 points)**What transport mechanisms determine acid penetration in acid fracturing.
32. **(1 point)**True or False. A fracture that is uniformly etched with acid will have excellent conductivity after closure stress is applied.
33. **(1 point)**True or False. Reaction of limestone with HCl is temperature independent.



34. **(4 points)** What does each term of the equation shown below represent?

$$\frac{\partial C}{\partial t} + \frac{\partial(u_x C)}{\partial x} - \frac{\partial(u_y C)}{\partial x} - \frac{\partial}{\partial y} \left(D_{eff} \frac{\partial C}{\partial y} \right) = 0$$

Bonus questions

35. What does plain strain mean to you in the context of the KGD and PKN models? **(2 points)**

36. Why do cracks grow under small external stresses? **(2 points)**

37. Central to Griffith's idea is the hypothesis that when cracks spread in a material without the application of external stress, the increased surface energy of the grains in the newly formed fracture surfaces balances the decrease in the strain energy of the material. What does this mean to you? **(2 points)**