

Using The Practice Final Effectively

This practice final exam contains **actual questions** that have been asked on one of my final exams in a previous quarter. This can be a useful studying tool if used properly.

Important notes about the practice exam:

- This practice final should not be the only studying tool you are using, because **the practice exams only show a small subset of the possible questions that could be tested.**
- At this point, you have hundreds of practice problems that you can look back on to get additional practice, between reworking lecture examples, book problems, and questions from the practice quizzes and exams you looked at earlier in the quarter.
- **Work the recommended book problems** to make sure that you fully understand all of the concepts that might be on the actual exams.
 - You need to be able to **explain why every step is done** in solving all of the recommended book problems (**without looking at the solutions**). Do not memorize the answers – this will not work.
 - Work problems multiple times to build skill and efficiency (but do not memorize).
- **The actual final will contain questions that differ from the practice final. They are not necessarily any easier or harder; they are just different.**
 - It would be pointless to give an exam with the exact same questions as the practice, because it would mean the exam is testing your memorization skills instead of your actual understanding of the material.
 - **To prepare for this, make sure you understand how to do all of the recommended book problems as discussed above.**

What this practice exam is intended to do:

- Help you diagnose general areas of strength/weakness and determine what you need to spend more time studying before the exam
- Allow you to check if you are answering questions quickly enough to complete the actual exam within the time limit
- Give you an idea of the general format of a multiple-choice exam

While taking the exam:

- Take this with a **3 hour time limit**, including the time it would take you to fill out a parscore
- **Do not use any outside notes or help**
- Do not look at any of the answers until you have completed the entire exam

After you complete the exam, check your answers against the key. For any problems you miss:

- Go through the worked-out solutions to see how to answer each question correctly
- **Make sure you understand why every step is done** in solving the problems you miss
- **Rework book problems** that are related to the questions you missed. This will help to strengthen your understanding of the topic. Without this, you will not gain a full understanding of the topic and risk missing similar questions on the actual exam.

Name: _____
Last Name First Name

First Letter of your last name: _____

Perm Number: _____

Instructions: No hats or hoods allowed. No books or notes allowed. No sharing of calculators. Cell phones, iPods, headsets/headphones, and any other electronic devices must be turned off and put away. If you are using a cell phone or any unauthorized electronic device during the exam, your score for the exam will be a zero.

There are a total of 16 pages (40 questions) on the exam. Not every question is worth the same number of points-- point values are indicated for each question.

Carefully bubble in your Perm number, form letter, and answers on your ParSCORE form. Fill in all bubbles completely.

You must show photo ID (preferably your Access Card) when you turn in your exam and ParSCORE form.

1. Which of the following statements is/are incorrect?

I. MgCl_2 is called magnesium chloride ✓

II. ZnO is called zinc(II) oxide ✗

III. CoS_2 is called cobalt(II) sulfide ✗

(IV)

- a) I only
b) II only
c) III only
d) II and III
e) I, II, and III

D

2. Which is the most polar bond?

- a) C-F
b) N-F ✗
c) O-F ✗
d) F-F ✗

A

3. One mole of a compound is added to a liter of water, producing 3 moles of ions in solution. What is the identity of the compound?

- a) AgNO_3 ✗ 2
- b) MgF_2 ✓ 3
- c) CaBr_2 ✓ 3
- d) FeCl_3 ✗ 4
- e) more than one of these

E

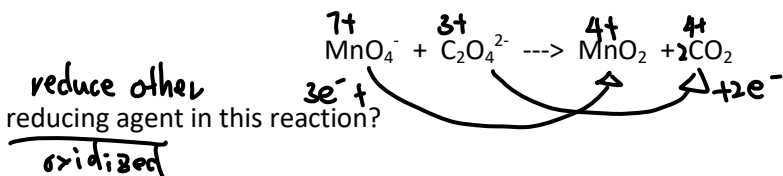
4. Which pair of symbols corresponds to two isoelectronic species?

- a) $^{32}_{16}\text{S}$ and $^{27}_{13}\text{Al}$ ✗
- b) ^7_3Li and $^{23}_{11}\text{Na}$ ✗
- c) $^{40}_{20}\text{Ca}^{2+}$ and $^{51}_{23}\text{V}^{5+}$
18 18
- d) $^{56}_{23}\text{Fe}^{3+}$ and $^{52}_{24}\text{Cr}^{6+}$ ✗

C

e) more than one of these answers is correct.

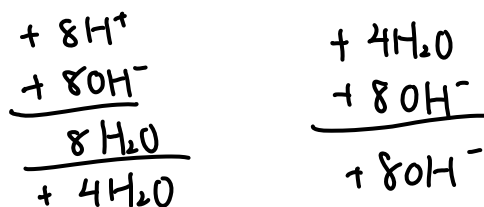
Questions 5 & 6. Consider the following unbalanced oxidation/reduction reaction that takes place in a basic solution.



5. What is the reducing agent in this reaction?

- a) MnO_4^-
- b) MnO_2
- c) $\text{C}_2\text{O}_4^{2-}$
- d) CO_2
- e) none of these

C



6. What is the coefficient in front of H_2O when this equation is balanced with lowest whole number coefficients?

- a) 4
- b) 8
- c) 6
- d) 2
- e) none of these

A

7. Identify the atom with the electron configuration $[\text{Ar}]4s^23d^5$

- a) Cr
- b) Mn
- c) Tc
- d) Ru
- e) Br

B

8. Which of the following orbital designations is not possible?

- a) 4s ✓
- b) 2p ✓
- c) 4d ✓
- d) 2f ✗

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$

D

e) more than one of these orbital designations is not possible

9. Which of the following atoms has exactly two unpaired electrons?

- a) Be ✗
- b) N^{2-} ✗
- c) Al^+ ✗
- d) S ✓

D

e) more than one of these has exactly two unpaired electrons

10. Determine the maximum number of electrons that can have the quantum numbers $n = 3, m_s = +1/2$

- a) 3
- b) 6
- c) 9
- d) 18
- e) 1

C

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$

11. Which of the following has the largest radius?

- a) Br^-
- b) Kr
- c) Rb^+

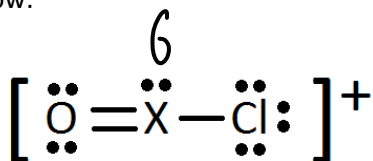
$\frac{36}{35}$

$\frac{36}{36}$

$\frac{37}{38}$

A

12. Consider the Lewis structure shown below:



Element X must belong to which group of the periodic table?

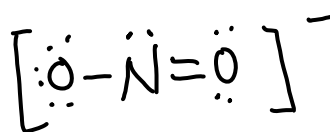
- a) Group 1A
- b) Group 5A
- c) Group 6A
- d) Group 7A
- e) Group 8A

C

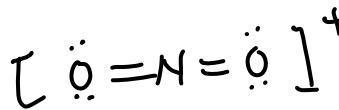
13. Consider the ions NO_2^- and NO_2^+ . Which ion has the longest bond lengths between nitrogen and oxygen?

- a) NO_2^-
- b) NO_2^+
- ☒ c) NO_2^- and NO_2^+ have the same bond lengths between nitrogen and oxygen
- d) more information is needed

A



$$\frac{3}{2}$$



$$\frac{4}{2}$$

14. In the Lewis structure for the molecule NOF, how many lone pairs are on the nitrogen atom, and what is the formal charge on the nitrogen atom?

- a) 2 lone pairs, formal charge = -3
- b) 0 lone pairs, formal charge = +1
- c) 1 lone pair, formal charge = 0
- d) 2 lone pairs, formal charge = -1
- e) 1 lone pair, formal charge = -3

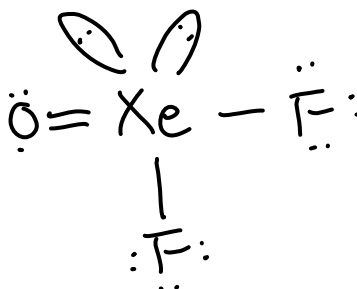
C



15. What is the molecular structure of OXeF_2 ? Xe is the central atom.

- a) Trigonal bipyramidal
- b) Tetrahedral
- c) See-saw
- d) T-shaped
- e) Octahedral

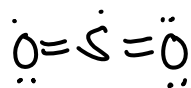
D



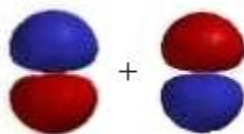
16. Which of these will the largest bond angle?

- a) NH_3
- b) CH_2O
- c) SO_2

B



17. When the following atomic orbitals overlap, what type of molecular orbital will be formed?



???

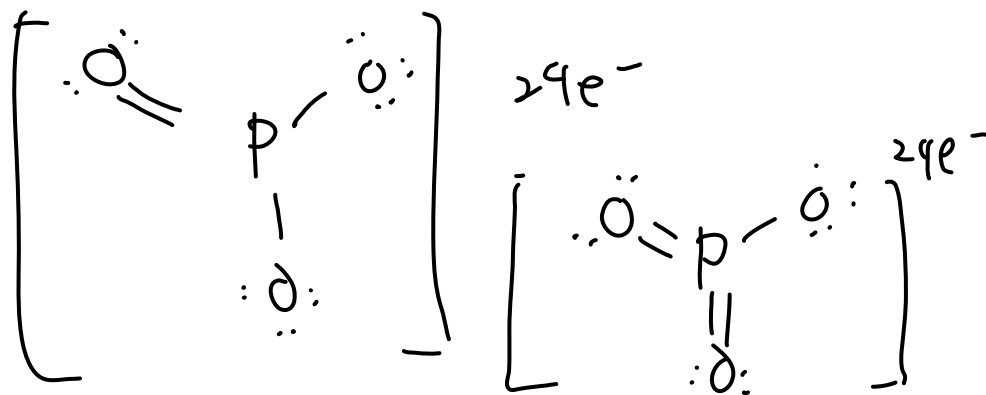
- a) σ^*
- b) π^*
- c) σ
- d) π

D

18. Which of the following is polar?

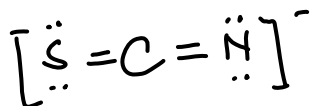
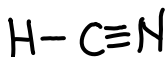
- a) BCl_3 ✗
- b) PO_3^- ✗
- c) PCl_3 ✓
- d) PF_5 ✗
- e) More than one of these

C



19. Rank HCN , SCN^- , and CH_3NH_2 in order of increasing C-N bond length

- a) $\text{HCN} < \text{SCN}^- < \text{CH}_3\text{NH}_2$ ✗
- b) $\text{SCN}^- < \text{HCN} < \text{CH}_3\text{NH}_2$ ✗
- c) $\text{CH}_3\text{NH}_2 < \text{SCN}^- < \text{HCN}$
- d) $\text{CH}_3\text{NH}_2 < \text{HCN} < \text{SCN}^-$
- e) $\text{SCN}^- < \text{CH}_3\text{NH}_2 < \text{HCN}$ ✗

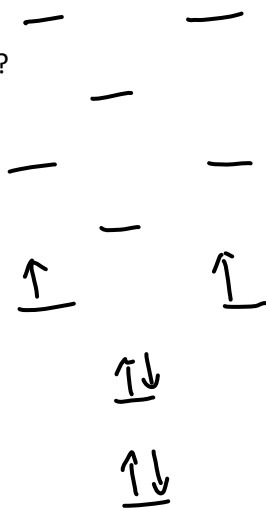


C

20. What is the predicted bond order of Li_2^- ?

- a) 0
- b) 0.5
- c) 1
- d) 1.5
- e) 2

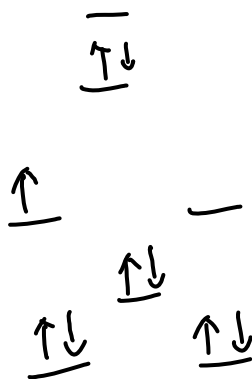
C



21. Which of the following is paramagnetic?

- a) H_2
- b) NO^+ (fills like N_2) ✓
- c) B_2
- d) More than one of these
- e) None of these

B



22. In which of the following molecules will the central atom have dsp^3 hybridization?

- a) SF_4^{2-} d^2sp^3
- b) SCl_4 ✓
- c) CCl_4 ✗
- d) SF_6 ✗
- e) More than one of these

B

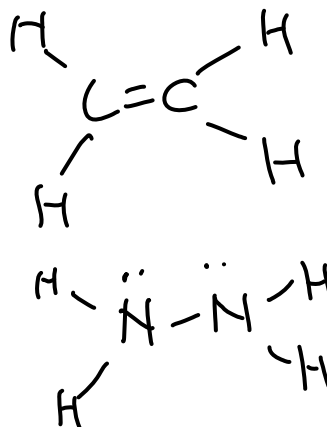
5

23. How many of the following molecules have all of their atoms in the same plane? BF_3 C_2H_4 N_2H_4 SO_2 ✓

✓ ✗ ✗

- a) 0
- b) 1
- c) 2
- d) 3
- e) 4

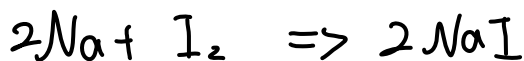
C



24. 35.0 grams of sodium reacts with 163.0 grams of iodine to form 53.8 grams of sodium iodide. The molar mass of sodium iodide is 149.89 g/mol. What is the percent yield for this reaction?

Na I

- a) 27.9%
- b) 23.9%
- c) 35.9%
- d) 100.0%
- e) none of these



I_2 limiting 1.2844 NaI produced

A

$$1.2844 \times 149.89 = 192.5$$

$$\frac{53.8}{192.5} = 27.9\%$$

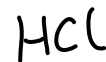
25. 115.3 mL of a 4.40 M potassium bromide solution is diluted to 1.5 L. What is the molarity of the diluted solution?

KBr

- a) 0.338 M
- b) 0.507 M
- c) 338 M
- d) 5.07 M
- e) none of these

$$\frac{0.1153 \times 4.4}{1.5} = 0.338$$

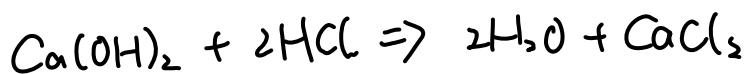
A



26. How many milliliters of 0.5 M calcium hydroxide are required to neutralize 25 mL of 0.8 M hydrochloric acid?

- a) 40. mL
- b) 25 mL
- c) 20. mL
- d) 10. mL
- e) none of these

C



$$\frac{25 \times 0.8}{2} = 0.5 \times V$$

$$V = 20$$

27. Which compound has the greatest number of oxygen atoms in a 100. gram sample?

- ~~a) MgO~~
- ~~b) HCH₃COO~~
- c) CO₂
- ~~d) C₆H₁₂O₆~~
- e) more than one of these

C



28. A mixture of gas contains 20 grams of oxygen gas and 83 grams of methane (CH₄) gas. If the total pressure is 850 torr, what is the partial pressure of oxygen gas?

- a) 91.5 torr
- b) 165 torr
- c) 102 torr
- d) 531 torr
- e) none of these

$$\frac{20}{32} = 0.625 \text{ mol}$$

$$\frac{83}{16} = 5.1875 \text{ mol}$$

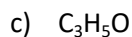
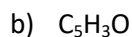
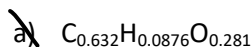
A

29. Elemental analysis of a compound shows that it is 63.2% carbon, 8.76% hydrogen, and 28.1 % oxygen by mass.

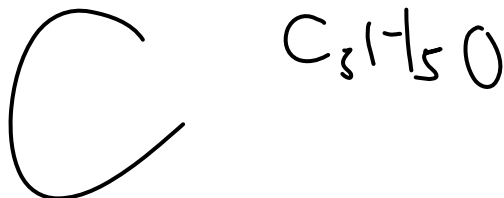
What is the empirical formula of the compound?

$$5.26667 : 8.76 : 1.75625$$

$$3 : 8 : 1$$



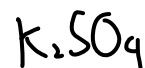
e) none of these



$$0.125 \times 0.5$$



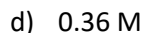
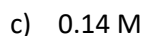
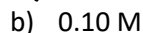
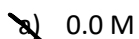
$$0.05 \times 0.9$$



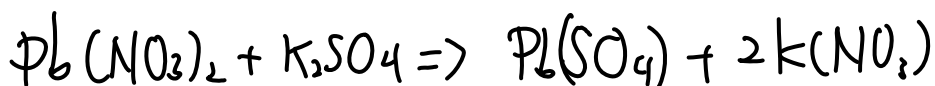
30. 125 mL of a 0.50 M solution of lead(II) nitrate is mixed with 50. mL of a 0.90 M solution of potassium sulfate. What is $[Pb^{2+}]$ in solution after the reaction has gone to completion?

$$0.25 \text{ mmol}$$

$$45 \text{ mmol}$$



e) none of these

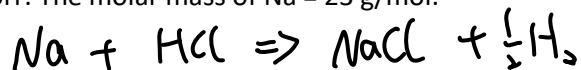


$$17.5 \text{ mmol left} \Rightarrow 0.1$$

B

Na

31. Sodium metal is reacted with excess aqueous HCl to form aqueous NaCl and H₂ gas. If 432 mL of H₂ is collected over water at 25°C and a total pressure of 763 torr, how much sodium reacted? Assume ideal gas behavior. The vapor pressure of water at 25°C is 23.8 torr. The molar mass of Na = 23 g/mol.



- a) 9.4 g
b) 0.82 g
c) 0.79 g
d) 0.40 g
e) none of these

C

$$\text{H}_2: \frac{(763 - 23.8)}{760} \times \frac{432}{1000} = n \times 0.08206 \times (25 + 273)$$

$$n = 0.01718 \text{ mol}$$

$$0.01718 \times 2 \times 23 = 0.79$$

32. A sample of an unknown gas diffuses at half the rate of helium. What is the density of the unknown gas at STP? Assume ideal gas behavior.

- a) 16 g/L
b) 0.83 g/L
c) 0.045 g/L
d) 0.71 g/L
e) none of these

D

$$\sqrt{\frac{4}{x}} = \frac{1}{2}$$

$$\frac{4}{x} = \frac{1}{4} \quad x = 16 \text{ g/mol}$$

$$101 \times 1 = n \times 8.31 \times 273$$

$$n = 0.04452$$

$$0.04452 \times 16 = 0.71$$

33. At what temperature is the average speed of O₂ equal to half the average speed of Ne at 25°C?

- a) -154°C
b) -124°C
c) 119°C
d) 12.5°C
e) none of these

A

$$\sqrt{\frac{8RT}{\pi \times \frac{32}{1000}}} = \frac{1}{2} \sqrt{\frac{8RT_1}{\pi \times \frac{20}{1000}}} \quad 279.5$$

$$\sqrt{\frac{T}{32}} = \frac{1}{2} \sqrt{\frac{278}{20}}$$

$$\frac{T}{32} = \frac{1}{4} \times \frac{278}{20}$$

$$T = 118.13 \text{ K}$$

$$T = -154^\circ \text{C}$$

34. Silver has two stable isotopes, ^{107}Ag (mass = 106.907 amu) and ^{109}Ag (mass = 108.910 amu). What is the abundance of ^{107}Ag ? Note: you must use 107.868 amu as the average molar mass of silver.

- a) 52.0%
- b) 37.6%
- c) 48.2%
- d) 0.00%
- e) 62.4%

$$100 \times 107.868 = 106.907 \times x + 108.910 \times (100 - x)$$

$$10786.8 = 10891 - 2.003x$$

$$x = 52\%$$

A

35. Calculate the de Broglie wavelength of a sulfur atom traveling at 2.39×10^5 m/s.

- a) 8.65×10^{-38} m
- b) 8.65×10^{-41} m
- c) 1.44×10^{-61} m
- d) 5.21×10^{-14} m
- e) 5.21×10^{-17} m

$$\lambda = \frac{6.626 \times 10^{-34}}{\left(\frac{32}{1000} \times N_A\right) \times 2.39 \times 10^5}$$

D

36. In the hydrogen atom spectrum, an emission line is observed at a wavelength of 1282 nm. If this line corresponds to an electronic transition to a final state of $n = 3$, what was the initial state? Note: $1 \text{ nm} = 10^{-9} \text{ m}$.

- a) 6
- b) 4
- c) 5
- d) 2
- e) none of these

$$\frac{h \times c}{1282 \times 10^{-9}} = 2.18 \times 10^{-18} \times 1^2 \left(\frac{1}{9} - \frac{1}{n_f^2} \right)$$

$$0.07112596 = \frac{1}{9} - \frac{1}{n_f^2}$$

$$n_f = 5$$

C

37. When a photon with a wavelength of 323 nm strikes the surface of a metal, an electron is ejected with a kinetic energy of $2.4 \times 10^{-19} \text{ J}$. What is the binding energy of the metal, in units of kJ/mol?

- a) $3.8 \times 10^{-22} \text{ kJ/mol}$
- b) $6.2 \times 10^{-46} \text{ kJ/mol}$
- c) 370 kJ/mol
- d) 144 kJ/mol
- e) 226 kJ/mol

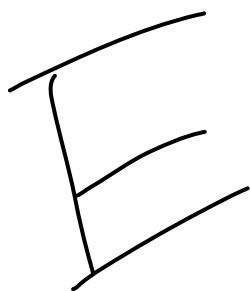
Input 323 nm light

Output 2.4×10^{-19}

Consumed ?

$$\frac{6.626 \times 10^{-34} \times 3 \times 10^8}{323 \times 10^{-9}} - 2.4 \times 10^{-19}$$

$$\frac{Na \times 3.754179 \times 10^{-19}}{1000} = 226$$



$$2.49075 \text{ used } 0.83025$$

38. Consider the following reaction: $\text{S}_8 (\text{s}) + 24 \text{F}_2 (\text{g}) \rightarrow 8 \text{SF}_6 (\text{g})$

How many grams of F_2 are left over if you react 36.0 grams of S_8 with 400.0 grams of F_2 ? The reaction has a 73.8% yield.

$$36 / (32 \times 8) = 0.140625 \text{ mol}$$

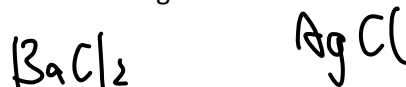
$$\frac{400}{19 \times 2} = 10.52631579$$

305

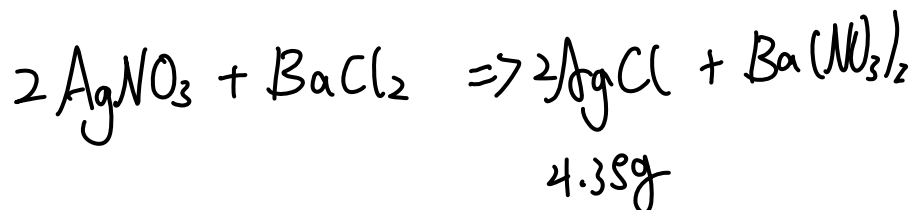
C



39. A 6.48 gram sample consisting of a mixture of silver nitrate and sodium nitrate is dissolved in water. This aqueous mixture then reacts with excess aqueous barium chloride to form 4.35 grams of silver chloride. Calculate the percent (by mass) of silver nitrate in the original mixture.



- a) 79.6%
- b) 56.6%
- c) 51.6%
- d) 54.8%
- e) 97.5%



4.35g

0.03034 mol

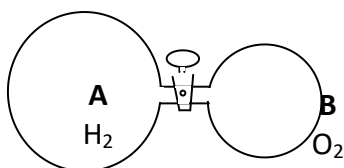
0.030345 mol

5.156g

79.6%

A

40. Consider the following apparatus consisting of two chambers (A and B) separated by a closed valve.



Chamber A has a volume of 3.0 L and is filled with 2.0 atm of hydrogen gas at 400K. Chamber B has a volume of 2.0 L and is filled with 3.0 atm of oxygen gas at 400K. The valve between the two chambers is opened, and the hydrogen and oxygen gas react to form water vapor. What is the total pressure in the apparatus? Assume ideal gas behavior and that the reaction goes to completion.

- a) 1.2 atm
- b) 1.8 atm
- c) 5.0 atm
- d) 2.4 atm
- e) none of these

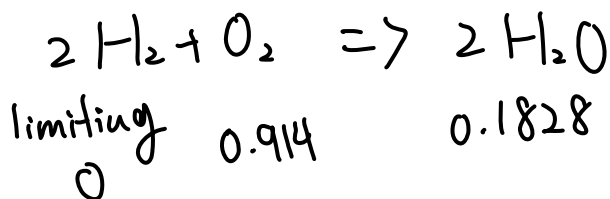
$$pV = nRT$$

$$A: \frac{pV}{RT} = n, 0.1828 \text{ mol } H_2$$

B: Same

B

B



0.2742 mol total

$$pV = nRT$$

$$= \frac{0.2742 \times 0.08206 \times 400}{3+2}$$

$$= 1.8 \text{ atm}$$

Answers:

- | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|
| 1) D | 2) A | 3) C | 4) C | 5) C | 6) A | 7) B | 8) D |
| 9) D | 10) C | 11) A | 12) C | 13) A | 14) C | 15) D | 16) B |
| 17) B | 18) C | 19) A | 20) B | 21) C | 22) B | 23) D | 24) A |
| 25) A | 26) C | 27) C | 28) A | 29) C | 30) B | 31) C | 32) D |
| 33) A | 34) A | 35) D | 36) C | 37) E | 38) C | 39) A | 40) B |