CHEM 3331 **Exam #2** **Name**_____
Dr. Minger **July 29, 2013**

Please read and sign the Honor Code statement below:

I pledge that on my honor, as a University of Colorado at Boulder student, I have neither given nor received unauthorized assistance on this exam.

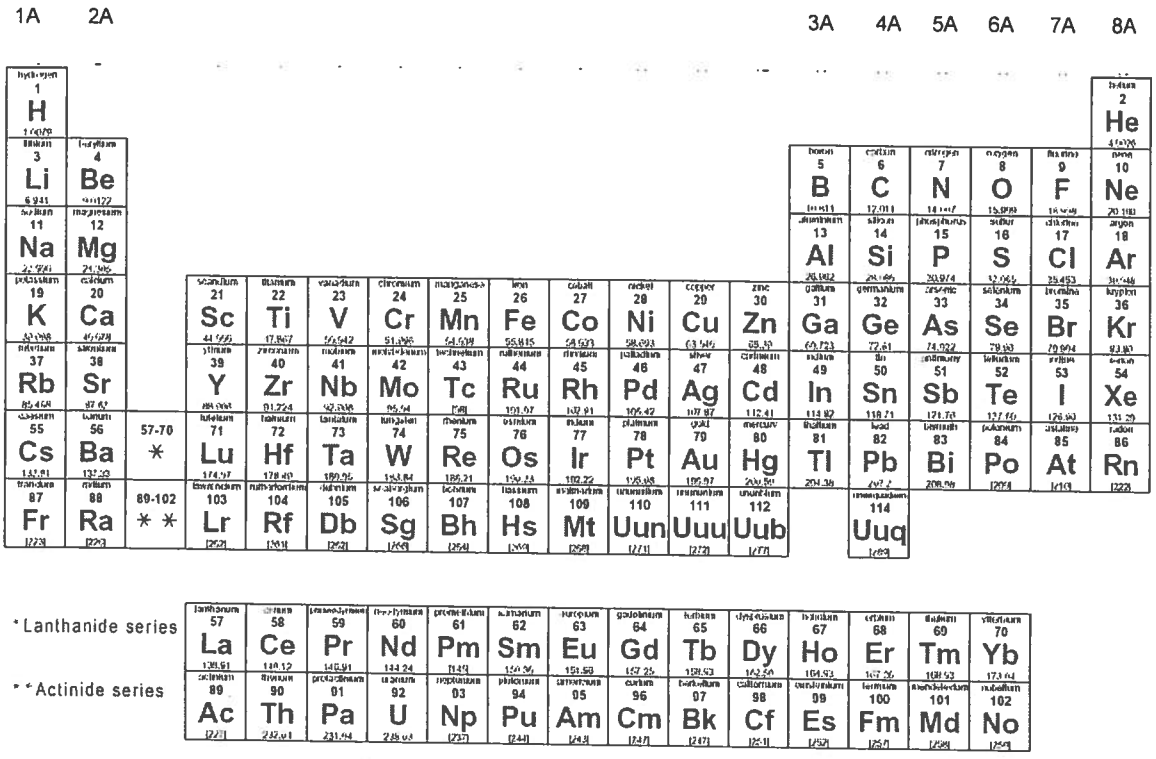
_____
Signature

General Instructions: There are 25 questions. Be sure you have them all. Read each question carefully so that you know exactly what is being asked.

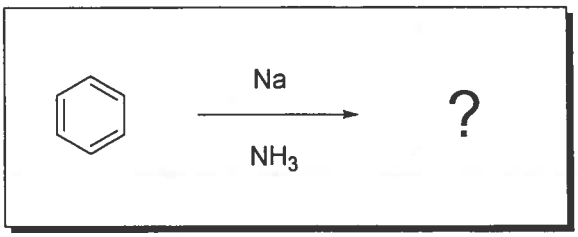
Each multiple choice question (1-25) is worth **4 points and has only one correct answer.** Bubble in your answers to these questions on the Scantron provided. **Only the Scantron will be graded, not anything that you write on the exam.**

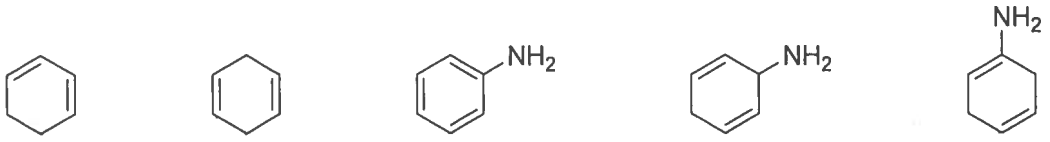
At the end of the exam, turn in your Scantron and this signed cover sheet. You may keep the rest of the exam to check your answers against the key later.

Good luck!



1. Select the correct product of the reaction conditions. Assume appropriate workup.



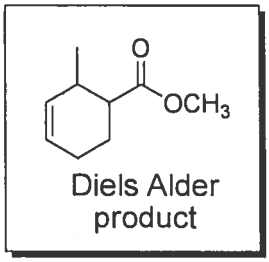


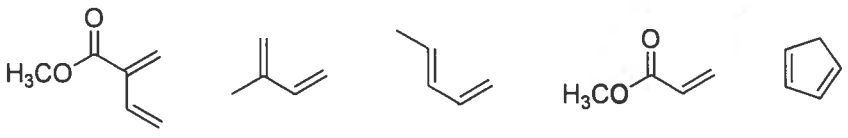
A B C D E

2. Which of these is the most appropriate solvent to use for a Grignard reaction?

a. H_2O
b. Et_2O
c. MeOH
d. EtOH
e. Acetic acid

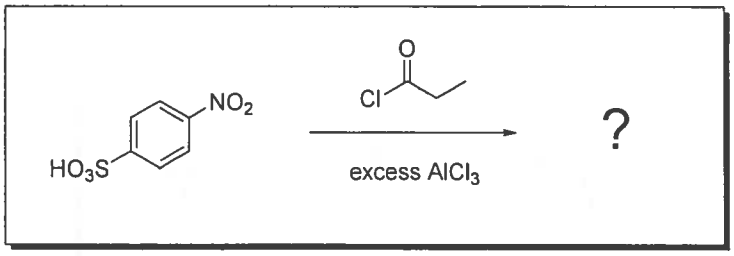
3. Which of these structures was the diene that was used to make this Diels Alder product?

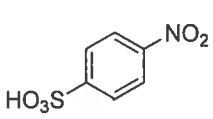




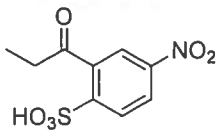
A B C D E

4. What is the most likely outcome of these reaction conditions?

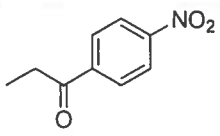




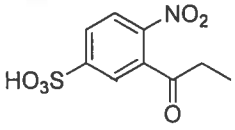
A



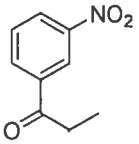
B



C

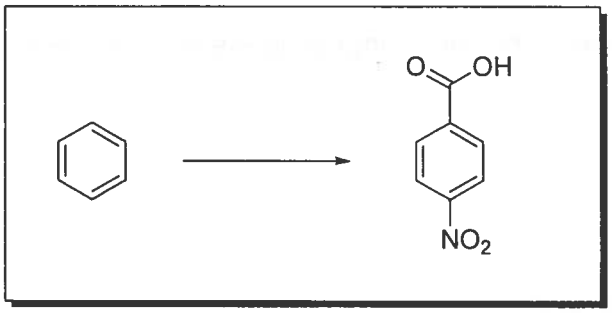


D



E

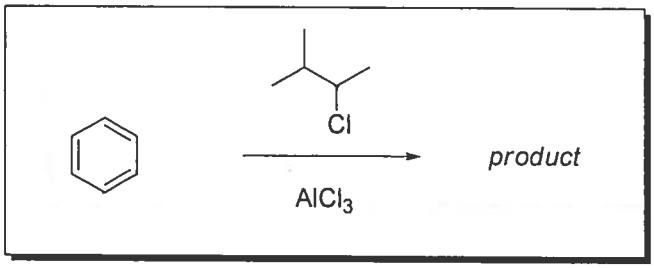
5. You wish to make the target molecule shown from benzene using a multistep synthesis:

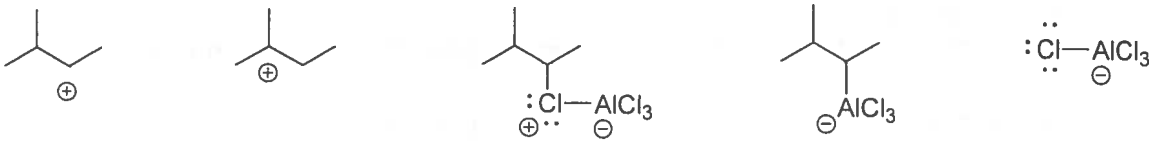


Which of the following reagents must be used to accomplish this transformation using chemistry that we have discussed in class?

a. $KMnO_4$
b. Br_2
c. H_2SO_4
d. $AlCl_3$
e. NBS

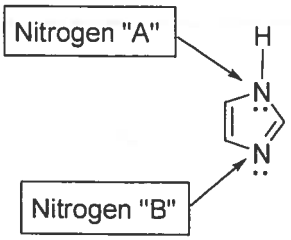
6. Select the electrophile from which the major product is formed in the Friedel Crafts acylation shown.





A B C D E

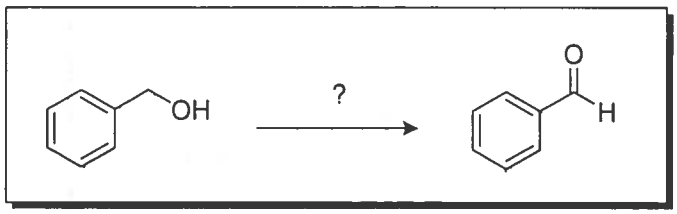
7. Which of the nitrogen atoms in imidazole is more basic? Use the labels on the structure to answer the question.



imidazole

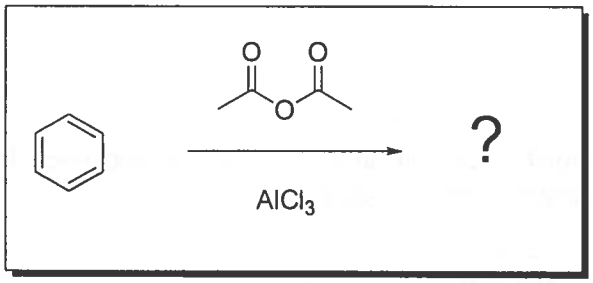
a. Nitrogen A
b. Nitrogen B
c. Both nitrogens are equally basic
d. Cannot be determined

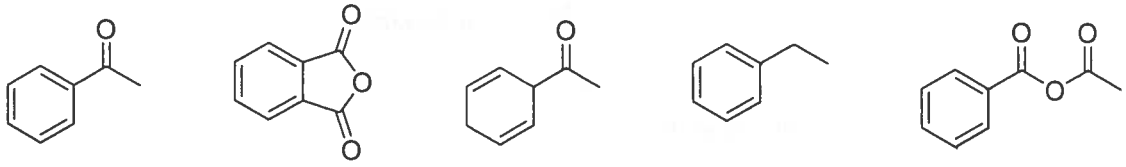
8. Select the reagent that will successfully convert the starting material to the product. Assume an appropriate solvent and workup.



a. NBS
b. CO, HCl, CuCl, $AlCl_3$
c. HCl, Hg/Zn
d. MnO_2
e. None of these reagents will accomplish this transformation.

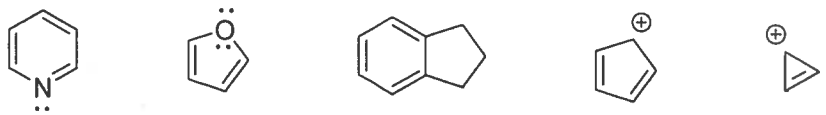
9. Select the correct product of the reaction conditions.





A B C D E

10. How many of these compounds are aromatic?

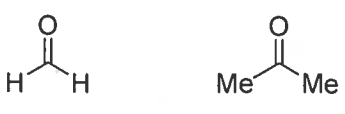


a. One
b. Two
c. Three
d. Four
e. Five

11. Select the correct reagent to accomplish this transformation. Assume appropriate workup.

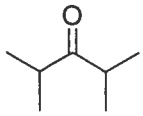
a. $NaBH_4$
b. LAH
c. HCl (aq), Hg/Zn
d. H_2NNH_2, KOH, heat
e. None of these

12. Select the compound with the smallest value of $K_{hydration}$.

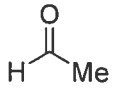


A

B



C

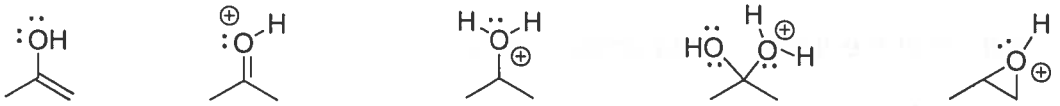


D

Cannot be determined

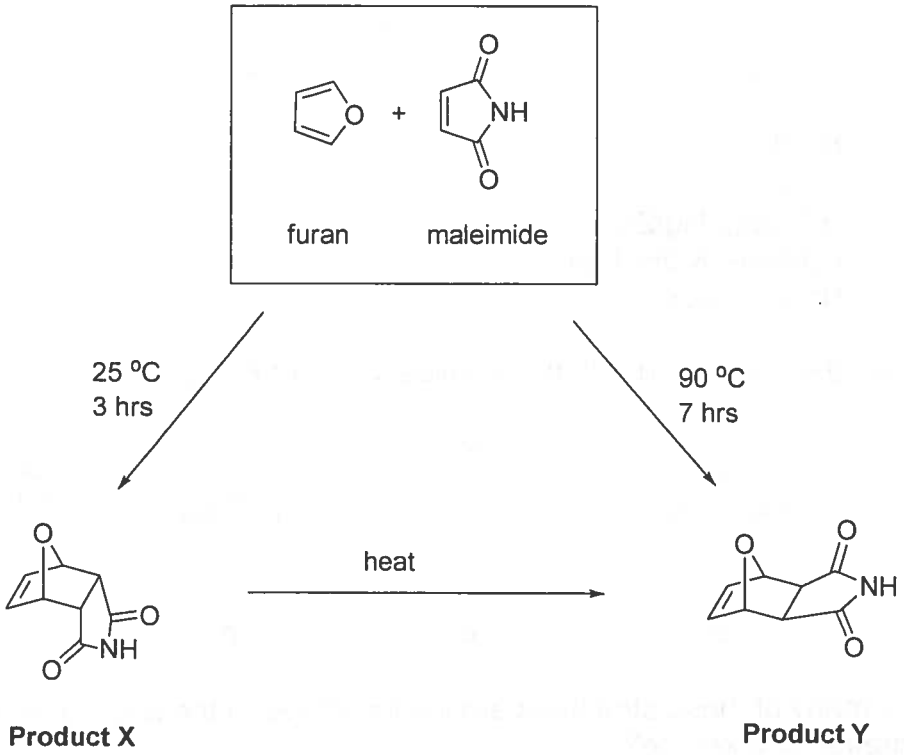
E

13. How many of these structures are intermediates in the acid-catalyzed hydration of a ketone?



a. One
b. Two
c. Three
d. Four
e. Five

14. Furan and maleimide are allowed to react in a Diels Alder reaction under different conditions, as shown here. Depending on conditions, one of two possible products forms. Product "X" is converted to Product "Y" if it is heated.

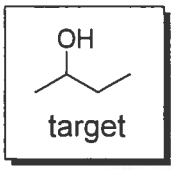


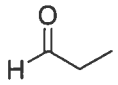
Product X **Product Y**

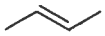
Which of the following statements is true?

a. The endo product is the kinetic product of the reaction.
b. The endo product is the more stable product.
c. Running the reaction at 150 °C is likely to increase the amount of Product "X" produced in the reaction.
d. The reaction is not reversible.
e. None of these statements is true.

15. From which of these compounds can the target alcohol be made in one step, including appropriate workup?



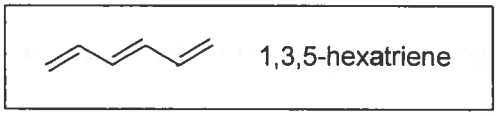




All these compounds are precursors to the alcohol

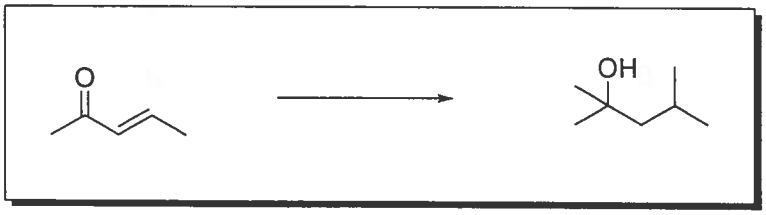
A B C D E

16. Which of these orbitals is the HOMO of 1,3,5-hexatriene? (Use the same approach discussed in class regarding the π molecular orbitals of 1,3-butadiene.)



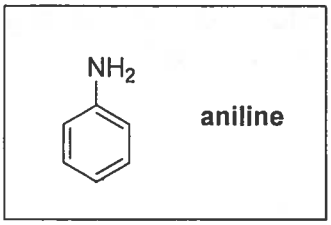
A B C D E

17. Assuming appropriate workup for all steps (e.g.. H_3O^+ after a reaction with an organometallic reagent), which of these choices describes how you would make the target from the starting material?



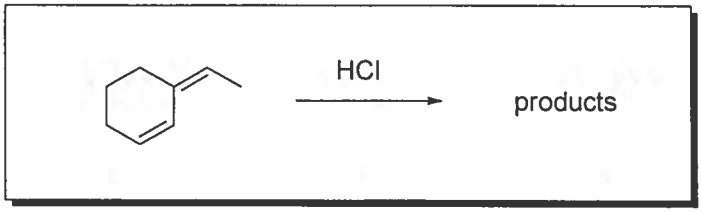
a. MeLi, then Me_2CuLi
b. Me_2CuLi, then MeLi
c. Me_2CuLi, then $NaBH_4$ or LAH
d. $NaBH_4$ or LAH, then MeLi
e. None of these would work

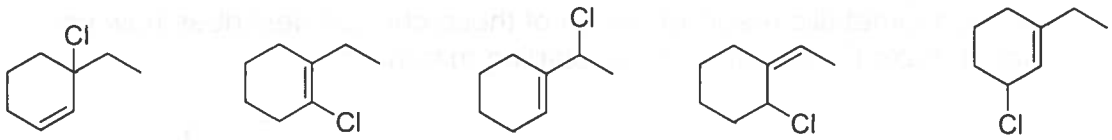
18. Which of these statements about acetylating the nitrogen in aniline is true?



a. It makes the ring more activated toward electrophilic aromatic substitution.
b. It completely deactivates the ring toward electrophilic aromatic substitution.
c. It makes the group containing the nitrogen a meta director.
d. It causes a Friedel Crafts reaction to occur.
e. None of these statements is true.

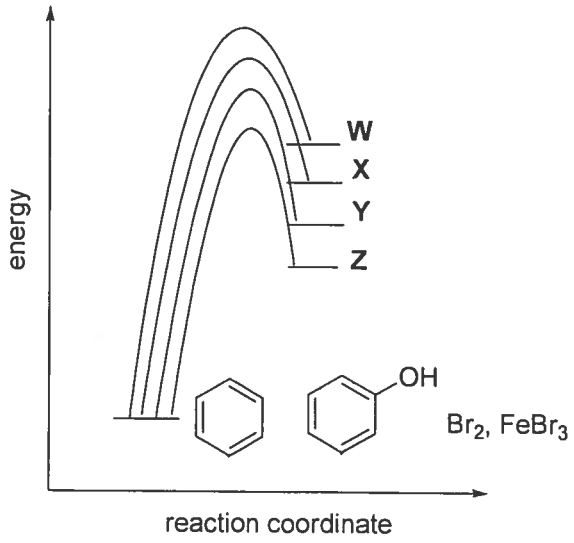
19. Select the thermodynamic product of the reaction.





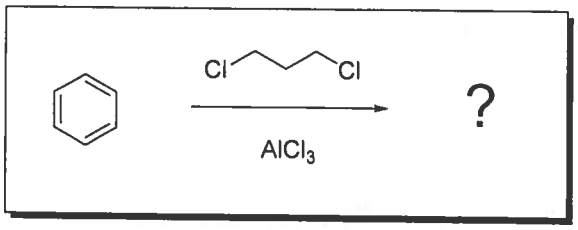
A B C D E

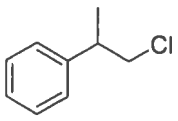
20. Equal amounts of benzene and phenol are mixed and allowed to react with bromine in the presence of the Lewis acid, $FeBr_3$, in an electrophilic aromatic substitution. An energy vs. reaction coordinate diagram for the rate-limiting step of the reaction is shown. Which structure corresponds to the intermediate for the ortho substitution pathway of phenol?



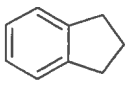
a. W
b. X
c. Y
d. Z
e. Cannot be determined

21. Which of the products shown in the answer choices is a possible outcome of these reaction conditions? (Note that you are not being asked to determine a major product, just whether something can possibly form.)

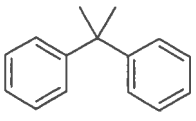




A



B



C

D. All of these might form

E. Only A and B could form

22. Consider the following three syntheses and the reagents that are available for you to use:

Synthesis "J"

Synthesis "K"

Synthesis "L"

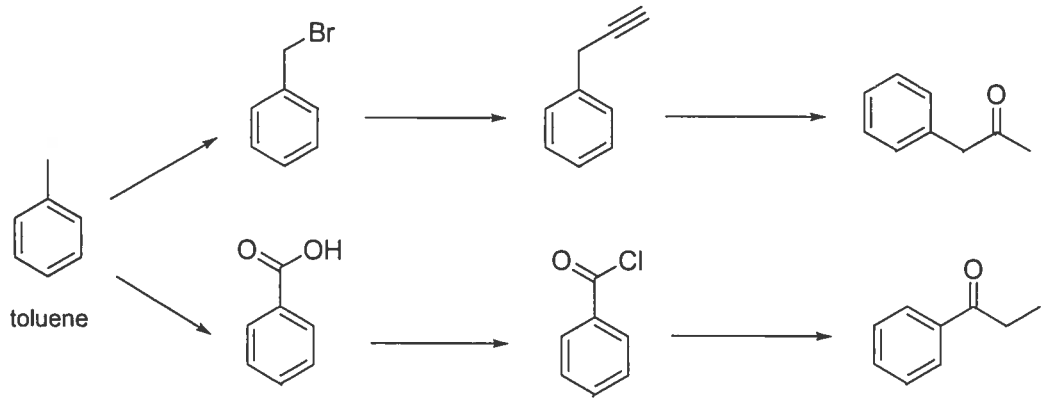
Available reagents:

LAH	Sia_2BH	$AlCl_3$		CH_3Li
OsO_4	Aqueous acid (H_3O^+)	$Hg(OAc)_2$, H_2O		$(CH_3)_2CuLi$
H_2O_2	Aqueous base (HO^-)	$KMnO_4$		CO
O_3	LDA	$NaBH_4$		HCl
DMS	Na metal	Jones reagent		CuCl
NBS	Li metal	$SOCl_2$		PCC
$FeBr_3$	NH_3	Br_2		MCPBA

Using only the reagents that are available to you (along with any necessary solvents), which of these three syntheses cannot be successfully accomplished?

a. J
b. K
c. L
d. All three can be successfully accomplished.
e. None of the three can be accomplished.

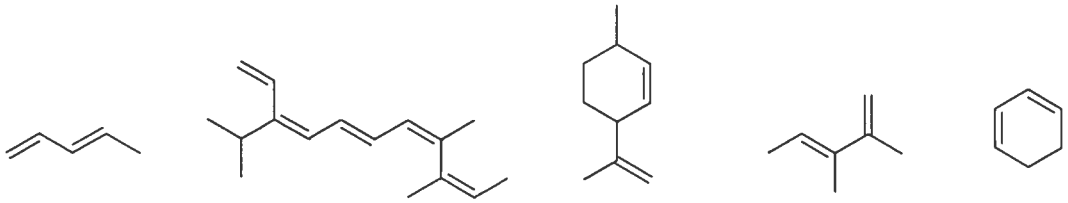
23. Here are two multi-step syntheses using toluene as the starting material:



Which of these reagents is used in both syntheses?

a. PCC
b. LAH
c. NBS
d. $AlCl_3$
e. There are no reagents common to both syntheses (not counting aqueous acid or base workups).

24. Which of these molecules has the *smallest* HOMO-LUMO gap?



A B C D E

25. Justin Bieber and his pet monkey are playing in the lab one day. The monkey decides that it would be funny to push Justin Bieber into a vat of dye. And it was! The dye absorbs visible light at a λ_{max} of 524 nm. What color is Justin Bieber now?

a. Violet
b. Blue
c. Green
d. Orange
e. Red