

## Mid-semester Test for Modules 06530, 06550, 06590

### Organic Chemistry

#### General remarks (read before answering the questions)

- The duration of the test is **30 minutes**.
- Each question contains five possible answers; **(A), (B), (C), (D)** and **(E)**. Select your answer by marking clearly the appropriate letter **on the answer sheet**.
- Students taking modules **06530** and **06590** are expected to attempt **Q1-12 only** (answering more questions will not gain you any additional marks).
- Students taking module **06550** are expected to attempt **all** questions.

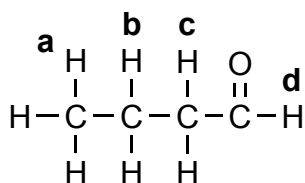
Hand your test in before you leave and do not forget to identify your test sheet below with your student number (or name) and the module number.

**STUDENT ID NUMBER:** \_\_\_\_\_

**MODULE:**                                    **06530**                                    **06590**                                    **06550**

## Start of questions

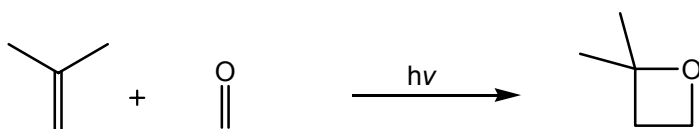
**Q1.** Consider the following statements regarding the compound below and its  $^1\text{H}$  NMR spectrum, and state the correct answer accordingly.



- (i) Protons **a** have the lowest ppm value.
- (ii) Protons **c** have the highest ppm value.
- (iii) Protons **b** appear as a sextet.
- (iv) Proton **d** is a singlet.

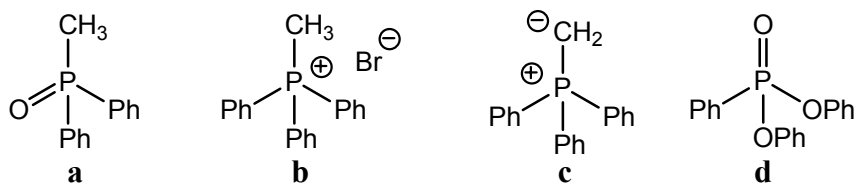
- (A) (i) only is correct
- (B) (i) and (ii) only are correct
- (C) (i), (ii) and (iii) only are correct
- (D) (i) and (iii) only are correct
- (E) (i), (ii), (iii) and (iv) are all correct

**Q2.** For the photochemical cycloaddition of 2-methylpropene and formaldehyde, pick out the following statement which is correct:



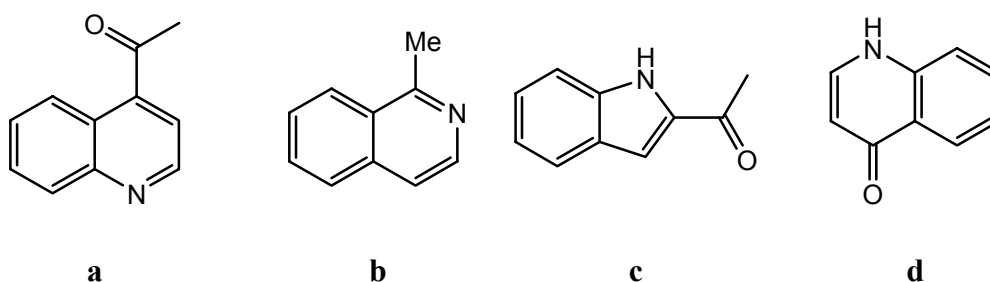
- (A) : The reaction is antarafacial and allowed
- (B) : The reaction is antarafacial and forbidden
- (C) : The reaction is suprafacial and allowed
- (D) : The reaction is suprafacial and forbidden
- (E) : None of the above

**Q3.** Consider the following statements regarding the compounds below, and identify the correct statement accordingly.



- (A) **a** is a phosphine oxide and **c** is a phosphonium salt
- (B) **b** is an ylid and **d** is a phosphonate
- (C) **c** is an ylid and **d** is a phosphine oxide
- (D) **a** is a phosphine oxide and **d** is a phosphonate
- (E) **c** is a phosphonium salt and **d** is a phosphine oxide

**Q4.** Consider the following statements regarding the compounds below, and identify the correct statement accordingly.



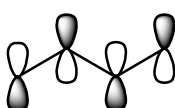
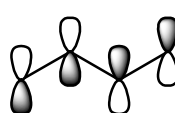
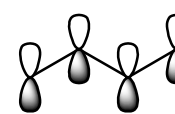
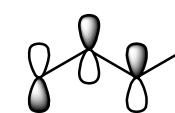
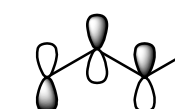
- (A) **a** is a quinoline and **c** is an isoquinoline
- (B) **a** and **b** are both quinolines
- (C) **b** is a quinoline and **c** is an indole
- (D) **c** is an indole and **d** quinolone
- (E) **b** is an isoquinoline and **d** is an indole

**Q5.** Consider the following statements regarding NMR spectroscopy, and state the correct answer accordingly.

- (i) Coupling constants ( $J$  values) do not vary with field strength.
- (ii) Diastereotopic protons are always equivalent.
- (iii) A chiral shift reagent can be used to determine enantiomeric excess.
- (iv) There is more chance of overlapping signals at higher field strength.

- (A) (i) only is correct
- (B) (i) and (ii) only are correct
- (C) (i) and (iii) only are correct
- (D) (iii) and (iv) only are correct
- (E) (iv) only is correct

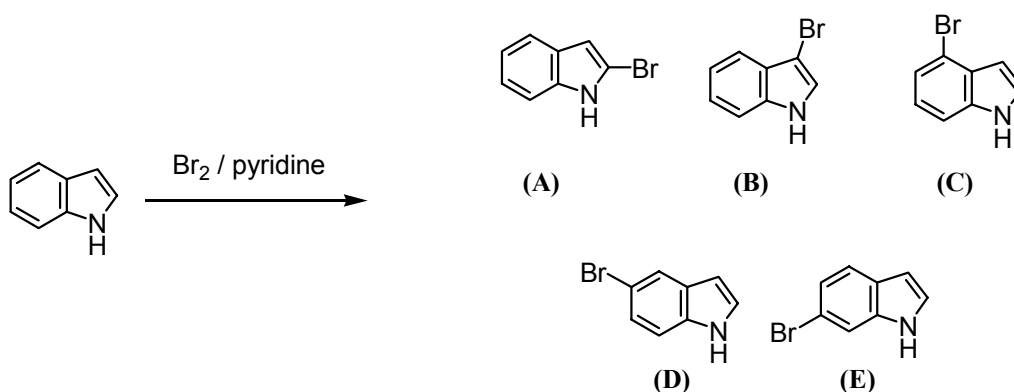
**Q6.** For butadiene, pick out the highest occupied molecular orbital (HOMO) for a six-electron component:

- (A) : 
- (B) : 
- (C) : 
- (D) : 
- (E) : 

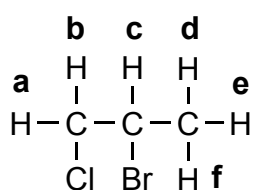
**Q7.** Consider the following statements which relate to the **Wittig reaction** and identify the true statement accordingly.

- (A) an unstabilized ylid gives predominantly the (*E*)-alkene
- (B) a stabilized ylid gives predominantly the (*Z*)-alkene
- (C) isomerization of the betaine arising from an unstabilized ylid with PhLi leads to a switch from (*E*) to (*Z*) selectivity.
- (D) isomerization of the betaine arising from an unstabilized ylid with PhLi leads to a switch from (*Z*) to (*E*) selectivity.
- (E) the counterion of the base has no effect on the (*E*)/(*Z*) selectivity.

**Q8.** The product formed in the following reaction is



**Q9.** Consider the following statements regarding the compound below and its  $^1\text{H}$  NMR spectrum, and state the correct answer accordingly.



- (i) All 6 protons (**a** to **f**) in the structure are different.
- (ii) Protons **a** and **b** are diastereotopic.
- (iii) Protons **a** and **b** are equivalent, and appear as a doublet.
- (iv) Protons **d**, **e** and **f** are equivalent, and appear as a doublet.

(A) (i) only is correct

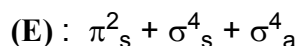
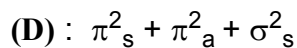
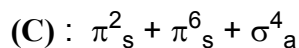
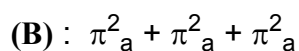
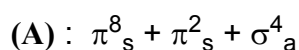
(B) (ii) only is correct

(C) (ii) and (iv) only are correct

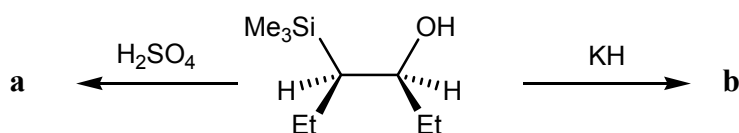
(D) (ii) and (iv) only are correct

(E) (iv) only is correct

**Q10.** Using Woodward-Hoffmann rules, pick out the combination which is thermally allowed:



**Q11.** Consider the following statements regarding the reactions below, and identify the correct statement accordingly.



(A) **a** is the (*Z*) alkene and **b** is the (*E*) alkene; the eliminations are stereospecific

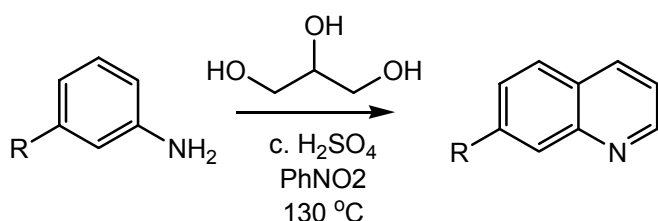
(B) **a** and **b** are both the (*E*) alkene

(C) **a** and **b** are both the (*Z*) alkene

(D) **a** is the (*E*) alkene and **b** is the (*Z*) alkene; the eliminations are stereospecific

(E) **a** is the (*E*) alkene and **b** is the (*Z*) alkene; the eliminations are stereoselective

**Q12.** Consider the following reaction and identify the correct statement.



(A) if R is electron-withdrawing, the reaction rate is faster than if it is electron-donating.

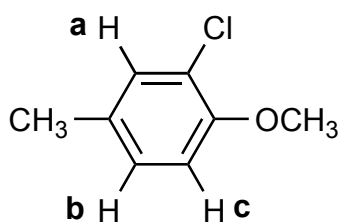
(B) the isomer shown is formed due to steric considerations alone.

(C) the rate of reaction is independent of the group R.

(D) if R is electron-withdrawing, the reaction rate is slower than if it is electron-donating.

(E) the product shown is the only isomer possible.

**Q13.** Consider the following statements regarding the compound below and its  $^1\text{H}$  NMR spectrum, and state the correct answer accordingly.



- (i) Proton **b** couples equally with protons **a** and **c** to give a triplet.
- (ii) Proton **b** will couple to different extents with protons **a** and **c** to give a double doublet.
- (iii) Proton **a** will be a singlet.
- (iv) The coupling constant ( $J$  value) between protons **b** and **c** is likely to be around 3 Hz.

- (A) (i) only is correct
- (B) (ii) only is correct
- (C) (i) and (iv) only are correct
- (D) (ii) and (iv) only are correct
- (E) (ii), (iii) and (iv) only are correct

**Q14.** For the following reaction, pick out the product:

