Started on	Thursday, 4 August 2022, 3:35 PM
State	Finished
Completed on	Thursday, 4 August 2022, 6:01 PM
Time taken	2 hours 25 mins
Grade	**94.0** out of 106.0 (**89**%)

Question **1**

Correct

Mark 2.0 out of 2.0

Which of the following is true ?

Select one:

- a. Boron has 3 electrons in its outermost shell
- b. Silicon has 4 electrons in its outermost shell
- c. All of these ✔
- d. Arsenic has 5 electrons in its outermost shell
- e. Phosphorus has 5 electrons in its outermost shell

The correct answer is: All of these

Correct

Marks for this submission: 2.0/2.0.

Question **2**

Correct

Mark 2.0 out of 2.0

Which of the following is true ?

Select one:

- a. All of these
- b. In intrinsic Silicon at 300°K there are no free electrons
- c. In intrinsic Silicon at 300°K only free electrons can conduct electricity
- d. In intrinsic Silicon at 300°K the number of holes is far less than the number of Silicon atoms ✔
- e. In intrinsic Silicon at 300°K the number of free electrons is about equal to the number of Silicon atoms

The correct answer is: In intrinsic Silicon at 300°K the number of holes is far less than the number of Silicon atoms

Correct

Marks for this submission: 2.0/2.0.

Question **3**

Correct

Mark 2.0 out of 2.0

As the reverse bias voltage across a PN junction is decreased, the potential barrier will

Select one:

- a. Decrease ✔
- b. None of these
- c. Stays the same
- d. Increase
- e. No way to determine

The correct answer is: Decrease

Correct

Marks for this submission: 2.0/2.0.

Question **4**

Correct

Mark 2.0 out of 2.0

Which of the following is true for the depletion region surrounding a PN junction?

Select one:

- a. None of these
- b. In the depletion region there are free electrons and holes which cause a separation of charge
- c. In the depletion region there are almost no immobile ions
- d. In the depletion region the amount of charge stored varies with the applied bias, causing a capacitance ✔
- e. In the depletion region there is zero electric field

The correct answer is: In the depletion region the amount of charge stored varies with the applied bias, causing a capacitance

Correct

Marks for this submission: 2.0/2.0.

Question **5**

Correct

Mark 2.0 out of 2.0

Which of the following circuits is part of a typical DC power supply?

Select one:

- a. None of these ✔
- b. A diode limiter
- c. A current regulator
- d. A high pass filter
- e. A load resistor

The correct answer is: None of these

Correct

Marks for this submission: 2.0/2.0.

Question **6**

Correct

Mark 2.0 out of 2.0

When does the voltage across a diode depend exponentially on the current flowing through?

Select one:

- a. When the voltage on the P side is higher than the voltage on the N side by at least 500mV
- b. When the voltage on the P side is higher than the voltage on the N side
- c. When the voltage on the N side is higher than the voltage on the P side, but lower than the breakdown voltage
- d. When the voltage on the N side is higher than the voltage on the P side, and higher than the breakdown voltage
- e. None of these ✔

The correct answer is: None of these

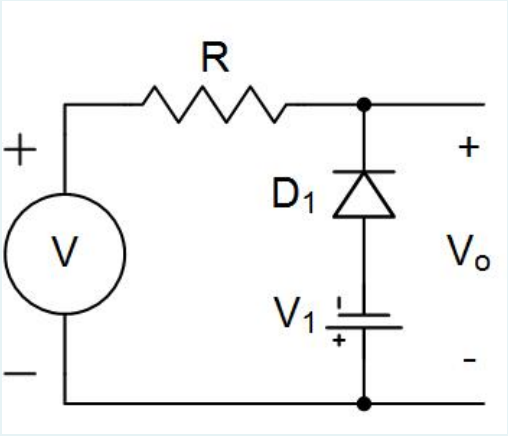
Correct

Marks for this submission: 2.0/2.0.

Question **7**

Correct

Mark 2.0 out of 2.0



Assuming ideal diodes, for the diode circuit shown :

Select one:

- a. The gain is equal to 0 when V is > -V1
- b. The minimum output voltage is +V1
- c. None of these
- d. The gain is equal to 0 when V is < -V1 ✔
- e. The maximum output voltage is +V1

The correct answer is: The gain is equal to 0 when V is < -V1

Correct

Marks for this submission: 2.0/2.0.

Question **8**

Correct

Mark 2.0 out of 2.0

Which of the following would cause the ripple voltage at the output of a power supply to increase?

Select one:

- a. Increasing the size of the load resistance
- b. Increasing the size of the filter capacitor
- c. None of these ✔
- d. Reducing the amplitude of the input voltage
- e. Increasing the frequency of the input voltage

The correct answer is: None of these

Correct

Marks for this submission: 2.0/2.0.

Question **9**

Correct

Mark 2.0 out of 2.0

Compared to the process transconductance for a PMOS FET, the process transconductance for an NMOS FET is :

Select one:

- a. Same
- b. None of these
- c. Larger ✔
- d. Smaller
- e. Impossible to determine

The correct answer is: Larger

Correct

Marks for this submission: 2.0/2.0.

Question **10**

Correct

Mark 2.0 out of 2.0

If an NMOS FET is biased with Vgs << Vt and Vds < Vgs – Vt, the device is in :

Select one:

- a. None of these
- b. Sub-threshold
- c. Triode
- d. Saturation
- e. Cutoff ✔

The correct answer is: Cutoff

Correct

Marks for this submission: 2.0/2.0.

Question **11**

Correct

Mark 2.0 out of 2.0

Silicon has approximately 1.5 x 10^10 atoms/cm^3.

Select one:

- True
- False ✔

The correct answer is 'False'.

Correct

Marks for this submission: 2.0/2.0.

Question **12**

Correct

Mark 2.0 out of 2.0

At room temperature (300°K) there is enough thermal energy to break some bonds and create electron-hole pairs.

Select one:

- True ✔
- False

The correct answer is 'True'.

Correct

Marks for this submission: 2.0/2.0.

Question **13**

Correct

Mark 2.0 out of 2.0

The ionized atoms in the depletion region cause a separation of charge between the two sides of a PN junction, with positive charge on the p-side and negative charge on the n-side.

Select one:

- True
- False ✔

The correct answer is 'False'.

Correct

Marks for this submission: 2.0/2.0.

Question **14**

Correct

Mark 2.0 out of 2.0

The Zener effect typically causes the reverse breakdown of PN junctions which break down at voltages < 5V.

Select one:

- (•) True ✔
- ( ) False

The correct answer is 'True'.

Correct

Marks for this submission: 2.0/2.0.

Question **15**

Correct

Mark 2.0 out of 2.0

The RC time constant for the filter capacitor in a power supply is typically set much smaller than the period of the input sine wave.

Select one:

- ( ) True
- (•) False ✔

The correct answer is 'False'.

Correct

Marks for this submission: 2.0/2.0.

Question **16**

Correct

Mark 2.0 out of 2.0

Bridge rectifiers are often used in power supplies instead of center-tapped transformers to lower cost.

Select one:

- (•) True ✔
- ( ) False

The correct answer is 'True'.

Correct

Marks for this submission: 2.0/2.0.

Question **17**

Correct

Mark 2.0 out of 2.0

Diodes can be used to limit how low the magnitude of a signal can go.

Select one:

- True
- False ✔

The correct answer is 'False'.

Correct

Marks for this submission: 2.0/2.0.

Question **18**

Correct

Mark 2.0 out of 2.0

For a Half Wave Rectifier the diode must be able to handle a Peak Inverse Voltage equal to nearly twice the peak of the input voltage.

Select one:

- True
- False ✔

The correct answer is 'False'.

Correct

Marks for this submission: 2.0/2.0.

Question **19**

Correct

Mark 2.0 out of 2.0

The flow of current between the drain and source of a MOSFET is controlled using electric fields.

Select one:

- True ✔
- False

The correct answer is 'True'.

Correct

Marks for this submission: 2.0/2.0.

Question **20**

Correct

Mark 2.0 out of 2.0

For a MOSFET in saturation, changes in Vds have only a small effect on the drain current because the channel stops being pinched off at the drain end as |Vds| is increased.

Select one:

- True
- False ✔

The correct answer is 'False'.

Correct

Marks for this submission: 2.0/2.0.

Question **21**

Correct

Mark 6.0 out of 6.0

If a silicon diffusion is doped with phosphorus at a concentration of 8.7 x 10^16/cm^3, what is the concentration of holes in this piece of silicon per cm^3? Assume ni = 1.5 x 10^10/cm^3 at 300°K

Answer: 2586.21 ✔

The correct answer is: 2586

Correct

Marks for this submission: 6.0/6.0.

Question **22**

Correct

Mark 6.0 out of 6.0

If a PN junction is doped with boron at a concentration of 7.0 x 10^18/cm^3 and phosphorus at a concentration of 1.1 x 10^17/cm^3, then what is the built-in voltage in millivolts for this junction? Assume ni = 1.5 x 10^10/cm^3 and Vt = kt/q = 26mV at 300°K. Since small changes in the built-in voltage imply large changes in the doping levels, be sure to give your answer to the nearest millivolt!

Answer: 930 ✔

The correct answer is: 930

Correct

Marks for this submission: 6.0/6.0.

Question **23**

Correct

Mark 6.0 out of 6.0

If the DC bias voltage, Vd, across a forward biased PN junction is equal to 728 mV then what is the current flowing through this diode, Id, in milliamps? Assume that the saturation current for the diode, Is, is equal to 51 fA. (Note that 1 fA = 1 femtoamp = 1 x 10^-15 A.) Also assume that the thermal voltage is equal to Vt = kt/q = 26mV. Since the diode current is very sensitive to small changes in the diode voltage, be sure to use Vd to the nearest millivolt when calculating your answer!

Answer: 73.76 ✔

The correct answer is: 73.76

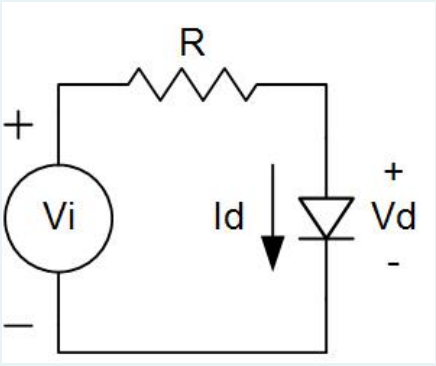
Correct

Marks for this submission: 6.0/6.0.

Question **24**

Correct

Mark 3.0 out of 6.0



If the input voltage to the diode circuit shown, Vi, changes by 1.9V then what will be the change in the diode voltage, Vd, in millivolts? To find the bias point needed for your small signal analysis use the constant voltage model for the diode with Vd = 666mV. Use a nominal value for Vi (the value before any changes) equal to 8.3V. Also use R = 7.8kΩ and Vt = kt/q = 26mV.

Answer: 6.45 ✔

The correct answer is: 6.4

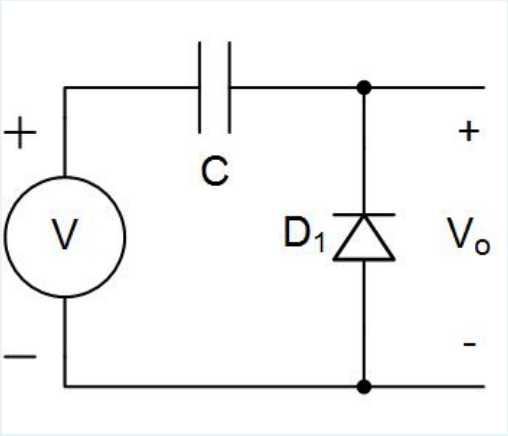
Correct

Marks for this submission: 6.0/6.0. Accounting for previous tries, this gives **3.0/6.0**.

Question **25**

Correct

Mark 3.0 out of 6.0



For the diode circuit shown, what will the minimum output voltage, Vo, be in volts if the input voltage, V, is a square wave which varies between +1.8V and -9.2V ? Assume that when the diode is turned on the voltage across it will be 0.7V.

Answer: -0.7 ✔

The correct answer is: -0.7

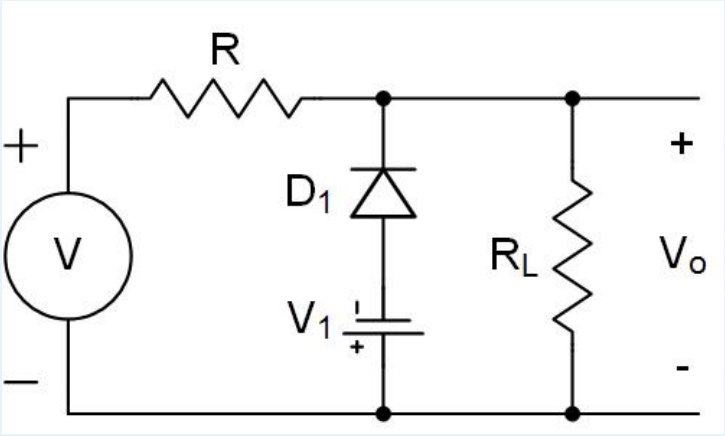
Correct

Marks for this submission: 6.0/6.0. Accounting for previous tries, this gives **3.0/6.0**.

Question **26**

Correct

Mark 3.0 out of 6.0



For the diode circuit shown, what will the output voltage, Vo, be in volts if the input voltage, V, is equal to 6V ? Assume that when the diode is turned on the voltage across it will be 0.7V, and for the battery use V1 = 7.2V. Also use R = 4.5kΩ and RL = 13.8kΩ.

Answer: 4.52 ✔

The correct answer is: 4.52

Correct

Marks for this submission: 6.0/6.0. Accounting for previous tries, this gives **3.0/6.0**.

Question **27**

Correct

Mark 3.0 out of 6.0

A full-wave diode rectifier circuit is driven by a 60Hz sine wave with a peak value of 11V. If the load resistance this circuit drives is 2.0kΩ and the ripple voltage at the output is 0.23 Vpeak-to-peak, then what is the peak current in the diode in milliamps?

Answer: 174.49 ✔

The correct answer is: 174.5

Correct

Marks for this submission: 6.0/6.0. Accounting for previous tries, this gives **3.0/6.0**.

Question **28**

Correct

Mark 6.0 out of 6.0

If a MOSFET with W = 1.1 µm and L = 0.5 µm is biased in triode, what is the gate-to-source capacitance, Cgs, in femtofarads? Assume the gate dielectric is silicon dioxide with tox = 68.7 angstroms.

Answer: 1.382 ✔

The correct answer is: 1.4

Correct

Marks for this submission: 6.0/6.0.

Question **29**

Correct

Mark 6.0 out of 6.0

If an NMOS FET with W = 68.9 µm and L = 0.8 µm is biased in triode with Vgs = 0.9 and Vds = 0V, what is the on-resistance of this MOS switch in Ohms? Use: VTN = 0.5V, k'n = 100µA/V^2

Answer: 290.27 ✔

The correct answer is: 290.3

Correct

Marks for this submission: 6.0/6.0.

Question **30**

Correct

Mark 6.0 out of 6.0

If a NMOS FET with W/L = 24.7 has Vgs = 0.62 and Vds = 0.84, what is the drain current in microamps? Use: VTN = 0.5V, k'n = 100µA/V^2, λ = 0

Answer: 17.78 ✔

The correct answer is: 17.8

Correct

Marks for this submission: 6.0/6.0.

Question **31**

Correct

Mark 6.0 out of 6.0

A half-wave diode rectifier circuit is driven by a 60Hz sine wave with a peak value of 17V. If the load resistance this circuit drives is 8.0kΩ and the ripple voltage at the output is 0.28 Vpeak-to-peak, then during what percent of each cycle does the diode conduct?

Answer: 2.89 ✔

The correct answer is: 2.89

Correct

Marks for this submission: 6.0/6.0.

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