Quiz 3

Graded

Student

Ryan So

Total Points

21 / 30 pts

Question 1

PWM Calculations **6** / 6 pts

1.1 **(no title)** **2** / 2 pts

✔ **+ 2 pts** Reasonable Approximation Close to 4ms

+ 0 pts Incorrect

1.2 **(no title)** **2** / 2 pts

✔ **+ 2 pts** Reasonably Close to 2.3

+ 0 pts Incorrect

1.3 **(no title)** **2** / 2 pts

✔ **+ 2 pts** Correct: ~57% (should match with previous answer)

+ 0 pts Incorrect

Question 2

PWM and Timer_A **6** / 8 pts

2.1 **(no title)** **2** / 2 pts

✔ **+ 2 pts** Correct: 200

+ 0 pts Incorrect

+ 1 pt Need to set to XXXXX

2.2 **(no title)** **2** / 2 pts

✔ **+ 2 pts** Correct: 60 =200x(20x10^(-6)*15000)

+ 0 pts Incorrect

2.3 **(no title)** **0** / 2 pts

+ 2 pts Correct: 40=200*(1-0.8)

✔ **+ 0 pts** Incorrect answer

2.4 **(no title)** **2** / 2 pts

✔ **+ 2 pts** `Timer_A_initCompare(TIMER_A2_BASE,&ccr3);`

+ 1 pt 1 argument correct, 2nd argument wrong

+ 0 pts Incorrect/Blank

Question 3

Encoder Basics **4** / 8 pts

3.1 **(no title)** **1** / 3 pts

+ 3 pts $\omega = \frac{1}{40}\frac{1}{\Delta t}\frac{60\text{ s}}{1\text{ min}}$

$\Delta t = 20\text{ ms}$

Therefore: $\omega = 75\text{ rpm}$

(Only need correct answer)

+ 1.5 pts Did $\frac{1}{360}$ instead of $\frac{1}{40}$.

$\omega = 8.33\text{ rpm}$

+ 1.5 pts Mostly correct

✔ **+ 1 pt** Other partial credit.

+ 0 pts Incorrect/Blank

3.2 **(no title)** **0** / 2 pts

+ 2 pts $c = 2\pi r = 188.45\text{mm}$
1 encoder step: $l_{enc} = \frac{c}{40} = 4.71\text{mm}$
speed $= l_{enc}/dt = 4.71mm/20\text{ms} = 0.2135mm/ms = 0.2135m/s$
(unrealistic, but those are the numbers)

+ 1 pt Partial credit

✔ **+ 0 pts** Incorrect/Blank

3.3 **(no title)** **3** / 3 pts

✔ **+ 3 pts** 4.71 m

+ 1.5 pts Partial Credit

+ 0 pts Incorrect

Question 4

Encoder with Timer_A **2** / 5 pts

+ 5 pts Correct

$\Delta t = \frac{3\times 2^{16} - (45000 - 17500)}{24000000} = 7.05\text{ ms}$

+ 3 pts Math for period of the timer incorrect. Otherwise would be correct.

✔ **+ 2 pts** Showed work

+ 0 pts Incorrect/Blank

Question 5

(no title) **3** / 3 pts

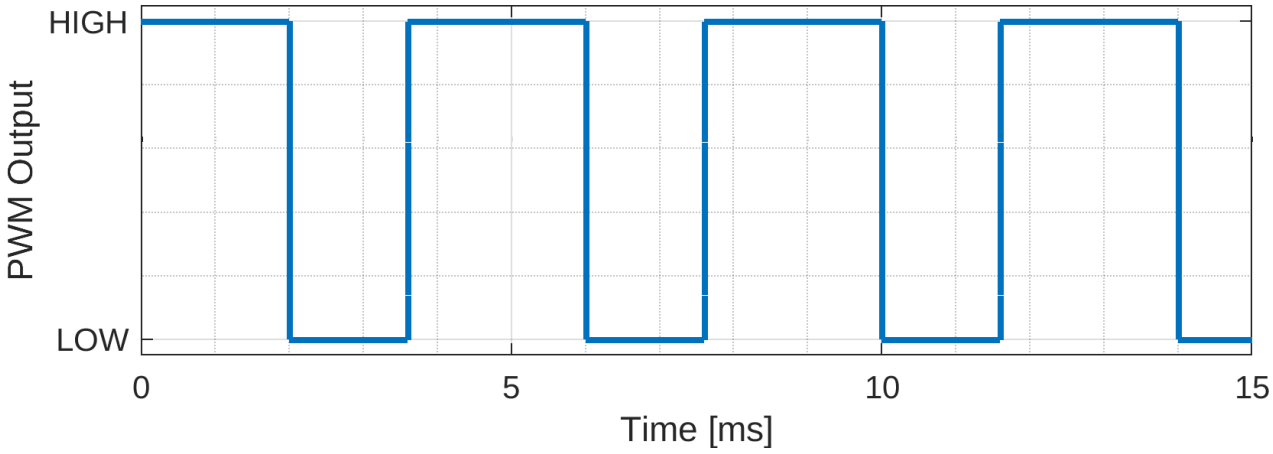
✔ **+ 3 pts** Correct

+ 0 pts Incorrect

Q1 PWM Calculations

6 Points

A PWM signal is generated as follows in the image below. Answer the following subquestions with respect to the described signal. Reasonably approximate values are acceptable.



Q1.1

2 Points

What is the period? Answer in unit MILLISECONDS.

4ms

Q1.2

2 Points

What is the pulse width? Answer in unit MILLISECONDS.

2.4ms

Q1.3
2 Points

What is the Duty Cycle? Answer in unit PERCENTAGE.

60%

Q2 PWM and Timer_A

8 Points

Two PWM signals are generated from a Timer_A module, given the partial initialization code below. Assume SMCLK is 24 MHz.

```
cfg.clockSource = TIMER_A_CLOCKSOURCE_SMCLK;
cfg.clockSourceDivider = TIMER_A_CLOCKSOURCE_DIVIDER_8;
cfg.timerPeriod = __XXXXX__;
Timer_A_configureUpMode(TIMER_A2_BASE,&cfg);

ccr2.compareRegister = TIMER_A_CAPTURECOMPARE_REGISTER_2;
ccr2.compareOutputMode = TIMER_A_OUTPUTMODE_RESET_SET; // !
ccr2.compareValue = __YYYYY__;
Timer_A_initCompare(_________,_________);

ccr3.compareRegister = TIMER_A_CAPTURECOMPARE_REGISTER_3;
ccr3.compareOutputMode = TIMER_A_OUTPUTMODE_SET_RESET; // !
ccr3.compareValue = __ZZZZZ__;
Timer_A_initCompare(_________,_________);

Timer_A_startCounter(TIMER_A2_BASE,TIMER_A_UP_MODE);
```

Q2.1

2 Points

What blank value needs to be set to configure a pwm **frequency** of 15 kHz? Give the value as well.

- (●) **XXXX**
- ( ) **YYYY**
- ( ) **ZZZZ**

Value:

200

Q2.2
2 Points

What blank value needs to be set to configure CCR2 with a **pulse width** of 20 µs? Give the value as well.

- XXXX
- **YYYY**
- ZZZZ

60

Q2.3
2 Points

What blank value needs to be set to configure CCR3 with a **duty cycle** of 80%? Give the value as well.

- XXXX
- YYYY
- **ZZZZ**

160

Q2.4
2 Points

Rewrite the line `Timer_A_initCompare(_____,_____);` with the blanks filled in for CCR3.

Timer_A_initCompare(TIMER_A2_BASE, &ccr3)

Q3 Encoder Basics

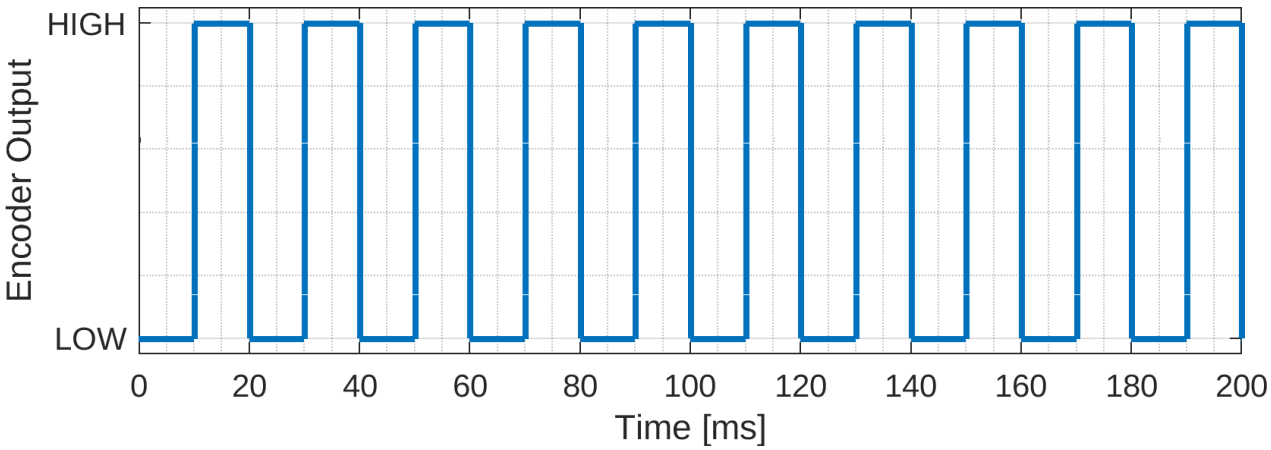
8 Points

A **40 "tooth" optical encoder** is attached directly to a wheel shaft. The wheel has a **radius of 30 mm**.

Q3.1

3 Points

Given the Encoder output below, what is the wheel speed in RPM (revolutions per minute)? You may add your math in the answer box for partial credit (not required).



48 revolutions per minute
(20*10^-3) * 40 * 60 = 48

Q3.2
2 Points

Assuming the wheel is traveling straight on the ground without slipping, how fast is the center of the wheel moving (straight line speed)?

24mm per second
(48/60) *30 = 24

Q3.3
3 Points

How far has the wheel traveled (straight line) if 1000 encoder events have been detected? Assume the wheel did not switch directions.

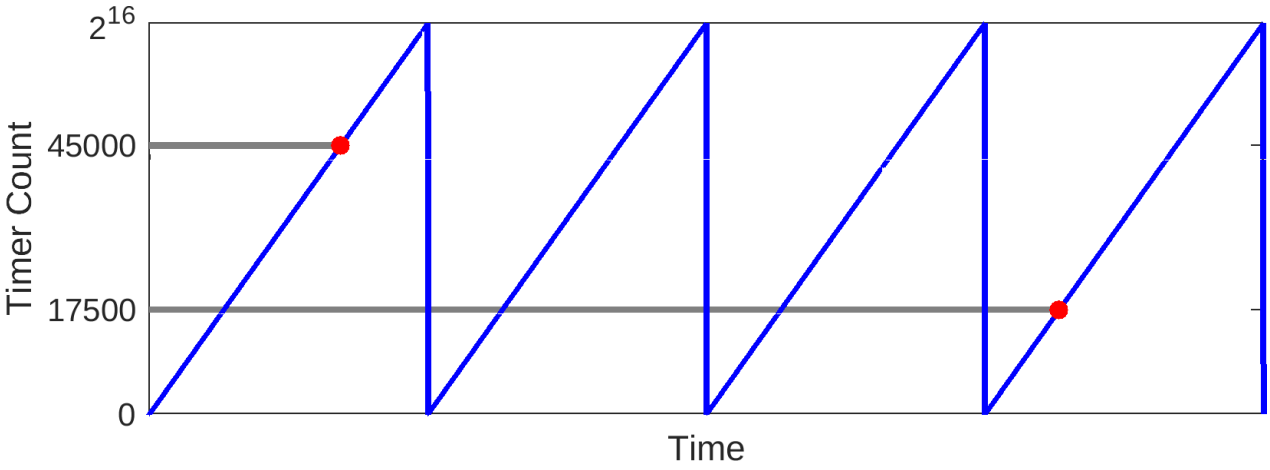
4172.39 mm
(1000/40) * (2 * 3.14 * 30) = 4172.39

Q4 Encoder with Timer_A

5 Points

A Timer_A module is configured as given (SMCLK = 24 MHz). Two capture events occurred as marked on the figure. How much time elapsed between the two capture events? You may add your math in the answer box for partial credit (not required).

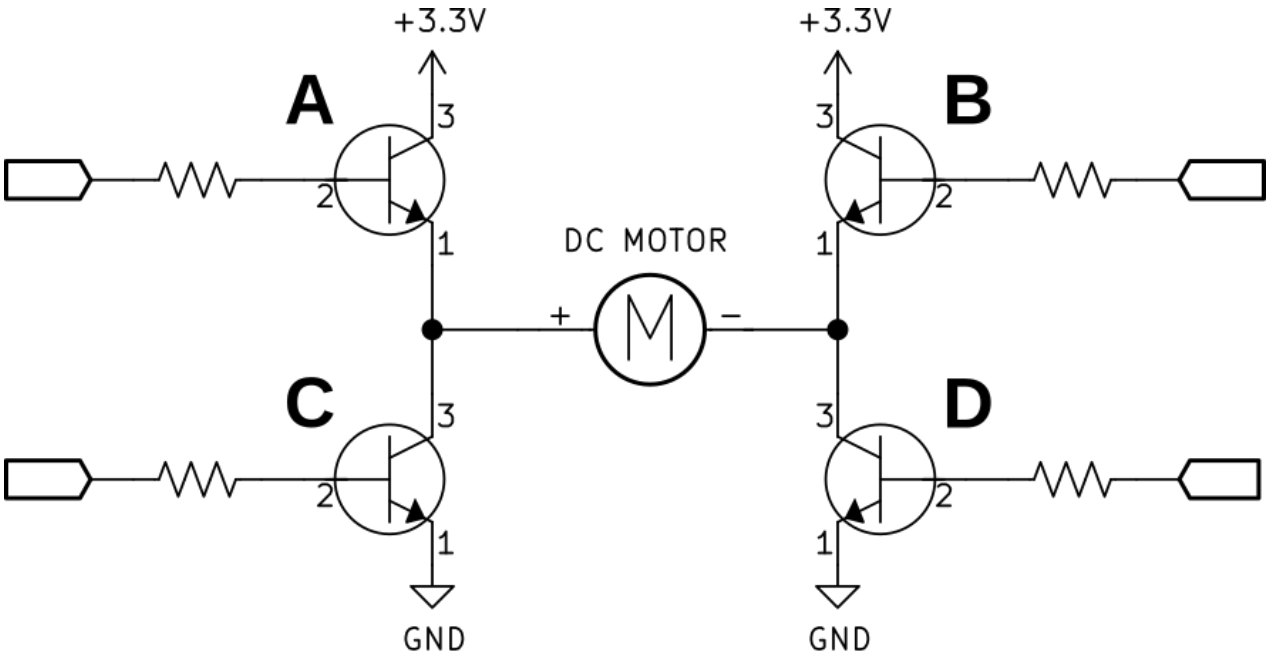
```
TA3cfg.clockSource = TIMER_A_CLOCKSOURCE_SMCLK;
TA3cfg.clockSourceDivider = TIMER_A_CLOCKSOURCE_DIVIDER_1;
TA3cfg.timerInterruptEnable_TAIE = TIMER_A_TAIE_INTERRUPT_ENABLE;
Timer_A_configureContinuousMode(TIMER_A3_BASE,&TA3cfg);
```



17500 - 45000 + 3(2^16) = 169108

Q5
3 Points

A motor is controlled by an H-bridge as shown. The motor spins **clockwise** when current flows from the motor's + terminal to the - terminal. What transistors must be ON (conducting) for the motor to spin **counter-clockwise**?



- [ ] A
- [x] B
- [x] C
- [ ] D