

Form#: 14

Allowed materials include calculator (without wireless capability), pencil or pen.

**Honor Statement:** On my honor, I promise that I have not received any outside assistance on this exam (I didn't look at another student's paper, I didn't view any unauthorized written materials, I didn't talk or listen to another student, . . .).

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Dept.	Course #			Section (last 2 dig)		Exam Form	
4	1	2	2				
0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9

- H11
- H12
- H13
- H14
- 001
- 002
- 003

- 10-11:50 TR Hall
- 2-3:50 TR Cronk
- 12-1:50 TR Swanbom
- 8-9:50 TR Barker
- 2-3:50 MW Swanbom
- 12-1:50 TR Cronk
- 8-9:50 TR Nelson

1 lb = 4.448 N  
 1 in = 25.4 mm  
 1 m = 3.281 ft  
 g = 9.81 m/s<sup>2</sup>

$$I = Pni$$

$$F = P(1 + ni)$$

$$F = P(1 + i)^n$$

$$P = F(1 + i)^{-n} \quad F = A \left[ \frac{(1+i)^n - 1}{i} \right] \quad P = A \left[ \frac{(1+i)^n - 1}{i(1+i)^n} \right]$$

☆ also fill in **CWID**, **name** and **course (122)** . . . don't forget to black in bubbles

☆ **you must show your work on problems that require calculations to receive credit**

Problem 1

(3 points) Select the item below which is NOT one of the steps of the IDEO design process ...

- a. Understand the problem
- b. Observe people in real life situations
- c. Visualize new to the world solutions
- d. Make a YouTube video describing your product's operation
- e. Evaluate and refine prototypes
- f. Implement the new concept for commercialization
- g. None of the above

## Problem 2

(4 points) Which of the following is NOT a characteristic of a good brainstorming session?

- a. Creative process
- b. Evaluate concept ideas
- c. Messy process
- d. Generate a large quantity of ideas
- e. Make of list of ideas
- f. Encourage wild ideas
- g. All of the above
- h. None of the above

### Problem 3

(4 points) When working with thin sheet metal, the *proper* tool or process for creating a hole in the sheet metal (a hole whose diameter exceeds the thickness of the sheet metal) is...

- a. Shear
- b. Brake
- c. Hand punch
- d. Cordless drill
- e. Drill press
- f. Rivet gun
- g. All of the above
- h. None of the above

#### Problem 4

(4 points) Two spur gears A and B, with compatible teeth, mounted on parallel shafts, are meshed together. Gear A has a larger diameter than Gear B. Gear A is rotated using an external torque applied to its shaft. Select the true statement from the following...

- a. Gear B will rotate at a lower RPM than Gear A.
- b. Gear A has fewer teeth than Gear B.
- c. Gear B will transmit less torque than is applied to Gear A.
- d. If Gear A rotates clockwise, then Gear B will also rotate clockwise.
- e. All of the above
- f. None of the above

## Problem 5

(5 points) One of your professors is having trouble figuring out how to text with a standard smartphone and decides to save up \$300 for a new smartphone with a better texting interface. If he can save money in an account that draws 9% interest compounded annually, then the amount he needs to put into the account today in order to save the \$300 by the end of 5 years is closest to ...

- a. \$195
- b. \$210
- c. \$225
- d. \$240
- e. \$255
- f. \$270
- g. \$285
- h. \$300

## Problem 6

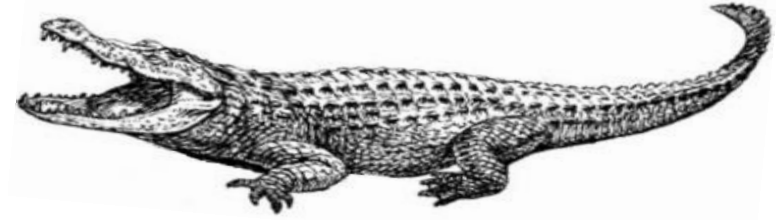
(5 points) Sheila wants to buy a new laptop now, but doesn't have any money. If she can get a loan at an 18% annual interest rate, compounded monthly, then the most she can pay for the laptop today if she can make monthly payments of \$65 for the next three years is closest to ...

- a. \$1,500
- b. \$1,800
- c. \$2,100
- d. \$2,400
- e. \$2,700
- f. \$3,000
- g. \$4,050
- h. \$5,120

### Problem 7

(5 points) Dr. Swanbom just bought a newly-hatched female alligator, which he named LeTourneau. Knowing that alligators may live for 60 years, he wants to provide for LeTourneau after his own demise. The alligator will require an average of \$600/month for food, doctor bills, and other needs. Dr. Swanbom has just put \$2,000 into a savings account that should earn an average of 11% annual interest, compounded monthly. If Dr. Swanbom should leave this earth after 20 years, then how much should he add to the savings account every month for the next 20 years so that LeTourneaus's total inheritance will take care of her for the 40 years after Dr. Swanbom passes?

- a. \$41
- b. \$54
- c. \$63
- d. \$82
- e. \$105
- f. \$123
- g. \$141
- h. \$167
- i. \$180
- j. \$203



## Problem 8

(5 points) A new engineering graduate wants to buy a house. She wants to repay the loan over a period of 15 years. If she determines that she can afford \$1,110 per month, and can get a loan for 4% annual interest, compounded monthly, then the most she can afford to purchase a house today is closest to ...

- a. \$50,000
- b. \$75,000
- c. \$100,000
- d. \$125,000
- e. \$150,000
- f. \$175,000
- g. \$200,000
- h. \$250,000



### Problem 9

(5 points) A new engineering graduate wants to buy a new OLED TV, but can't afford the \$9,000 sticker price. If she can save \$430 each month in a savings account that draws 9% annual interest, compounded monthly, then how many months will she need to wait before she can buy the TV? (Assume that the TV will still cost \$9,000 when she gets ready to make the purchase.)

- a. 2
- b. 5
- c. 8
- d. 10
- e. 12
- f. 15
- g. 18
- h. 20
- i. 22
- j. 25

### Problem 10

(5 points) A student is able to get to get a loan of \$1,000 at 7% simple annual interest. At the end of 6 years, the student will owe a total of approximately ...

- a. \$420
- b. \$500
- c. \$1,000
- d. \$1,420
- e. \$1,500
- f. \$1,600
- g. \$1,700

## Problem 11

(5 points) Felicity wants to buy a new car. The sticker price, including taxes, is \$18,000. If Felicity can get a loan for the car at an annual interest rate of 8%, compounded monthly, and agrees to pay the loan off in 5 years, then her monthly payments will be closest to ...

- a. \$365
- b. \$390
- c. \$420
- d. \$450
- e. \$465
- f. \$490
- g. \$520
- h. \$555
- i. \$585

## Problem 12

(5 points) Your friend has a credit card debt of \$2500. You convince him to stop using the credit card and to begin paying off the debt, making payments of \$50 per month. If the card has an effective annual interest rate of 18% compounded monthly, the time required to pay of the debt is closest to ...

- (a) 2.3 years
- (b) 4.9 years
- (c) 5.7 years
- (d) 6.3 years
- (e) 7.8 years
- (f) 9.1 years
- (g) 10.8 years

### Problem 13

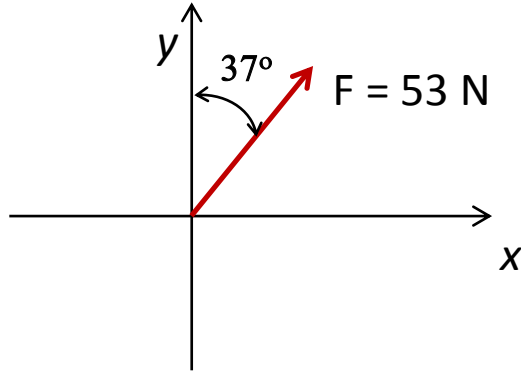
(5 points) You decide to borrow \$1000 from Easy Loan for 1 year at 9% annual interest compounded monthly. If you repay the loan in equal monthly payments, the amount of each payment is closest to ...

- (a) \$50.00
- (b) \$65.43
- (c) \$73.33
- (d) \$87.45
- (e) \$92.12
- (f) \$96.33

Problem 14

(5 points) The x component of the force shown below is closest to .....

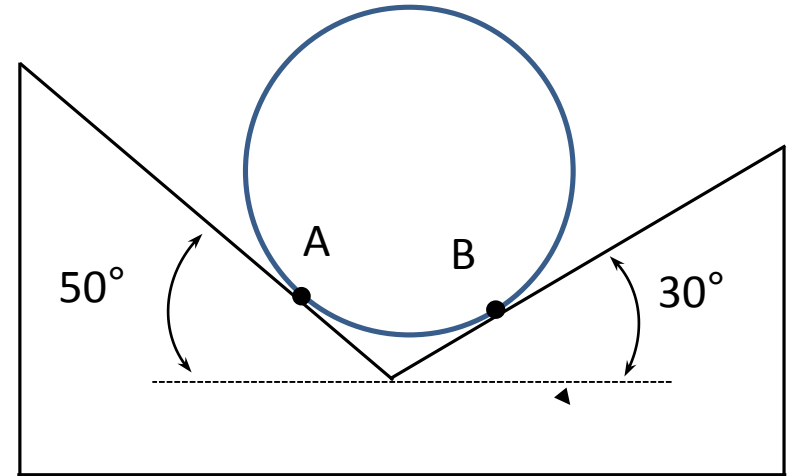
- (a) 31.9 N
- (b) 35.3 N
- (c) 42.3 N
- (d) 45.1 N
- (e) 47.2 N
- (f) 62.6 N



### Problem 15

(5 points) A sphere is held in place by the rack as shown in the figure below. The weight of the sphere is 245 N. Assuming frictionless contact between the rack and the sphere, the force at B is closest to...

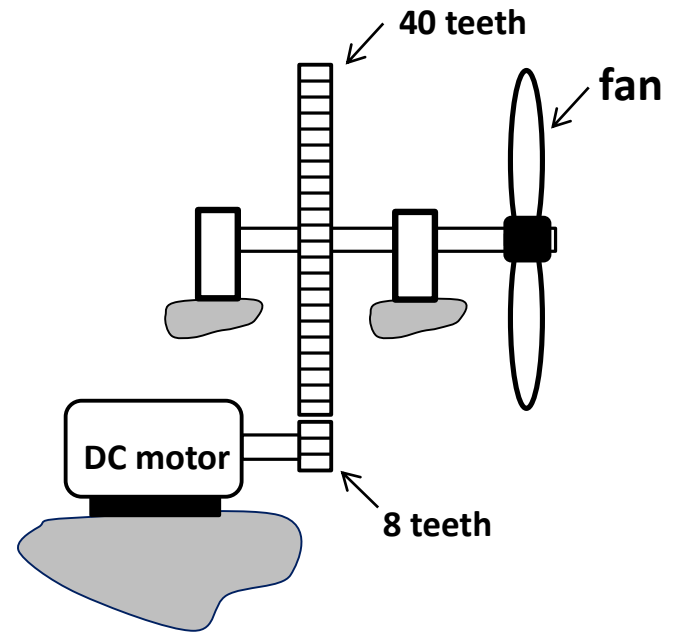
- a. 319 N
- b. 212 N
- c. 157 N
- d. 381 N
- e. 283 N
- f. 191 N
- g. 245 N



### Problem 16

(5 points) A spur gear with 8 teeth meshes with another a gear with 40 teeth. If the motor spins at 3600 RPM, then the RPM of the fan is closest to . . .

- a. 90 RPM
- b. 320 RPM
- c. 450 RPM
- d. 720 RPM
- e. 1440 RPM
- f. 18000 RPM

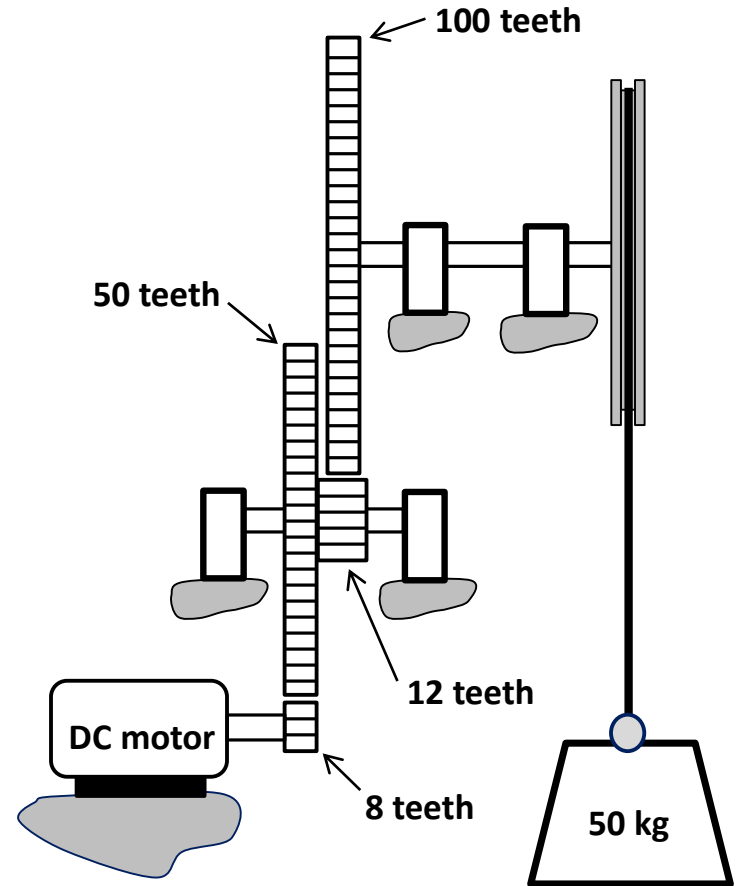




### Problem 17

(5 points) A DC motor connected to a 24V power supply draws 10 A while powering a weight lifting device. Assuming a system efficiency of 62%, the speed at which the 50 kg mass is lifted is closest to . . .

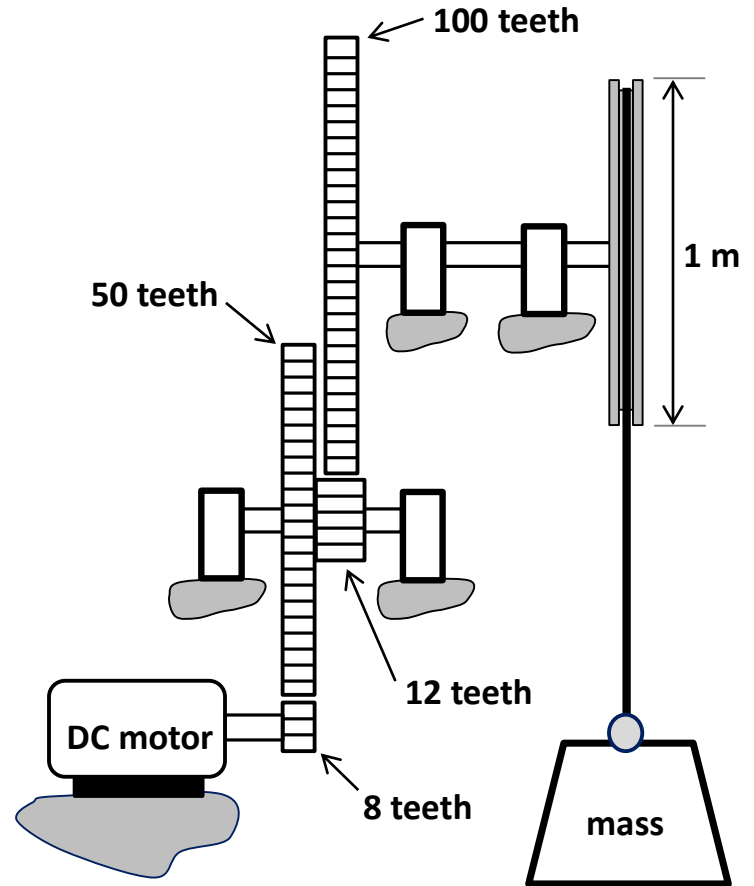
- a. 0.12 m/s
- b. 0.24 m/s
- c. 0.30 m/s
- d. 0.36 m/s
- e. 0.49 m/s
- f. 1.2 m/s
- g. 20 m/s
- h. 42.1 m/s



### Problem 18

(5 points) A DC motor spins at 10,000 RPM while generating 1 N-m of torque. Assuming that the gear train has a 100% efficiency, the speed that the mass is lifted is closest to . . .

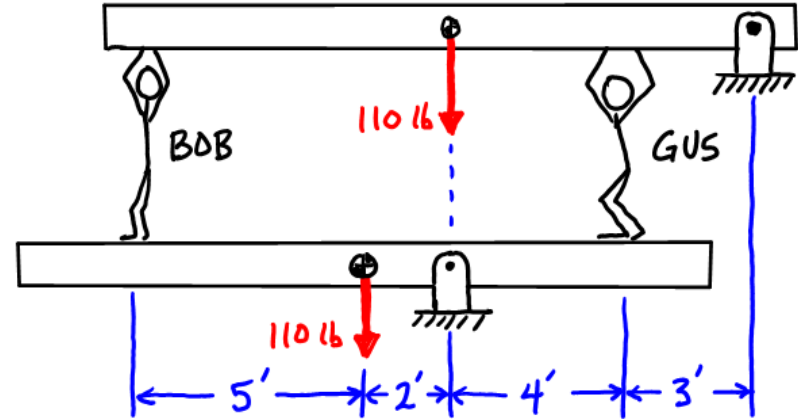
- a. 5 m/s
- b. 10 m/s
- c. 15 m/s
- d. 20 m/s
- e. 25 m/s
- f. 30 m/s
- g. 35 m/s
- h. 40 m/s



### Problem 19

(5 points) Bob and Gus are trying to keep these two levers balanced and level. Each lever weighs 110lb. Bob weighs 120lb and Gus weighs 230lb. The force with which Bob has to push up on the upper lever is closest to:

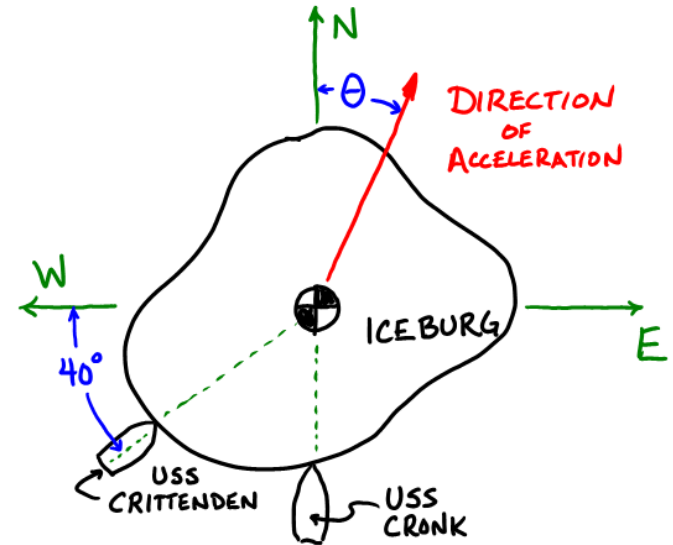
- (a) 29.5 lb
- (b) 34.5 lb
- (c) 39.5 lb
- (d) 44.5 lb
- (e) 49.5 lb
- (f) 54.5 lb
- (g) 59.5 lb
- (h) 64.5 lb
- (i) 69.5 lb
- (j) 74.5 lb



### Problem 20

(5 points) The USS Cronk and the USS Crittenden are tasked with moving an iceberg. The USS Crittenden begins pushing in the direction shown with a force of 3 tons. The USS Cronk begins pushing due north with a force of 2 tons. Assume that these are the only forces acting on the iceberg. The direction ( $\theta$ ) that the iceberg begins to accelerate (relative to due north) is closest to .....

- (a)  $18.3^\circ$
- (b)  $21.3^\circ$
- (c)  $24.3^\circ$
- (d)  $27.3^\circ$
- (e)  $30.3^\circ$
- (f)  $33.3^\circ$
- (g)  $36.3^\circ$
- (h)  $39.3^\circ$
- (i)  $42.3^\circ$
- (j)  $45.3^\circ$



### Problem 21

(5 points) Two loads are applied to this shelf bracket, one from above and one from a string tied to the upper tip at  $20^\circ$  from vertical. The moment that these two loads create around the bottom tip of the bracket is closest to .....

- (a) 34 in\*lb
- (b) 151 in\*lb
- (c) 360 in\*lb
- (d) 430 in\*lb
- (e) 526 in\*lb
- (f) 618 in\*lb
- (g) 640 in\*lb
- (h) 656 in\*lb
- (i) 711 in\*lb
- (j) 854 in\*lb

