Name (PRINT neatly): _____

Seat Assignment: _____

Specify your **EXAM ID** on the right. Use 000 if you do not know your exam ID.

Circle your LAB SECTION

	ZEC 377 (Tickle Side)	ZEC 371 (Stadium Side)
9:50 am	**B377** **McKensie**	**B371** **Graham**
11:30 am	**C377** **McKensie**	**C371** **Tyler**
1:10 pm	**D377** **Tyler**	**D371** **Graham**

0 ○	0 ○	0 ○
1 ○	1 ○	1 ○
2 ○	2 ○	2 ○
3 ○	3 ○	3 ○
4 ○	4 ○	4 ○
5 ○	5 ○	5 ○
6 ○	6 ○	6 ○
7 ○	7 ○	7 ○
8 ○	8 ○	8 ○
9 ○	9 ○	9 ○

Instructions

- Completely color in the dot for your chosen answers on multiple choice.
- Assume **3 significant figures** for all given numbers unless otherwise stated
- Show all of your work – no work, no credit
- Make sure your **symbolic equation(s)** for solving the problem is **clearly stated** on the page before you input numerical values to solve for a final answer.
- Pace yourself and attempt every problem, even if its only writing the symbolic equation.

1. (1 pt) In MATLAB, the text entered after a prompt generated by the `input` function is:

evaluated as code	returned as literal text	dependent on other arguments passed to `input`
○	○	○

2. (1 pt) The area under the curve for a Force-Distance graph gives:

Change in Kinetic Energy	Change in Momentum	Change in Velocity
○	○	○

3. (1 pt) The angle of the vector $(12\hat{\imath} - 5.1\hat{\jmath})$ft counterclockwise from the x-axis is:

113°	157°	293°	337°
○	○	○	○

4. (1pt) How much work is done by the force, $F = (-\mathbf{6}\hat{\boldsymbol{\imath}} + \mathbf{4}\hat{\jmath})\ N$, as it acts on a 3.0-kilogram object while it moves through a displacement of $\boldsymbol{d} = (-3\hat{\boldsymbol{\imath}} + \mathbf{7}\boldsymbol{j})\ m$.

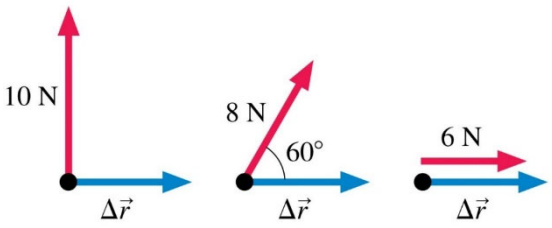
10 N-m	46 N-m	54.9 N-m	-30 N-m
○	○	○	○

5. (1 pt) A spring loaded gun shoots a ball with a speed of 1.0 m/s. If the spring is compressed 3 times as far, the speed of the ball will be:

1.0 m/s	3.0 m/s	9.0 m/s
○	○	○

6. (1 pt) Which force below does the most work? All three displacements are the same.

10 N force	8 N force	6 N force	They all do the same work
○	○	○	○



7. (1 pt) What is **NOT** a unit of power?

$\frac{ft * lb}{s}$	$\frac{J}{s}$	$\frac{W}{s}$	W
○	○	○	○

8. (1 pt) In a perfectly inelastic collision, which is true?

Only momentum is conserved	Only energy is conserved	Both energy and momentum are conserved	Neither momentum nor energy are conserved
○	○	○	○

9. (1 pt) Two objects of equal mass are moving with equal and opposite velocities when they collide. Can all the kinetic energy be lost in the collision?

Yes	No	Cannot determine
○	○	○

10. (1 pt) A hockey puck sliding on ice at 5 m/s comes to a 1-m-high hill. Will it make it to the top of the hill?

Yes	No	Can't answer without knowing mass of puck	Can't answer without knowing angle of hill
○	○	○	○

11. (1 pt) The area under the curve for a Force-Time graph gives:

Change in Kinetic Energy	Change in Momentum	Change in Velocity
○	○	○

12. (1 pt) What is the value for the coefficient of restitution for an inelastic collision?

0	Between 0 and 1	1	Depends upon the velocities
○	○	○	○

13. (1 pt) The value of $(\hat{k} \times \hat{\imath})$ is:

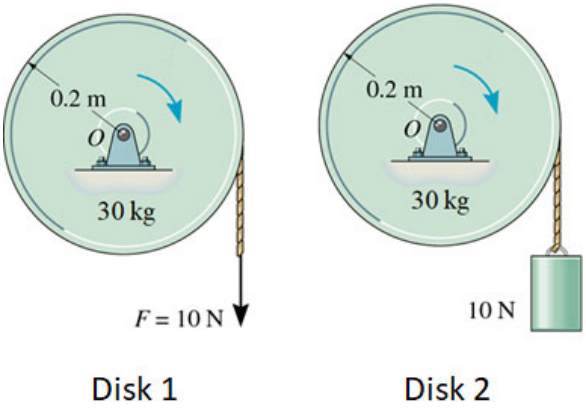
$+\hat{\imath}$	$-\hat{\imath}$	$+\hat{\jmath}$	$-\hat{\jmath}$	$+\hat{k}$	$-\hat{k}$	1	0
○	○	○	○	○	○	○	○

14. (1 pt) The direction of the torque vector is:

parallel to $\bar{F}$	parallel to $\bar{r}$	perpendicular to plane containing $\bar{r} \times \bar{F}$
○	○	○

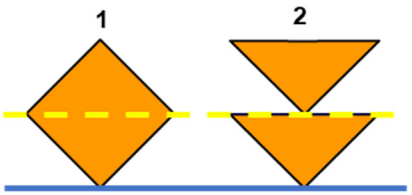
15. (1 pt) Which disk has the greater angular acceleration?

Disk 1	Disk 2	Both have the same angular acceleration
○	○	○



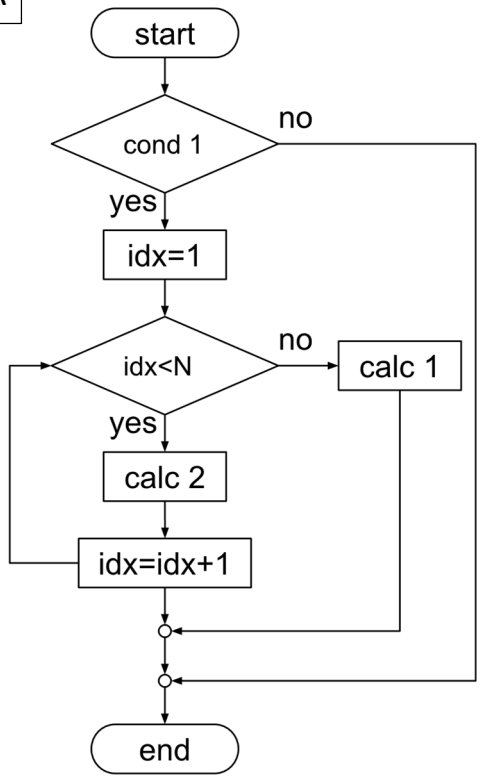
16. (1 pt) The square plate shown in (1) clearly has its center of mass at the center. Suppose the plate is cut in half and the pieces arranged as shown in (2). Where is the center of mass of (2) as compared to (1)?

Higher	Lower	At the same place	There is no definable CM in this case
○	○	○	○

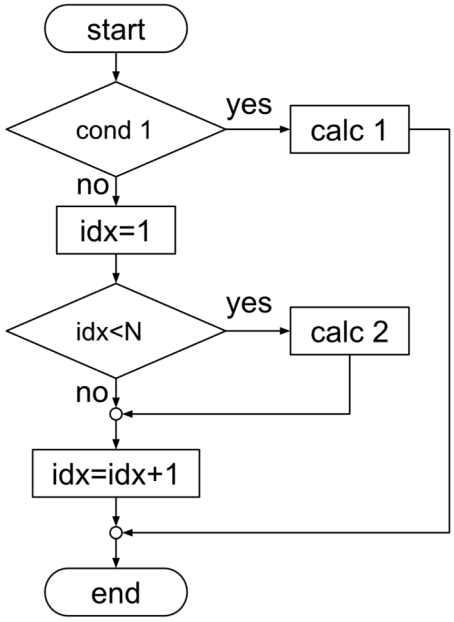


MATLAB: For each code block (on next page), indicate which of the flowcharts below is implemented.

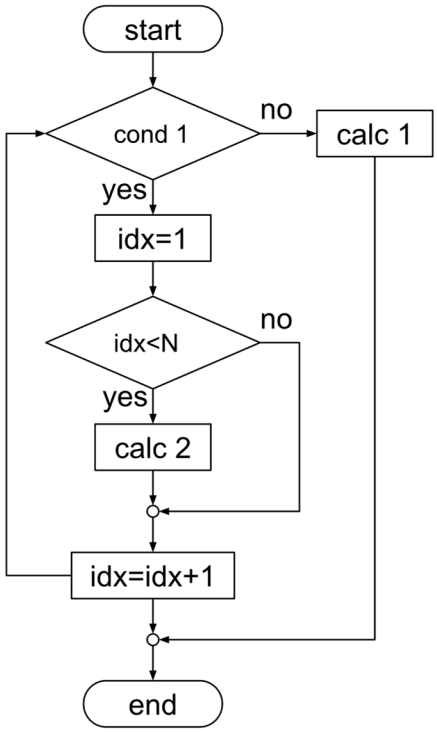
A



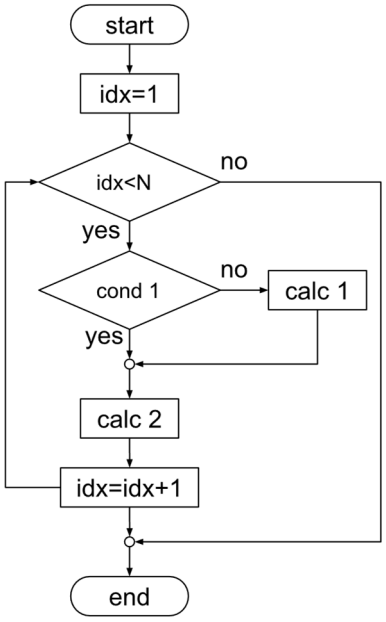
C



B



D



Match the following code to the algorithms provided on the previous page. If a code block implements none of the provided flowcharts, select "None". (2 points for each)

17.

```
while {cond 1}
    idx=1
    if idx<N
        {calc 2}
    end
    idx=idx+1;
end
{calc 1}
```

Flow Chart A	Flow Chart B	Flow Chart C	Flow Chart D	None
○	○	○	○	○

18.

```
if {cond 1}
    for idx=1:N
        {calc 2}
    end
    {calc 1}
end
```

Flow Chart A	Flow Chart B	Flow Chart C	Flow Chart D	None
○	○	○	○	○

19.

```
for idx=1:N
    if ~{cond 1}
        {calc 1}
    end
    {calc 2}
end
```

Flow Chart A	Flow Chart B	Flow Chart C	Flow Chart D	None
○	○	○	○	○

20.

```
idx=1;
if {cond 1}
    {calc 1}
elseif idx<N
    {calc 2}
else
    idx=idx+1;
end
```

Flow Chart A	Flow Chart B	Flow Chart C	Flow Chart D	None
○	○	○	○	○

21.

```
if {cond 1}
    idx=1;
    while idx<N
        {calc 2}
        idx=idx+1;
    end
    {calc 1}
end
```

Flow Chart A	Flow Chart B	Flow Chart C	Flow Chart D	None
○	○	○	○	○

22.

```
if {cond 1}
    {calc 1}
else
    idx=1;
    if idx<N
        {calc 2}
    end
    idx=idx+1;
end
```

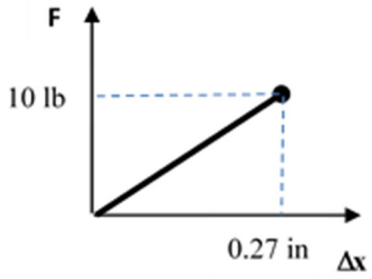
Flow Chart A	Flow Chart B	Flow Chart C	Flow Chart D	None
○	○	○	○	○

23. (2 pts) Let the following matrix be defined in the MATLAB workspace as, `A = [5,-3,3,-5]`. What will be the output of the following line of code, `result = length(A)`?

24. (2 pts) What values will display in the Command Window after this code is run?

```
a = 4;
b = 2;
if a < 4
      fprintf('%0.0f ',a)
elseif a > 1
     fprintf('%0.0f ',b)
end
```

25. (4 pts) What is the spring constant of the spring if the force required to deform a spring at varying distances is shown in the graph to the right?



26. (4 pts) A baseball, m = 0.145 kg, thrown at 40.2 m/s is hit by a bat and leaves the bat at 49.1 m/s. If the bat had contact with the ball for 0.0007s, what is the average force the bat exerted on the ball?

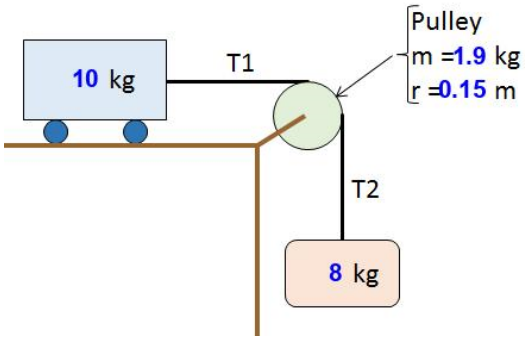
27. (4 pts) A snowmobile utilizes 25.4 kW of power to drive up a hill at a constant speed. If the engine is 30% efficient, how much power does it need to generate?

28. (4 pts) Two pucks of the same mass collide on an ice rink (+ to the right). Puck one initially is moving right at a 3.2 m/s while puck 2 is at rest. After the collision, puck 2 is moving 2.6 m/s to the right and puck 1 is moving at 0.2 m/s to the right. What is the coefficient of restitution of this collision?

29. (4 pts) A 4.2 lb cart moving at 14 ft/s to the right directly strikes a 5.7 lb cart that is initially moving to the left at 6.2 ft/s. After the collision, the carts stick together. What is their new velocity (both magnitude and direction) after the collision?

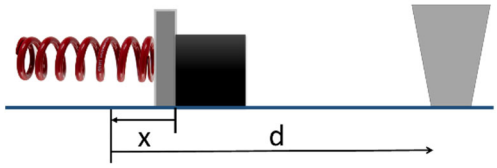
30. (4 pts) Draw a FBD = KD of the pulley in this diagram.

FBD **=** **KD**

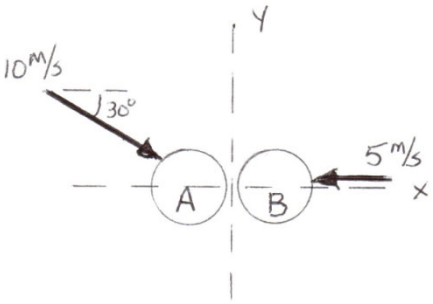


31. (4 pts) A figure skater with a mass moment of inertia of 1.1 kg-m^2 is spinning at 2.9 rad/sec. The figure skater lowers her arms, so her mass moment of inertia is 0.7 kg-m^2. What is her new angular speed after she lowers her arms?

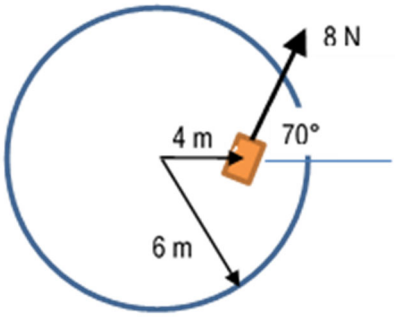
32. (10 pts) Dr. McCave uses a spring, k = 210 lb/in, to slide a 5.3 lb box across the floor (μ_s=0.29, μ_k=0.24) at a bucket full of confetti located 2.7 feet away. The box needs to hit the bucket with a speed of 2.6 ft/s to tip the bucket and spill confetti over Dr. Maczka. The picture shows the spring in its undeformed position. How far (x) does Dr. McCave need to compress the spring for the box to tip the bucket over?



33. (10 pts) Two identical balls collide as shown. The velocity of ball B after the collision is +6.0 m/s in the x direction. What is the magnitude of the final velocity of ball A after the collision?



34. (10 pts) A horizontal circular platform ($I = 42$ kg-m^2) spins freely about its center axis. A 3.0 kg fan mounted on the platform provides a constant force as shown. How many revolutions does the platform make in one minute if it starts from rest? Treat the fan as a point mass. (Hint: find angular acceleration first)



35. (10 pts) Look through the script for mistakes that would cause the results of the following script to be unsatisfactory. There are a total of 3 lines of code in the script that contain mistakes. In the table provided below the script, specify the line number with the mistake and re-write the line of code beside it, correcting all errors discovered.

```
1   clear; clc
2
3   % objects_data.mat contains the following variable arrays:
4   % names (text/string), masses (number), mu_ks (number)
5   load('objects_data.mat');
6   nObjects = length(names); % all arrays have the same length
7
8   %% Inputs
9   pushForce = 1500; % N, force applied to the object
10  rampHeight = 5;   % m, height reached by ramp
11  rampIncline = 15; % degrees ccw from x, angle of ramp incline
12  g = 9.81;         % m/s^2, acceleration due to gravity
13
14  %% Calculate
15  weight = masses*g; % weight of all the objects (array of length nObjects)
16  forceFriction_flat = weight*mu_ks;
17  netForce = pushForce - forceFriction_flat;
18
19  % Gravitational potential energy is the weight (m*g) times the final height
20  U_gf = weight*rampHeight;
21
22  d2 = rampHeight/sind(rampIncline); % m, the distance along the ramp
23
24  % Force of friction on the incline is defined as F_incline = N*mu_k
25  forceFriction_incline = weight.*mu_ks*cosd rampIncline;
26  E_loss = forceFriction_incline*d2;
27
28  % With all the intermediate calculations complete, we can now calculate d1
29  d1 = (U_gf + E_loss)./netForce;
30
31  %% Output
32  for objIdx=1:nObjects
33      if (d1(objIdx) < 0)
34          fprintf("The applied push force is not sufficient to overcome " + ...
35              "the force of friction of the %.3g kg %s.\n", masses(objIdx), names(objIdx));
36      else
37          fprintf("The %s will have to be pushed for %.1f meters\n", names(objIdx), d1);
38      end
39  end
```

Line #	Corrected Code