

**Description**

This set of 1 statement of commitment to academic integrity and 15 questions is the final exam for PHYS 115 Fall 2021 at the University of Saskatchewan.

1/3 of the exam mark is based on the answers for the 10 multiple-choice questions submitted through WebAssign. All 10 multiple-choice questions are weighted equally.

2/3 of the exam mark is based on the answers (submitted through WebAssign) and solutions (submitted through Canvas) for the 5 word problems. All 5 word problems are weighted equally.

**Instructions**

Answers for **all** questions need to be submitted in WebAssign.

For each of questions 12, 13, 14, 15, and 16, in addition to submitting your answers in WebAssign, write the complete solution, **including a diagram**, using the problem-solving method discussed in class.

*Your solutions must use the same symbols as are used on the formulae sheet.*

*Include a short sentence, a phrase, or a few words describing the principle(s) used in your solution.*

*Formulas not on the Formulae Sheet must be derived.*

**Keep extra decimal places throughout your calculations, and then round-off your final answer to three significant figures.**

Submit your answer to each question in WebAssign.

When you have finished the entire exam, scan your written work for questions 12 through 16 and submit a single multi-page PDF file using the link in the Canvas site for your section.

**Your WebAssign submission is due no later than 180 minutes (three hours) after the questions become available and your Canvas submission is due no later than 210 minutes (three-and-a-half) hours after the questions become available.**

1. - UofS-P115-P117-Honour [4820285]

On my honour, I pledge that I will not give or receive aid during this assessment. I understand that I am expected to complete this assessment with no communication with other persons and no resource material other than the PHYS 115/117 Formulae sheet. I recognize that it is my responsibility to uphold academic integrity and I agree to follow the rules of this assessment and the guidelines laid forth in the policies of the University of Saskatchewan. Furthermore, I fully understand that disciplinary action may be taken against me if I am discovered to have communicated with another person or to have used an internet resource.



Yes, I understand and agree.

2. - P115-2021-FNL-1-A1 [5141051]

The difference in pressure,  $\Delta P$ , between two points that are separated by a vertical distance of  $y$  in a fluid of density  $\rho$  is given by  $\Delta P = \rho gy$ . Water has a density of  $\rho = 1.00 \times 10^3 \text{ kg/m}^3$ . Using the provided equation for  $\Delta P$ , calculate the difference in pressure between two points that are separated by a vertical distance of 75.6 cm in a filled swimming pool.

- $7.41 \times 10^3 \text{ N}$ 
  $7.4 \times 10^3 \text{ N/m}^2$ 
  $741 \text{ N}$ 
  $7.41 \times 10^3 \text{ N/m}^2$ 
  $7.41 \times 10^5 \text{ N/m}^2$

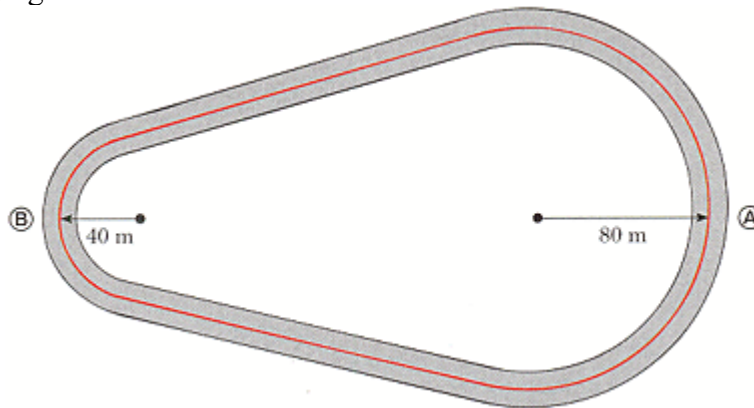
3. - P115-2021-FNL-1-A2 [5141052]

A package is released from a plane which is flying horizontally over flat horizontal ground. After release the package has an initial velocity which is the same as the plane. When the package is released, the plane is a height  $H$  above the ground and the speed of the plane is  $V$ . If we ignore air resistance, which statement is correct about the time interval between when the package is released and when it hits the ground?

- It depends on both  $H$  and  $V$ .  
 It depends only on  $V$  and not on  $H$ .  
 It does not depend on either  $H$  or  $V$ .  
 It depends only on  $H$  and not on  $V$ .

4. - P115-2021-FNL-1-A3 [5141072]

Consider the following figure.



A race track is constructed such that two curves of constant radius 80 m at  $A$  and 40 m at  $B$  are joined by two stretches of straight track as in the figure above.

While testing a new car, a driver travels at a constant speed of 50 m/s for one complete lap.

Which one of the following options is correct for the ratio of the centripetal acceleration of the car at  $A$  to the centripetal acceleration of the car at  $B$ ?

- $a_{cA}/a_{cB} = 1/2$ 
  $a_{cA}/a_{cB} = 1/4$ 
  $a_{cA}/a_{cB} = 2$ 
  $a_{cA}/a_{cB} = 4$   
 The centripetal acceleration is zero at both points.

5. - P115-2021-FNL-1-A4 [5141045]

You wish to lift a box from the ground to the back of a truck. Which of the following methods of moving the box requires you to do the least amount of work on the box? Initially the box is at rest on the ground and finally it is at rest in the back of the truck.

- Slowly lifting the box vertically.
- All the described methods require you to do the same amount of work on the box.
- Rapidly lifting the box vertically.
- Rapidly sliding the box up a frictionless ramp.
- Slowly sliding the box up a frictionless ramp.

6. - P115-2021-FNL-1-A5 [5141077]

Using a screwdriver, you try to remove a screw from a piece of furniture, but can't get it to turn. To increase the chances of success, you should use a screwdriver that

- is longer.
- is shorter.
- has a narrower handle.
- has a wider handle.

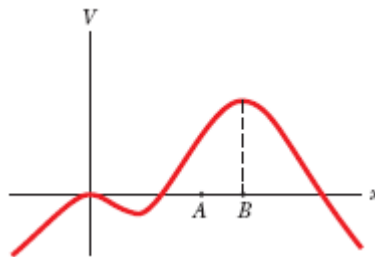
7. - P115-2021-FNL-1-A6 [5141046]

A star originates as a large body of slowly rotating gas. Because of gravitational attraction, this large body of gas slowly decreases in size. Which one of the following statements correctly describes what happens as the radius of the body of gas decreases? You can assume that no external forces are acting.

- Both the angular momentum and the angular velocity increase.
- The angular momentum remains constant and the angular velocity increases.
- Both the angular momentum and the angular velocity decrease.
- Both the moment of inertia and the angular velocity increase.
- The angular momentum increases and the angular velocity decreases.

8. - P115-2021-FNL-1-A7 [5141081]

The figure below is a graph of an electric potential as a function of position.



If a positively-charged particle is released from rest at point  $A$ , what will be its subsequent motion? The positively-charged particle will...

- move to the right.
- move to the left.
- oscillate around point  $B$ .
- remain at point  $A$ .

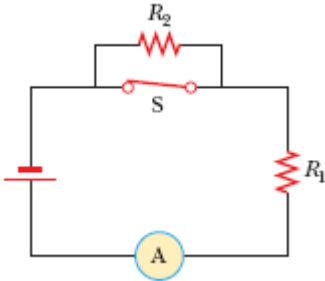
9. - P115-2021-FNL-1-A8 [5141047]

Consider two point charges located on the  $x$ -axis. A charge  $-Q$  is located at position  $-r$  and a charge  $+Q$  is located at position  $+r$ . The net electric field midway between the two charges at the origin of the  $x$ -axis is:

- zero.
- $2k_e|Q|/r^2$  in the  $-x$  direction.
- $k_e|Q|/r^2$  in the  $+x$  direction.
- $2k_e|Q|/r^2$  in the  $+x$  direction.
- $k_e|Q|/r^2$  in the  $-x$  direction.

10. - P115-2021-FNL-1-A9 [5141211]

In the figure below the current is measured with the ammeter at the bottom of the circuit.



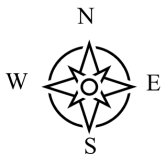
A circuit is comprised of two rectangular loops, one on top of the other. The bottom loop contains a battery on the left side with the positive terminal on the bottom, an ammeter on the bottom side, a resistor  $R_1$  on the right side, and a closed switch on the top side. The top loop contains a resistor  $R_2$  on the top side and a closed switch on the bottom side which is also the top side of the bottom loop.

When the switch is opened, the reading on the ammeter...

- decreases
- increases
- does not change

11. - P115-2021-FNL-1-A10 [5141212]

An electron has an initial velocity that is horizontal and directed toward the South. It then enters a region of space where there is a magnetic field. The electron is observed to curve upward in the magnetic field so that after a short time it is travelling vertically up. In which direction is the magnetic field?



- East
- West
- Up
- Down
- North

12. - P115-2021-FNL-1-B1 [5141053]

A locomotive exerts a constant force of  $6.53 \times 10^5$  N on a train that has a mass of  $1.01 \times 10^7$  kg. The train is on level rails. How much time does it take to increase the speed of the train from rest to 75.7 km/h? (Ignore air resistance and any resistance force from the rails on the wheels of the train. Enter your answer in minutes.) **To receive full marks, you must include a diagram showing the physical situation and your choice of coordinate system.**

5.42 min

13. - P115-2021-FNL-1-B2 [5141075]

A block of wood, with mass 1.26 kg, rests stationary on horizontal ground. The coefficient of kinetic friction between the block and the ground is 0.905. A bullet, with mass 0.250 kg, moving horizontally hits and sticks into the block of wood. We find that the speed of the block of wood, with the bullet embedded in it, just after the collision is 13.5 m/s. **To receive full marks, you must include a diagram showing the physical situation and your choice of coordinate system.**

(a) Calculate the speed of the bullet before hitting the block of wood.

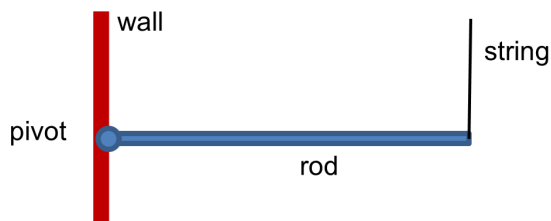
81.5 m/s

(b) Calculate how far the block slides along the ground before coming to rest.

10.3 m

14. - P115-2021-FNL-1-B3 [5141080]

A uniform rod has a mass of 2.12 kg and has a length of 1.13 m. It is hinged to a wall by a pivot at one end and is held in a horizontal position by a light vertical string attached to the other end as shown. **To receive full marks, you must include a diagram showing the physical situation and your choice of coordinate system.**



(a) Calculate the magnitude of the tension in the string.

10.4 N

(b) The string is now cut. Calculate the magnitude of the angular acceleration (in  $\text{rad/s}^2$ ) of the rod about the pivot point just after the string is cut. Ignore the mass of the string.

26  $\text{rad/s}^2$

15. - P115-2021-FNL-1-B4 [5141083]

An ionized nitrogen molecule ( $\text{N}_2^+$ ) at point A has charge  $+e$  and moves at  $1.8 \times 10^3$  m/s in the positive  $x$ -direction. A constant electric force in the negative  $x$ -direction slows the molecule to a stop at point B, a distance of 0.886 mm past A on the  $x$ -axis. Calculate the  $x$ -component of the electric field and the potential difference between points A and B. (The mass of a nitrogen molecule is  $4.65 \times 10^{-26}$  kg and the fundamental charge is  $e = 1.602 \times 10^{-19}$  C.) **To receive full marks, you must include a diagram showing the physical situation and the coordinate system.**

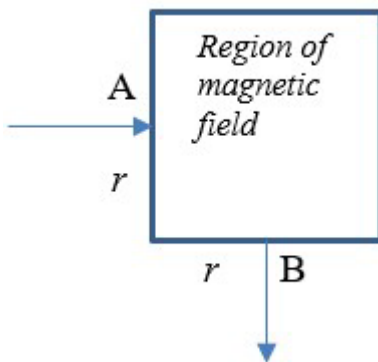
(a) the  $x$ -component of the electric field (in V/m)
  -531 V/m

(b) the potential difference between points A and B (in V)

  0.47 V

16. - P115-2021-FNL-1-B5 [5141213]


Beams of electrons can be steered using magnets. It is desired to change the trajectory of a beam of electrons by passing the beam through a magnetic field as shown in the diagram, where  $r = 4.52$  cm.



(a) Draw a diagram showing the path followed by the electrons while they are in the magnetic field, i.e. the path from A to B.

(b) The electrons have kinetic energies of 3.93 keV. Calculate the magnetic field (magnitude and direction) so that the electrons entering at A leave the magnet at B. You may assume that the magnetic force is the only force acting on the electrons. The mass of an electron is  $9.11 \times 10^{-31}$  kg. Which one of the following is the required direction of the magnetic field?

- to the left  
  toward the bottom of the page  
  into the page  
  to the right  
 out of the page  
  toward the top of the page

Required magnitude of magnetic field:   0.00468 T