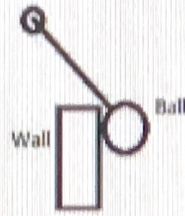
Gr. 12 Physics

Grade 12 Physics Exam Review

1. A ball, hanging diagonally from a string, rests against a wall. The situation is illustrated below:



Draw a FBD for the ball.

2. A comet flies through space at a constant velocity. Is there a net force on the comet? Explain.

3. Snehvir just finished watching Superman and is extremely motivated. He tries to push a bus, but despite his "tremendous" pushing force, the bus does not move. Explain why by discussing the forces acting on the bus.

4. Terell is helping his family garden by pulling a heavy soil bag from his car to his backyard. He notices that pulling the bag across the pavement of his driveway seemed much more difficult than pulling the bag across his grass. Explain why by discussing the forces acting on the bag of soil.

5. The electrostatic force between 2 equally charged objects, separated by a distance r, is F. How would the electrostatic force between the 2 equally charged objects change if the distance between the 2 objects were reduced to a third of the original distance, r?

6. Object 1 has mass m and is being suspended at a height of 50 m over the Earth's surface. Object 2 also has mass m and is being suspended at a height of 50 m over the moon's surface. Which object has more gravitational potential energy? Explain.

7. Shahan decides to take a break after studying for so long. He goes to the park (in his winter jacket and snow pants) and slides down a slide. If he reaches a maximum speed of 7.2 m/s at the bottom of the slide, how tall is the slide?

8. Hooke's law states that $F = -kx$. By describing the direction of F when x is zero (at rest position), negative (to the "left" of rest position), and positive (to the "right" of rest position), explain why F is an example of a restorative force.

9. A truck with mass $3.5 * 10^3$ kg travels at a speed of 11 km/h. Long, who has a mass of about 56 kg invents an awesome jetpack and is able to travel at a speed of $1.1 * 10^3$ m/s! If the jetpack has a mass of 4.6 kg, who has more momentum?

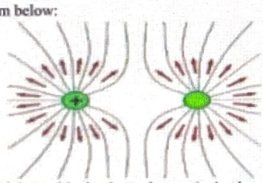
10. While the grade 12 physics students are writing their final exam, Mrs. Regular and Mr. On decide to have a Play Doh fight. Mrs. Regular creates a Play Doh ball with a mass of 57 g and throws it at Mr. On with a speed of 26 m/s. Mr. On creates a Play Doh ball with a mass of 65 g and throws it at Mrs. Regular with a speed of 19 m/s. The two Play Doh projectiles undergo a completely inelastic collision. Who gets hit by Play Doh?

11. While playing pool, Shereen hits the white ball with her cue stick, which in turn, hits the red and blue ball. Before the collision, the white ball was traveling at a velocity of 17 m/s [right]. After the collision, the white ball stops in its place, while the red ball travels 11 m/s [up 69° right] and the blue ball travels 7.8 m/s [down 70° right]. Assuming that the masses of all the balls are equal, what type of collision is this? Explain.

12. During a physics lab, Dupinder spins a yoyo over his head (in a horizontal plane) at a speed of v. Urvish decides that Dupinder is way too reckless and instead spins a yoyo over his head at a speed of $\frac{1}{5}v$. How does the centripetal force on Dupinder's yoyo compare to the centripetal force on Urvish's yoyo?

13. Aakash discovers that he has electrostatic powers and decides to use his powers to fight crime, as Electroman. One day, he captures villains who attempt to rob a bank by repelling 7.45 g bullets by charging himself to 6.8 C. The bullets, which are fired 76 m from Aakashe's position, experience an acceleration of 405 m/s^2 away from Aakash. What is the charge on the bullet?

14. Examine the diagram below:



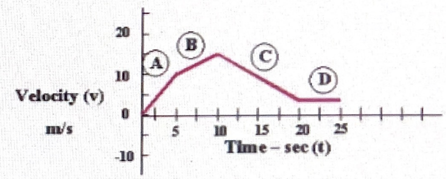
Is the object on the right positively charged, negatively charged, or neutral? Explain.

15. Pelumi conjures up a plan to get more study time before exams come. He hops on a spaceship and zooms around at a speed of 0.6c until his first exam day. Is this a good idea? Explain.

16. Using the idea of impulse, explain why moving your hand back as you catch a speeding ball hurts less compared to catching a speeding ball without moving your hand back.

17. An electron travels with a velocity of $5.4 * 10^4$ m/s [N 43° E] into a magnetic field of 0.78 T [S 38° E]. What is the magnitude and direction of the magnetic force acting on the electron?

18. Pulkit takes a drive and his trip is modeled by the following velocity/time graph:



a) Draw the corresponding acceleration/time graph.
b) Draw the corresponding displacement/time graph.

19. Why is it possible for a car to spin out of a turn if driving too fast? How does turning on a banked curve help prevent a car from spinning out?

20. Monochromatic light falls on two very narrow slits 0.035 mm apart. Successive nodal points on a screen 3.4 m away are 2.7 cm apart near the centre of the pattern. Calculate the wavelength of the light.

21. A laptop rests on the surface of a table.

a) Use Newton's First Law to explain this situation.
b) Use Newton's Second Law to explain this situation.
c) Use Newton's Third Law to explain this situation.

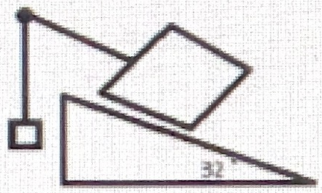
22. What is the difference between the electromagnetic force and the strong nuclear force in a molecule?

23. In Young's double slit experiment, both dark sports and bright spots can be observed on the screen. Explain how the dark and bright spots are created.

24. The particle-wave duality model of light suggests that light can sometimes act as a particle while at other times, it can act as a wave.

a) List and explain an experiment that demonstrates the particle nature of light.
b) List and explain an experiment that demonstrates the wave nature of light.

25. A large 25.3 kg box rests on a ramp, but is attached to a smaller 21.6 kg box as illustrated below:



Assuming that friction is negligible, in which direction is the system moving?

26. In order to win a bet against Long, Harmeet must invent a faster jetpack. One night, instead of studying for his physics exam, Harmeet completes a prototype of his new jetpack and decides to take it for a spin. With a combined mass of 63 kg, Harmeet and his jetpack achieve a speed of $0.13c$!

a) What is the rest energy of Harmeet and his jetpack?
b) What is the total energy of Harmeet and his jetpack?
c) What is the kinetic energy of Harmeet and his jetpack?

27. An equation that is often used to describe the photoelectric effect is $K_{MAX} = hf - \gamma$, where γ is called the work function. What is the significance of γ in the photoelectric effect?

28. A light with a radiation frequency of $8*10^{14}$ Hz is shone on a metal with a work function of $3.7*10^{-19}$ J. As a result, photoelectrons are emitted from the surface of the metal. What is the maximum speed that a photoelectron can achieve when being emitted from the metal's surface?

29. Navey, who is driving along in his car, brakes hard to avoid running into a line of ducks who obliviously decide to cross the street. He feels as if he is being pushed forward. Is Navey in an inertial or non-inertial frame of reference? Explain.

30. True or False: It's possible for the electric force on a particle inside an electric field to point in the same direction as the electric field. Justify your answer.

31. True or False: It's possible for the magnetic force on a particle inside a magnetic field to point in the same direction as the magnetic field. Justify your answer.

Grade 12 Physics Exam

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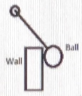
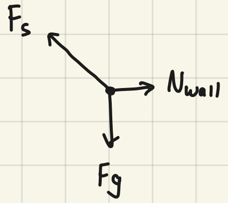


Draw a FBD for the ball.



2. A comet flies through space at a constant velocity. Is there a net force on the comet? Explain.

$F = ma \rightarrow a = 0 \rightarrow F = 0$

No, there is no net force on the comet because due to Newton's second law any object traveling at constant speed have no net force.

3. Snehvir just finished watching Superman and is extremely motivated. He tries to push a bus, but despite his "tremendous" pushing force, the bus does not move. Explain why by discussing the forces acting on the bus.

The bus would have a huge amount of friction acting on it because of it's weight. Snehvir would have to over come the friction in order to move the bus.

4. Terell is helping his family garden by pulling a heavy soil bag from his car to his backyard. He notices that pulling the bag across the pavement of his driveway seemed much more difficult than pulling the bag across his grass. Explain why by discussing the forces acting on the bag of soil.

The friction force on the pavement would be higher than on grass. Since pavements are harder and rougher it would have a high coefficient of friction.

5. The electrostatic force between 2 equally charged objects, separated by a distance r is F. How would the electrostatic force between the 2 equally charged objects change if the distance between the 2 objects were reduced to a third of the original distance, r?

Coulombs Law: $F = \dfrac{k \cdot Q_1 \cdot Q_2}{r^2}$

$Q_1 = Q_2 = Q$

$r_2 = \frac{1}{3} r.$

$F_1 = \dfrac{2kQ}{r_1^2}$

$\dfrac{F_2}{F_1} = \dfrac{\dfrac{\cancel{2kQ}}{(\frac{1}{3}r)^2}}{\dfrac{\cancel{2kQ}}{r_1^2}}$

$\dfrac{F_2}{F_1} = \dfrac{\cancel{r_1^2}}{\frac{1}{9}\cancel{r_1^2}}$

$\dfrac{F_2}{F_1} = 9$

∴ The electrostatic force would increase by a factor of 9.

6. Object 1 has mass m and is being suspended at a height of 50 m over the Earth's surface. Object 2 also has mass m and is being suspended at a height of 50 m over the moon's surface. Which object has more gravitational potential energy? Explain.

$E_g = mgh$

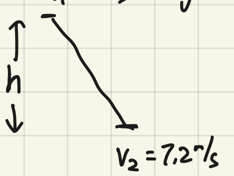
$g_e = 9.81\ m/s^2$

$g_m = 1.62\ m/s^2$

Object over the earth would have higher gravitational potential energy. Because earth have higher gravitational force and higher radius than the moon.

7. Shahan decides to take a break after studying for so long. He goes to the park (in his winter jacket and snow pants) and slides down a slide. If he reaches a maximum speed of 7.2 m/s at the bottom of the slide, how tall is the slide?

$g = 9.8\ m/s^2$

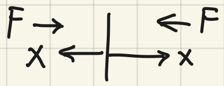


$U = K$

$\cancel{m}gh = \frac{1}{2}\cancel{m}v^2$

$h = \dfrac{v^2}{2g} = \dfrac{(7.2\ m/s)^2}{2(9.8\ m/s^2)} = 2.645\ \dfrac{m^{\cancel{2}}/\cancel{s^2}}{\cancel{m}/\cancel{s^2}} = 2.6\ m$

8. Hooke's law states that $F = -kx$. By describing the direction of F when x is zero (at rest position), negative (to the "left" of rest position), and positive (to the "right" of rest position), explain why F is an example of a restorative force.



F is an example of a restorative force because it always tries to bring the object back to the equilibrium position (at rest).

9. A truck with mass $3.5 * 10^3$ kg travels at a speed of 11 km/h. Long, who has a mass of about 56 kg invents an awesome jetpack and is able to travel at a speed of $1.1 * 10^3$ m/s! If the jetpack has a mass of 4.6 kg, who has more momentum?

$m_t = 3.5 \times 10^3$ kg

$V_t = 11$ km/h

$= 11 \frac{km}{h}\left(\frac{1000m}{km}\right)\left(\frac{h}{60s}\right)$

$V_t = 183$ m/s

$m_L = 56$ kg

$m_j = 4.6$ kg

$V_L = 1.1 \times 10^3$ m/s

$P_t = m_t V_t$

$P_t = (3.5\times10^3 kg)(183 m/s)$

$P_t = 640500 \frac{m \cdot kg}{s}$

$P_L = (m_L + m_j) V_L$

$P_L = (56kg + 4.6kg)(1.1\times10^3 m/s)$

$P_L = 66660 \frac{kg \cdot m}{s}$

$P_t > P_L$ ∴ the truck has more momentum

10. While the grade 12 physics students are writing their final exam, Mrs. Regular and Mr. On decide to have a Play Doh fight. Mrs. Regular creates a Play Doh ball with a mass of 57 g and throws it at Mr. On with a speed of 26 m/s. Mr. On creates a Play Doh ball with a mass of 65 g and throws it at Mrs. Regular with a speed of 19 m/s. The two Play Doh projectiles undergo a completely inelastic collision. Who gets hit by Play Doh?

Completly inelastic collision (2 obj. stick together)

$m_R = 57g$ $m_o = 65g$

$V_R = 26$ m/s $V_o = -19$ m/s

R - ↔ + O

$P' = P_R + P_o$

$m'v' = m_R V_R + m_o V_o$

$(57g + 65g)\, v' = (57g)(26 m/s) + (65g)(-19 m/s)$

$v' = \frac{1482 \frac{g \cdot m}{s} - 1235 \frac{g \cdot m}{s}}{122g}$

$v' = 2.02$ m/s

$v' > 0$

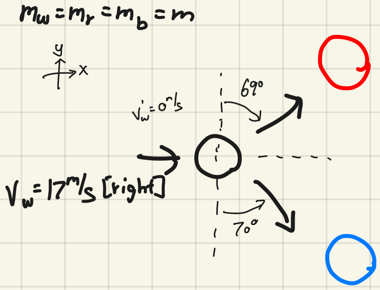
∴ Mr. On gets hit by the play doh.

11. While playing pool, Shereen hits the white ball with her cue stick, which in turn, hits the red and blue ball. Before the collision, the white ball was traveling at a velocity of 17 m/s [right]. After the collision, the white ball stops in its place, while the red ball travels 11 m/s [up 69° right] and the blue ball travels 7.8 m/s [down 70° right]. Assuming that the masses of all the balls are equal, what type of collision is this? Explain.

Elastic collision (kinetic energy conserved)

Inelastic collision (kinetic energy not conserved)

$m_w = m_r = m_b = m$



$V_r' = 11$ m/s [up 69° right]

$V_{ry}' = 11$ m/s $\cos(69°) = 3.94$ m/s

$V_{rx}' = 11$ m/s $\sin(69°) = 10.27$ m/s

$V_b' = 7.8$ m/s [down 70° right]

$V_{by}' = -7.8$ m/s $\cos(70°) = -2.66$ m/s

$V_{bx}' = 7.8$ m/s $\sin(70°) = 7.33$ m/s

$KE_i = KE_f$

$\cancel{\frac{1}{2}}\cancel{m} V_w^2 = \cancel{\frac{1}{2}}\cancel{m} V_r'^2 + \cancel{\frac{1}{2}}\cancel{m} V_b'^2$

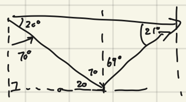
$V_w^2 = V_r'^2 + V_b'^2$

$17^2 = 11^2 + 7.8^2$

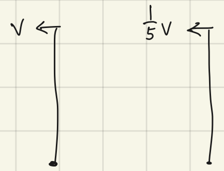
$289 \, m^2/s^2 = 181.84 \, m^2/s^2$

$KE_i \neq KE_f$

∴ inelastic collision



12. During a physics lab, Dupinder spins a yoyo over his head (in a horizontal plane) at a speed of v. Urvish decides that Dupinder is way too reckless and instead spins a yoyo over his head at a speed of $\frac{1}{5}v$. How does the centripetal force on Dupinder's yoyo compare to the centripetal force on Urvish's yoyo?



$a_c = \frac{v^2}{r}$

$F_c = \frac{mv^2}{r}$

$$\frac{F_{c2}}{F_{c1}} = \frac{\frac{\cancel{m}\left(\frac{1}{5}\cancel{v}\right)^{2}}{\cancel{r}}}{\frac{\cancel{m}\cancel{v^2}}{\cancel{r}}} = \frac{1}{25}$$

∴ Urvish's yoyo have $\frac{1}{25}$ the centripetal force of Dupinder's yoyo.

13. Aakash discovers that he has electrostatic powers and decides to use his powers to fight crime, as Electroman. One day, he captures villains who attempt to rob a bank by repelling 7.45 g bullets by charging himself to 6.8 C. The bullets, which are fired 76 m from Aakashe's position, experience an acceleration of 405 m/s² away from Aakash. What is the charge on the bullet?

$m = 7.45 g$

$Q_1 = 6.8 C$

$r = 76 m$

$a = 405 m/s^2$

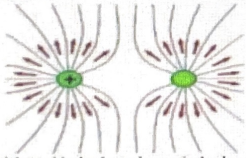
$$F = ma \qquad F = \frac{k \cdot Q_1 \cdot Q_2}{r^2} \qquad K = 8.99 \times 10^9 \frac{N \cdot m^2}{C^2}$$

$$\frac{k \cdot Q_1 \cdot Q_2}{r^2} = ma$$

$$Q_2 = \frac{mar^2}{k \cdot Q_1} = \frac{0.00745 kg (405 m/s^2)(76 m)^2}{8.99 \times 10^9 \frac{N \cdot m^2}{C^2} \; 6.8 C}$$

$$Q_2 = \frac{17427.64}{6.1132 \times 10^{10}} = 2.85 \times 10^{-7} C$$

14. Examine the diagram below:



Is the object on the right positively charged, negatively charged, or neutral? Explain.

Positively charged b/c it's repelling the positivly charged particle on the left.

15. Pelumi conjures up a plan to get more study time before exams come. He hops on a spaceship and zooms around at a speed of 0.6c until his first exam day. Is this a good idea? Explain.

$C = 3.0 \times 10^8 m/s$

$0.6 C = 1.8 \times 10^8 m/s$

$460 m/s$

Not a good idea b/c it won't actually allow him to have more time to study.

16. Using the idea of impulse, explain why moving your hand back as you catch a speeding ball hurts less compared to catching a speeding ball without moving your hand back.

~~when catching a ball and not moving your hand, a lot of the kinetic energy will be absorbed by your hand. If you move your hand backward some of the energy will be absorbed.~~

* by moving your hand back you increase the time the impulse is applied, therefore decreasing the Impulse force

Frame of Reference

Law of Inertia

inertial frame of reference

non-inertial frame of reference $\rightarrow$ fictitious forces

Apparant Weight

3.2 Centripetal Acceleration

uniform circular motion

- Const. speed & radius

Centripetal Acceleration $(\vec{a}_c)$

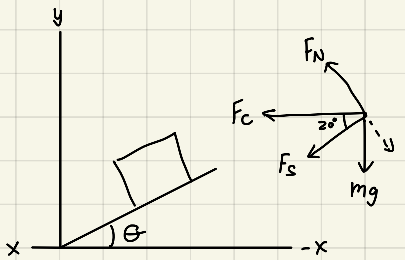
$$\boxed{a_c = \frac{v^2}{r}} \qquad v = \frac{2\pi r}{T}$$

$$\boxed{a_c = \frac{4\pi^2 r^2}{r T^2} = \frac{4\pi^2 r}{T^2} \text{ or } f^2 4\pi^2 r}$$

3.3 Centripetal Force $(\vec{F}_c)$

$$\vec{F}_c = m\vec{a}_c \qquad \vec{F}_c = \frac{mv^2}{r} = \frac{4m\pi^2 r}{T^2} = mf^2 4\pi^2 r$$

Banked Curve Question



$\mu_s = 0.6$

$r = 2.0 \times 10^2$ m

$\theta = 20.0°$

$$F_s = \mu_s F_N$$

$$\Sigma F_c = F_s \cos 20° + F_N \sin 20°$$

$$\Sigma F_c = \mu_s F_N \cos 20° + F_N \sin 20°$$

$$\Sigma F_c = F_N(\mu_s \cos 20° + \sin 20°)$$

$$\Sigma F_c = \frac{mg}{\cos 20° - \mu_s \sin 20°}(\mu_s \cos 20° + \sin 20°)$$

$$\Sigma F_y = F_{Ny} - mg - F_{sy}$$

$$0 = F_N \cos 20° - mg - F_s \sin 20°$$

$$F_N \cos 20° = mg + F_s \sin 20°$$

$$F_N \cos 20° = mg + \mu_s F_N \sin 20°$$

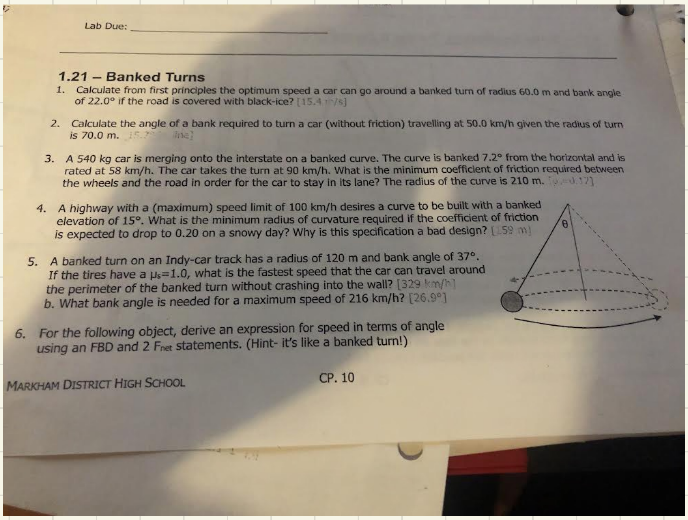
$$F_N(\cos 20° - \mu_s \sin 20°) = mg$$

$$\boxed{F_N = \frac{mg}{\cos 20° - \mu_s \sin 20°}}$$

$$\vec{F}_c = \frac{mv^2}{r}$$

$$\frac{\cancel{m}v^2}{r} = \frac{\cancel{m}g}{\cos 20° - \mu_s \sin 20°}(\mu_s \cos 20° + \sin 20°)$$

$$v = \sqrt{\frac{gr}{\cos 20° - \mu_s \sin 20°}(\mu_s \cos 20° + \sin 20°)} = 49 \text{ m/s}$$



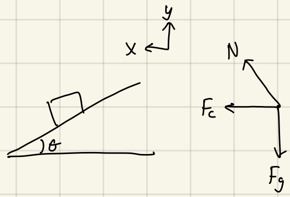
Lab Due: ____________________

1.21 – Banked Turns

1. Calculate from first principles the optimum speed a car can go around a banked turn of radius 60.0 m and bank angle of 22.0° if the road is covered with black-ice? [15.4 m/s]
2. Calculate the angle of a bank required to turn a car (without friction) travelling at 50.0 km/h given the radius of turn is 70.0 m. [15.7° incline]
3. A 540 kg car is merging onto the interstate on a banked curve. The curve is banked 7.2° from the horizontal and is rated at 58 km/h. The car takes the turn at 90 km/h. What is the minimum coefficient of friction required between the wheels and the road in order for the car to stay in its lane? The radius of the curve is 210 m. [μ_s=0.17]
4. A highway with a (maximum) speed limit of 100 km/h desires a curve to be built with a banked elevation of 15°. What is the minimum radius of curvature required if the coefficient of friction is expected to drop to 0.20 on a snowy day? Why is this specification a bad design? [159 m]
5. A banked turn on an Indy-car track has a radius of 120 m and bank angle of 37°. If the tires have a μ_s=1.0, what is the fastest speed that the car can travel around the perimeter of the banked turn without crashing into the wall? [329 km/h]
   b. What bank angle is needed for a maximum speed of 216 km/h? [26.9°]
6. For the following object, derive an expression for speed in terms of angle using an FBD and 2 F_{net} statements. (Hint- it's like a banked turn!)

MARKHAM DISTRICT HIGH SCHOOL CP. 10

1.



$r = 6\text{om}$

$\theta = 22^\circ$

$F_c = N\sin\theta$

$F_c = mg\tan\theta$

$F_y = N\cos\theta - F_g$

$0 = N\cos\theta - mg$

$N = \dfrac{mg}{\cos\theta}$

$F_c = \dfrac{mv^2}{r}$

$\cancel{m}g\tan\theta = \dfrac{\cancel{m}v^2}{r}$

$v = \sqrt{rg\tan\theta}$

$v = \sqrt{6\text{om}\,(9.81\,\text{m/s}^2)\tan(22°)}$

$\boxed{v = 15.4\,\text{m/s}}$

2.

$g\tan\theta = \dfrac{v^2}{r}$

$\theta = \tan^{-1}\left(\dfrac{v^2}{rg}\right)$

$\theta = 15.7°$

$v = 50\,\frac{\text{km}}{\text{h}}\left(\frac{1000\,\text{m}}{\text{km}}\right)\left(\frac{\text{h}}{3600\,\text{s}}\right)$

$v = 13.89\,\text{m/s}$

$r = 70\,\text{m}$

3.

$m = 540\,\text{kg}$

$\theta = 7.2°$

$v = 90\,\frac{\text{km}}{\text{h}}\left(\frac{1000\,\text{m}}{\text{km}}\right)\left(\frac{\text{h}}{3600\,\text{s}}\right)$

$v = 25\,\text{m/s}$

$r = 210\,\text{m}$

$v = \sqrt{rg\,\dfrac{\sin\theta + \mu_s\cos\theta}{\cos\theta - \mu_s\sin\theta}}$

$v^2 = rg\,\dfrac{\sin\theta + \mu_s\cos\theta}{\cos\theta - \mu_s\sin\theta}$

$v^2\cos\theta - \mu_s v^2\sin\theta = rg\sin\theta + rg\mu_s\cos\theta$

$v^2\cos\theta - rg\sin\theta = rg\mu_s\cos\theta + \mu_s v^2\sin\theta$

$v^2\cos\theta - rg\sin\theta = \mu_s(rg\cos\theta + v^2\sin\theta)$

$\mu_s = \dfrac{v^2\cos\theta - rg\sin\theta}{rg\cos\theta + v^2\sin\theta}$

$\mu_s = 0.17$

Kinematic Equations

$$\vec{v}_f = \vec{v}_i + \vec{a}\Delta t$$

$$\Delta\vec{d} = \frac{1}{2}(\vec{v}_i + \vec{v}_f)\Delta t$$

$$\Delta\vec{d} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2$$

$$\Delta\vec{d} = \vec{v}_f\Delta t - \frac{1}{2}\vec{a}\Delta t^2$$

$$\vec{v}_f^{\,2} = \vec{v}_i^{\,2} + 2\vec{a}\Delta\vec{d}$$

Electricity

Charge $\quad \oplus \leftrightarrow \oplus \qquad \oplus \rightarrow\leftarrow \ominus$

$\qquad \ominus \leftrightarrow \ominus$

electron $\quad q_e = -e = -1.60 \times 10^{-19}\,C$

proton $\quad q_p = +e = +1.60 \times 10^{-19}\,C$

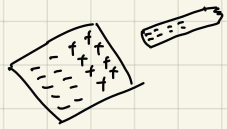
Conservation of Charge. Total charge stay constant in a closed system.

Ways to charge:

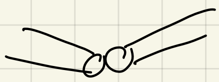
1. Friction

   Electrostatic Series: Strength of how certain substance hold charge (electron)

2. Induced Charge Separation



3. Conduction: charge balance out (mostly) when one or 2 charged object touch



   Grounding: when object is in contact w/ the earth

4. Induction w/ grounding

SPH4U 7.5 Electric Potential due to Point Charge

Electric Field: $\varepsilon = \dfrac{kq}{r^2}$ $\qquad (\Delta d = r)$

Electric Potential: $\Delta V = -\varepsilon \Delta d \qquad V = \dfrac{kq\Delta d}{r^2} = \dfrac{kq}{r}$

V has same sign as q (the source charge)

E_E of two point charges: $E_E = F_E \Delta d = \dfrac{kq_1q_2\Delta d}{r^2} = \dfrac{kq_1q_2}{r} \quad (\Delta d = r)$

Change in E_E : $\Delta E_E = \dfrac{kq_1q_2}{r_f} - \dfrac{kq_1q_2}{r_i} = kq_1q_2\left(\dfrac{1}{r_f} - \dfrac{1}{r_i}\right) \qquad W = -\Delta E$

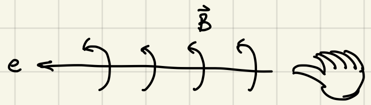
SPH4U 8.1 Magnets and Electromagnets

1. Permanent magnets

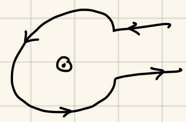
Magnetic Fields : $\vec{B}$ area that experience mag. force
mag. field lines : line showing strength and direction of magnetic fields
mag. poles : north and south, opposite attract, likes repel
Earth's mag. field : magnetic pole ≠ geographic pole
magnetic N is near geographic S
Poles move around ~60 km per year (also flips every 1000s of years)
Cause : earth's molten core (?)
Compass : mag. that align w/ earth's field
cosmic rays : charged particles in the atmosphere that are affected by the magnetic field
(Aurora borealis)

2. Electromagnetism

Principle of em. : moving electric charges produces magnetic field.
RHR for straight cond. :



⊙ going out



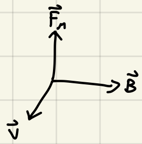
Current loop : still follows RHR
Solenoid : a conducting wire wound into a coil.

Electromagnet : magnet that is controled electrically (Solenoid)
factors : Solid magnetic core w/in the coil. (↑ the field)
More coils (↑ the field)
Tighter wound (↑ the field)
More current (↑ the field)
application : Big magnet to pick up cars
Door bells
etc..

SPH4U 8.2 Magnetic Force on Moving Charges

$\vec{B}$, unit: T (tesla) $1T = 1 \frac{kg}{C \cdot s}$

Magnetic force: depend on velocity of the charge



$F_M = qvB\sin\theta$ θ, b/w velocity & B
↳ dot product b/w $\vec{V} \times \vec{B}$

direction: always perpendicular to field & velocity of charge
↳ direction of electron is opposite.

SPH4U 8.3 Magnetic Force on a Current Carrying Conductor

Electric Curren: collection of charge moving together

Single Charge: $F_M = qvB\sin\theta$

Wire w/ Current: $F_M = ILB\sin\theta$

I, current (A)
L, length of wire

direction: RHR

SPH4U 8.4 Motion of Charged Particles in Magnetic Fields

1. Unform Circular Motion of Charges

Moving parallel to $\vec{B}$: $\theta = 0°$, $F_M = 0$

" perpendicular to $\vec{B}$: $\theta = 90°$, $F_M = qvB$ force is always perpendicular to mvmt

result: Circular motion w/ a fixed radius

Centripetal force: $F_c = F_m$ $\frac{mv^2}{r} = qvB$

$\boxed{r = \frac{mv}{qB}}$

equation: $r = \frac{mv}{qB}$

2. Mass Spectrometer

Mass Spectrometer: beam of ion through mag. field, measuring deflection can determine mass & charge