2019-2020 Physics 1st Semester Exam Review Problems

Name: Key

Exam will cover chapters 1-6

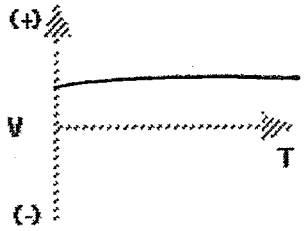
1. Calculate the following, and express the answer with the correct number of significant figures and in scientific notation: 10500 x 8.8 x 3400

2. Convert the following:
   a. 102 cm= 1.02 m
   b. 35.2 g= 0.0352 kg
   c. 4500mm= 0.0045 km
   d. 3500 μg= 0.0035 g
   e. 6.70 x 10^2 MJ= 6.70×10^8 J
   f. 34.2 g = 0.336 N

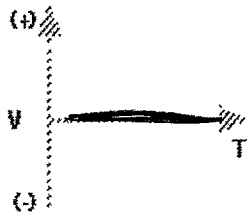
G/M/Kind Based cm/m/n

$F = mg = (0.0342\,kg)(9.81\,m/s^2)$

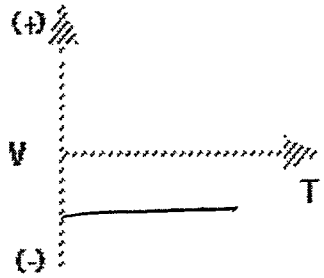
Sketch velocity vs time graph that corresponds to the following descriptions of motion.



3) Object is moving away from the starting point at a constant speed.



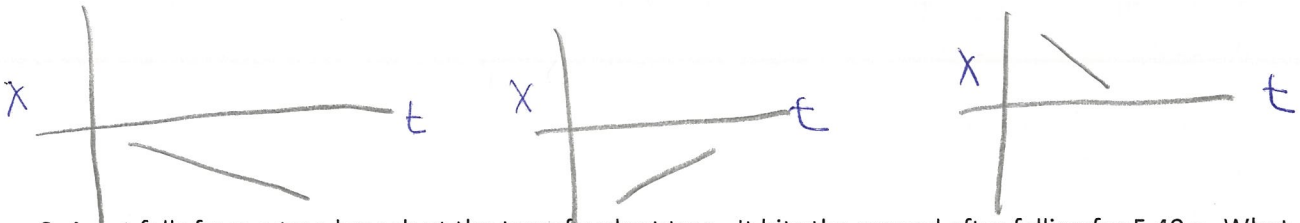
4) Object is standing still.



5) Object moving in the negative direction with a constant speed.

6. Draw a position time graph from an object at rest.

7. Draw a position time graph for an object moving at a constant speed in a negative direction.



8. A nut falls from a tree branch at the top of walnut tree. It hits the ground after falling for 5.40 s. What was the height from which the nut fell from the tree? (disregard air resistance, g= -9.81 m/s^2)

$\Delta Y = v_i \Delta t + \frac{1}{2}$

$\Delta Y = \frac{1}{2}(-9.81 m/s^2)(5.40s) = -143m$ 143 m

9. A dog running has an initial velocity of 9.6 m/s and experiences a constant acceleration of 1.2 m/s^2. What is the finial velocity of the dog after 5.0 s?

$V_f = v_i + a\Delta t$

$V_f = 9.6 m/s + (1.2 m/s^2)(5.0s)$ $V_f = 16 m/s$

10. From the starting line a drag car accelerates at a constant rate from rest to a speed of 65.0 m/s in 7.00 s. What is the displacement of the sports car in this time interval?

$\Delta X = \frac{1}{2}(v_i + v_f)\Delta t$

$\Delta x = \frac{1}{2}(0 + 65.0 m/s)(7.00s)$ $\Delta X = 228 m$

11. A dog runs 15 km in 1.5 h. What is the dog's average velocity in m/s?

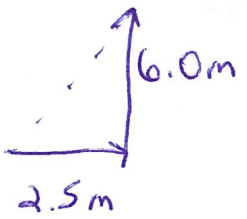
$V = \frac{\Delta X}{\Delta t} = \frac{15 km}{1.5 h}\left|\frac{1000 m}{1 km}\right|\left|\frac{1 h}{3600 s}\right| = 2.8 m/s$

12. A penny is dropped from the top of an office building. What is the height from which the penny is dropped if it hits the sidewalk after 8.2 s? (Disregard air resistance)

$\Delta Y = \frac{1}{2} g \Delta t^2$

$\Delta Y = \frac{1}{2}(-9.81 m/s^2)(8.2s)^2 = -330m$ 330m

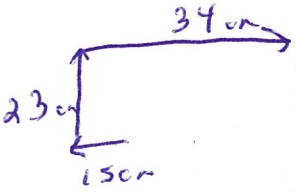
13. A duck waddles 2.5 m east and 6.0 m north. What are the magnitude and direction (include angle) of the duck's displacement with respect to its original position?



$(2.5m)^2 + (6.0m)^2 = c^2$ $\quad c = 6.5m$

$\theta = \tan^{-1}\left(\frac{6.0m}{2.5m}\right) =$ $\quad 67^\circ$ NE

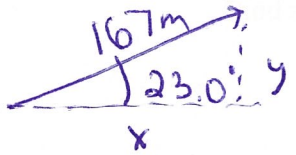
14. An ant on a picnic table travels 15 cm westward then 23 cm northward and finally 34 cm eastward. What is the ants displacement in respect to its original position (include magnitude and direction)?



$(23cm)^2 + (34-15cm)^2 = c^2$ $\quad c = 30cm$

$\theta = \tan^{-1}\left(\frac{23cm}{19cm}\right) =$ $\quad 50^\circ$ NE

15. A bird flies 167 m at an angle of 23.0° above the horizon. What are the horizontal and vertical components of the bird's displacement?



$\cos 23.0^\circ = \frac{x}{167m}$ $\quad x = 154m$

$\sin 23.0^\circ = \frac{y}{167m}$ $\quad y = 65.3m$

16. A cannon ball is launched horizontally off a cliff at a speed of 32.0 m/s. The cliff is 22.0 m above the ground. What is the horizontal displacement of the cannon ball?

$\Delta Y = \frac{1}{2} g \Delta t^2$

$t = \sqrt{\frac{2\Delta Y}{g}}$

$V_i = 32.0 m/s$

$\Delta Y = 22.0m$

$\Delta X = ?$

$\Delta X = V_x \Delta t$

$\Delta X = (32.0 m/s)\sqrt{\frac{2(22.0m)}{9.81 m/s^2}}$

$\Delta X = 6.78m$

17. A golfer hits a ball a horizontal distance of 302 m. What is the maximum height the ball will reach if it were launched at an angle of 35.0° to the ground at an initial velocity of 72.3 m/s? or find Δt then ΔY

$V_i = 72.3 m/s$

$\Delta X = 302m$

$\Delta Y = ?$

$\theta = 35.0^\circ$

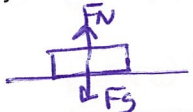
$V_{yf}^2 = V_i^2 (\sin\theta)^2 + 2g\Delta Y$

$0 = (72.3 m/s)^2 (\sin 35.0)^2 + 2(-9.81 m/s^2)\Delta Y$

$\Delta Y = 87.7m$

18. Draw force diagram for the following situations:

A. Object lies motionless on a surface.

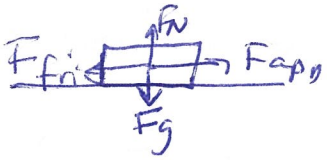


$F_N = F_g$

B. An object descending with a constant velocity. Consider air resistance.

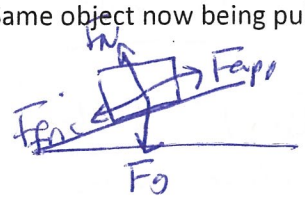
$F_{air} = F_g$

C. The object is pulled by a force parallel to the surface to the right. The surface is rough (has friction).

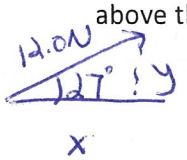


$F_N = F_g$ $F_{fric} < F_{app}$

D. Same object now being pulled up an incline.



19. A boy pulls a box by attaching a rope to the box and pulling with a force of 12.0 N at an angle of 27º above the horizontal. Find the perpendicular and parallel components of force on the box.



$F_x = \cos 27° = \frac{x}{12.0N}$ $x = 11N$

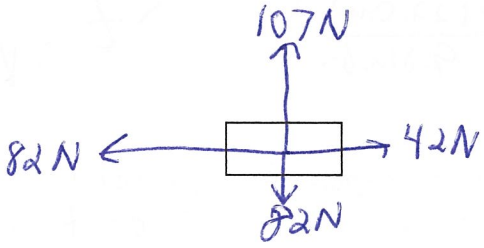
$F_y = \sin 27° = \frac{y}{12.0N}$ $y = 5.4N$

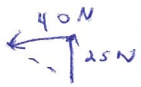
20. A 65.2 kg box is sitting in equilibrium on a horizontal surface. What is the normal force of this box?

$F_g = F_N = mg$

$F_N = (65.2kg)(9.81m/s^2) = 640N$

21. Four force act simultaneously on an object with a mass of 55.0 kg. The forces act 107 N north, 82 N south, 42 N east, and 82 N west. A) Draw a free body diagram for this situation. (4pts)





B) What is the resultant **acceleration** of the object? (Include direction) (6pts)

$\Delta Y = 107N - 82N = 25N$ N

$\Delta X = 82N - 42N = 40N$ west

$(25N)^2 + (40N)^2 = C^2$

$F_{net} = C = 47N$

$F_{net} = ma$

$47N = (55.0kg)\,a$

$a = 0.86 m/s^2$

$\theta = \tan^{-1}\left(\frac{25N}{40N}\right) = 32° NW$

or 58° WN

22. A mule uses a rope to pull a box rightward that has a mass of 20.2 kg across a level surface against the floor with a frictional force of 72.0 N. The rope makes an angle of 30.0° above the floor, and the force on the rope is 90.0 N. Find the following: (disregard SF) **Include UNITS.**

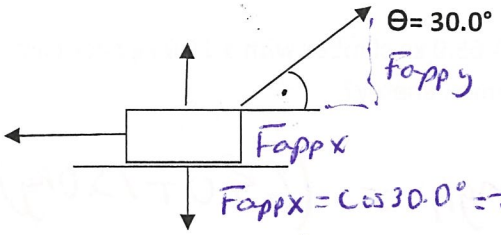
F_g= 198N

F_N = 153N

F_{fric} = 72 N

F_{net}= 5.9N

a= 0.292m/s²



$F_{appx} = \cos 30.0° = \frac{x}{90N}$

$x = 77.9N$

$F_{appy} = \sin 30.0° = \frac{y}{90N}$

$y = 45N$

$F_g = mg = (20.2kg)(9.81m/s^2) = 198.2N$

$F_N = F_g - F_{appy}$

$F_N = 198N - 45N = 153N$

$F_{net} = F_{appx} - F_{fric}$

$= 77.9 - 72N = 5.9N$

$F_{net} = ma$

$5.9N = (20.2kg)\,a$

$a = 0.292m/s^2$

23. A 30.0 N crate is pushed across the floor with a force of 12 N. What is the acceleration of the crate?

$F = ma$

$W = mg$

$12N = \left(\frac{30.0N}{9.81m/s^2}\right) a$

$a = 3.9m/s^2$

24. After a 345 kg box is in motion, a horizontal force of 892 N keeps it moving with a constant speed. The box initially at rest on a horizontal surface requires a 987 N force to set it in motion. Find the coefficients of kinetic friction and static friction between the box and the floor.

$\mu_s = \frac{F_s}{F_N} = \frac{987N}{(354kg)(9.81m/s^2)} = 0.292$

$\mu_K = \frac{F_K}{F_N} = \frac{892N}{(345kg)(9.81m/s^2)} = 0.264$

$F_N = F_g$

25. A horizontal force of 190 N is applied to move a 45 kg television set across a 12 m level surface. What is the work done by the 190 N force on the television set?

$W = Fd$ $\quad W = (190N)(12m) = 2280$ $\quad 2300J$

26. What is the kinetic energy of a 0.126 kg baseball thrown at 20.0 m/s?

$KE = \frac{1}{2}mv^2 = \frac{1}{2}(0.126\text{kg})(20.0\text{m/s}) = 25.2\text{ J}$

27. A 65.0 kg climber with a 15.0 kg pack climbs 8848 m to the top of Mt. Everest. What is the climber's potential energy?

$PE = mgh = (65.0+15.0\text{kg})(9.81\text{m/s}^2)(8848\text{m}) = 6.94\times10^6\text{ J}$

28. How much work is done on a wagon pulled 4.2 m by a force of 35.4 N at an angle of 23° above the horizontal?

$W = Fd\cos\theta = (35.4\text{N})(4.2\text{m})(\cos 23°) = 140\text{ J}$

29. A spring has a force constant of 42.0 N/m and a length of 0.45 m when relaxed. How much energy is stored in the spring if the spring length is 0.72 m?

$PE_e = \frac{1}{2}kx^2 = \frac{1}{2}\left(42.0\frac{\text{N}}{\text{m}}\right)(0.72-0.45\text{m})^2 = 1.5\text{ J}$

30. A boy is pushed across a frictionless surface with a force of 89 N. The boy's final kinetic energy is 452J. How far did the boy travel starting from rest to achieve this energy?

$W_{net} = \Delta KE$

$Fd = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ($v_i = 0$)

$(86\text{N})d = 452\text{J}$

$d = 5.1\text{ m}$

31. A 165 kg bobsled zips down an ice track starting at 185 m vertical distance up the hill. Disregarding friction, what is the velocity of the bobsled at the bottom of the hill, if the bobsled starts from rest?

$ME_i = ME_f$

$PE_i + KE_i = PE_f + KE_f$ ($KE_i = 0$, $PE_f = 0$)

$mgh = \frac{1}{2}mv_f^2$

$(9.81\text{m/s}^2)(185\text{m}) = \frac{1}{2}v_f^2$

$v_f = 60.2\text{ m/s}$

32. How much power is supplied by a 642 N man running up a flight of stairs rising vertically 4.0m in 4.2 s?

$P = \frac{W}{t} = \frac{Fd}{t} = \frac{(642\text{N})(4.0\text{m})}{4.2\text{s}} = 610\text{W}$

33. Find the momentum of a 200 kg horse trotting at 4 m/s.

$p = mv = (200\text{kg})(4\text{m/s}) = 800\text{ kg}\cdot\text{m/s}$

34. What is the impulse given to a 0.1 kg baseball moving right towards the bat at 25 m/s which bounces off the bat at 30 m/s?

$Ft = \Delta p$ $\quad Ft = (0.1kg)(30m/s) - (0.1kg)(25m/s) = -5.5$

5.5 kg·m/s Left

b) If the impulse is delivered over 0.05 seconds, what force does the ball experience?

$$F = \frac{5.5 kg \cdot m/s}{0.05s} = -110N$$

35. An empty train car (1 .0kg) moving east as 21 m/s collides with a loaded train car initial at rest that has twice the mass of the empty car. The two cars stick together.

a. what type of collision is this? inelastic

b. Find the velocity of the two cars after the collision.

$m_1v + m_2v = (m + m)v$

$(1.0kg)(21m/s) + (2.0kg)(0m/s) = (1.0 + 2.0kg)V_f$ $\quad V_f = 7.0m/s$

c. Find the final speed if the loaded car moving at 17 m/s has hit the empty car initially at rest.

$(1.0kg)(0m/s) + (2.0kg)(17m/s) = (1.0 + 2.0kg)V_f$ $\quad V_f = 11m/s$

36. Two billiard balls, each with a mass of 0.35 kg, strike each other head-on. One ball initially moving left at 4.1 m/s and ends up moving right at 3.5 m/s. The second ball is initially moving to the right at 3.5 m/s. Find the final velocity of the second ball. elastic

$m_1v + m_2v = m_1v + m_2v$

$(0.35kg)(-4.1m/s) + (0.35kg)(3.5m/s) = (0.35kg)(3.5m/s) + (0.35kg)V_f$

$V_f = 4.1m/s$ Left

Equation Sheet

$g = 9.81\ m/s^2$

$\Delta x = \frac{1}{2}(V_i + V_f)\Delta t$

$V_f = V_i + a\Delta t$

$\Delta x = V_i \Delta t + \frac{1}{2} a (\Delta t)^2$

$V_f^2 = V_i^2 + 2a\Delta x$

$V_{ave} = \Delta x / \Delta t$

$A_{ave} = \Delta v / \Delta t$

Remember Y can replace X.

$W = mg$

$\Sigma F = ma$

$\mu_s = F_s / F_n$

$\mu_k = F_k / F_n$

$\Delta x = V_x \Delta t$

$V_x = V_{xi} =$ constant

$\Delta Y = \frac{1}{2} g (\Delta t)^2$

$V_{y,f} = g\Delta t$

$V_{y,f}^2 = 2g\Delta y$

$F = mg$

$W = Fd$

$W_{net} = \Delta KE$

$ME_i = ME_f$

$W = Fd\cos\Theta$

$P = W/\Delta t = Fv = mgd/t$

$KE = \frac{1}{2} mv^2$

$PE_g = mgh$

$PE_e = \frac{1}{2} kx^2$

$\Delta x = V_i (\cos\theta) \Delta t$

$V_x = V_i (\cos\theta) =$ constant

$\Delta y = V_i (\sin\theta) \Delta t + \frac{1}{2} g(\Delta t)^2$

$V_{y,f} = V_i (\sin\theta) + g\Delta t$

$V_{y,f}^2 = V_i^2 (\sin\theta)^2 + 2g\Delta y$

$p = mv$

$F\Delta t = \Delta p = mv_f - mv_i$

$\Delta x = \frac{1}{2}(v_i + v_f)\Delta t$

$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$

$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$