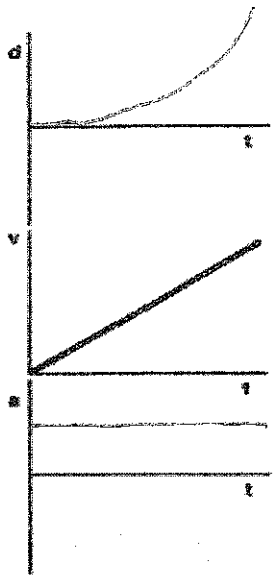
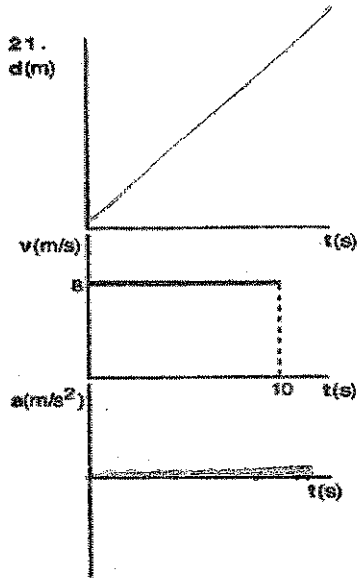
Physics 11 Final Review Part 1

1) a. Sketch d-t and a-t graphs that correspond to the v-t graphs b.





$V_f = 61.1 m/s$

2) A plane needs to reach a speed of 220 km/h in order to take off. It is capable of accelerating at 6.0 m/s^2.

a. What is the minimum length of runway required? 311 m

b. How much time passes before lift off? 10.2 sec.

3) A soccer player kicks a ball straight up in the air at 18 m/s. $V_f = V_i + at$ $-18 = +18 + (-9.8)t$

a. What is the ball's total hangtime? 3.7 sec.

b. What is the maximum height reached by the ball? 16.5 m

c. When is the ball 12 m above the ground? 0.88 sec. and 2.8 sec.

4) A boy scout in a canoe can paddle at 5.0 m/s in still water. He points his canoe due North and paddles across a river that is 450 m wide and flows at 4.0 m/s West.

a. How long does it take to cross the river? $t = \frac{d}{v} = \frac{450m}{5 m/s} = 90$ sec.

b. What is his total resultant speed? $V_R^2 = 5^2 + 4^2$ $V_R = 6.4 m/s$

c. If he needed to cross directly to the North, what heading should he take? $\sin\theta = \frac{4}{5}$ $\theta = 53°$ E of N

~~5)~~ A ball rolls off of a 1.2 m high table at 2.0 m/s. How far does it land from the base of the table? OMIT

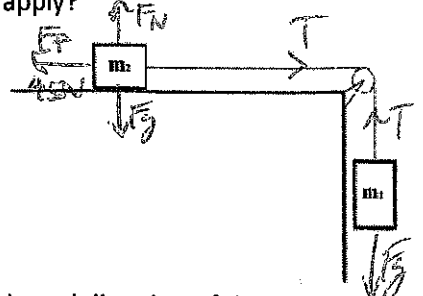
7) An 1100 kg race car exerts 9600 N of force and accelerates at 8.0 m/s^2. How much friction acts on the car?

$F_f \leftarrow$ [car] $\rightarrow 9600N$ $F_{net} = 9600 - F_f$ $1100(8) = 9600 - F_f$ $F_f = 800N$

8) A 5.0 kg model rocket blasts off with an acceleration of 15 m/s^2. How much force does it apply?

$F_{app} = F_g + F_{thrust} = 5(9.8) + 5(15) = 124N$

9) A 12.0 kg mass sitting on the table is attached to a 10.0 kg mass hanging freely. There is 45 N of friction between the 12.0 kg block and the table.



a. What is the acceleration of the 12.0 kg block?

b. What is the tension in the string?

$ma = F_g - F_f$

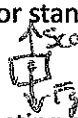
$22a = (10)(9.8) - 45$

$a = 2.41 m/s^2$

$ma = F_g - T$ $10(2.41) = 98 - T$

$T = 73.9N$

10) A 65 kg student on an elevator stands on a scale that reads 820 N. What is the magnitude and direction of the acceleration of the elevator?



$F_{net} = Scale - F_g$ $65a = 820N - 65(9.8)$ $a = 2.82 m/s^2$

~~11)~~ What is the force of gravity acting on a 3500 kg satellite that orbits the Earth at an altitude of 3.0×10^6 m?

OMIT

12) OMIT

13) A student notices that it requires 750 N in order to push their 1200 kg car at a constant velocity. What is the coefficient of friction between the car and the ground? $F_f = 750N$ $750 = \mu(1200)(9.8)$ $\mu = 0.064$

$\mu = \frac{750}{(1200)(9.8)}$

14) What is the momentum of an 90.0 kg sprinter travelling at 12.0 m/s?

$p = mv = (90)(12) = 1080\ kg \cdot m/s$

15) A 0.100 tennis ball is traveling at 24 m/s when it is hit backward at 30. m/s.

a. What is the impulse felt by the ball? $\Delta p = m\Delta v = (.100)(-54) = -5.4\ N\cdot s$

b. What is the impulse felt by the tennis racquet? $5.4\ N\cdot s$

c. If the ball is in contact with the racquet for 0.050 s, how much force did the racquet exert on the ball?

$\Delta p = Ft$ $F = 5.4/.05 = 108N$

16) A 95 kg running back is travelling at 12 m/s East when he collides with a 115 kg linebacker traveling at 9.0 m/s West. If the two stick together after the collision, what is their combined velocity? $95(12) + 115(-9) = (95+115)v'$

$v' = 0.5\ m/s\ (E)$

17) A 2.5 kg curling rock traveling at 3.0 m/s strikes a 5.0 kg rock and bounces back at 1.0 m/s. What is the final velocity of the 5.0 kg rock? $(2.5)(3) + (5)(0) = (2.5)(-1) + 5v'$ $v' = 1\ m/s$

18) A 55 kg skier starts at rest at the top of a 32 m high hill. $E_K = 1.7\times10^4 J$

a. How much kinetic energy does she have at the bottom of the hill? $E_{P_{top}} = E_{K_{bottom}}$ $mgh = \frac{1}{2}mv^2$ $9.8(32) = \frac{1}{2}v^2$

b. How fast is she moving? $v = 25\ m/s$

c. Another student has a mass of 85 kg. How fast is he moving at the bottom of the hill?

Same $v = 25\ m/s$

Work, Power, Energy Review

1. Calculate the work done by a 47 N force pushing a pencil 0.26 m.

$W = Fd = 12.22\ J$

2. Calculate the work done by a 47 N force pushing a 0.025 kg pencil 0.25 m against a force of 23 N.

$W = Fd = (47N)(.25m) = 11.75\ J$

3. Calculate the work done by a 2.4 N force pushing a 400 g sandwich across a table 0.75 m wide.

$W = Fd = (2.4N)(.75m) = 1.8\ J$

4. How far can a mother push a 20.0 kg baby carriage, using a force of 62 N, if she can only do 2920 J of work?

$d = \frac{W}{F} = \frac{2920\ J}{62N} = 47m$

5. How much work is it to lift a 20 kg sack of potatoes vertically 6.5 m?

$W = Fd = mgh = (20)(9.8)(6.5) = 1274\ J$

6. If a small motor does 520 J of work to move a toy car 260 m, what force does it exert?

$F = \frac{W}{d} = \frac{520\,J}{260\,cm.} = 2\,N$

7. A girl pushes her little brother on his sled with a force of 300 N for 750 m. How much work is this if the force of friction acting on the sled is (a) 200 N, (b) 300 N?

$W = Fd = (300\,N)(750\,m) = 2.25 \times 10^5\,J$ for (a) & (b)

more F_f = ↓ Power not Work!

8. A 75.0 kg man pushes on a 500,000 t wall for 250 s but it does not move. How much work does he do on the wall?

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9. A boy on a bicycle drags a wagon full of newspapers at 0.80 m/s for 30 min using a force of 40 N. How much work has the boy done?

$d = v \cdot t = 0.8\frac{m}{s} \times 30\,min \times \frac{60\,s}{min} = 1440\,m$

$W = Fd = (40\,N)(1440\,m) = 5.76 \times 10^4\,J$

10. What is the gravitational potential energy of a 61.2 kg person standing on the roof of a 10-storey building relative to (a) the tenth floor, (b) the sixth floor, (c) the first floor. (Each storey is 2.50 m high.)

(a) $E_p = mgh = (61.2)(9.8)(2.5) = 1500\,J$

(b) $E_p = (61.2)(9.8)(5)(2.5) = 7500\,J$

(c) $E_p = (61.2)(9.8)(10)(2.5) = 15000\,J$

11. A 10 000 kg airplane lands, descending a vertical distance of 10 km while travelling 100 km measured along the ground. What is the plane's loss of potential energy? $E_p = (10000)(9.8)(10000)$ $E_p = 9.8 \times 10^8\,J$

12. A coconut falls out of a tree 12.0 m above the ground and hits a bystander 3.00 m tall on the top of the head. It bounces back up 1.50 m before falling to the ground. If the mass of the coconut is 2.00 kg, calculate the potential energy of the coconut relative to the ground at each of the following sites:

(a) while it is still in the tree, $(12)(9.8)(2) = 235\,J$

(b) when it hits the bystander on the head, $(2)(9.8)(3) = 59\,J$

(c) when it bounces up to its maximum height, $(2)(9.8)(4.5) = 88\,J$

(d) when it lands on the ground, $0\,J$

(e) when it rolls into a groundhog hole, and falls 2.50 m to the bottom of the hole.

$(2)(9.8)(-2.5) = -49\,J$.

13. Calculate the kinetic energy of a 45 g golf ball travelling at: (a) 20 m/s, (b) 40 m/s, (c) 60 m/s.

(a) $E_K = \frac{1}{2}mv^2 = \frac{1}{2}(.045)(20)^2 = 9\,J$

(b) $\frac{1}{2}(.045)(40)^2 = 36\,J$

(c) $\frac{1}{2}(.045)(60)^2 = 81\,J$

14. When the speed of an object doubles, does its kinetic energy double? Explain your answer.

No quadruples (v^2)

15. How fast must a 1000 kg car be moving to have a kinetic energy of: (a) 2.0×10^3 J, (b) 2.0×10^5 J,

$\sqrt{\frac{2E_K}{m}} = v$

(a) 2 m/s

(b) 20 m/s

16. How high would you have to lift a 1000 kg car to give it a potential energy of: (a) 2.0×10^3 J, (b) 2.00×10^5 J,

$h = \frac{E_P}{mg}$

(a) .20 m

(b) 20 m

17. A 50 kg bicyclist on a 10 kg bicycle speeds up from 5.0 m/s to 10 m/s.

(a) What was the total kinetic energy before accelerating? $E_K = \frac{1}{2}(60)(5)^2 = 750\,J$

(b) What was the total kinetic energy after accelerating? $\frac{1}{2}(60)(10)^2 = 3000\,J$

(c) How much work was done to increase the kinetic energy of the bicyclist? $\Delta E = 2250\,J$

(d) Is it more work to speed up from 0 to 5.0 m/s than from 5.0 to 10.0 m/s?

$5 \rightarrow 10$ It's only 750 J $0 \rightarrow 5$

2250 J $5 \rightarrow 10$!

20. How long would it take a 500 W electric motor to do 1.50×10^5 J of work?

$t = \frac{W}{P} = \frac{1.5 \times 10^5}{500} = 300$ sec.

22. A force of 5.0 N moves a 6.0 kg object along a rough floor at a constant speed of 2.5 m/s.

(a) How much work is done in 25 s.? $d = v \cdot t = 2.5\frac{m}{s} \times 25 s = 62.5 m$ $W = (5)(62.5) = 312.5 J$

(b) What power is being used? $\frac{312.5 J}{25 s} = 12.5 W$

(c) What force of friction is acting on the object?

5 N due to $F_{net} = 0$ Since $a = 0$.

25. A 3.0 kg metal ball, at rest, is hit by a 1.0 kg metal ball moving at 4.0 m/s. The 3.0 kg ball moves forward at 2.0 m/s and the 1.0 kg ball bounces back at 2.0 m/s.

(a) What is the total kinetic energy before the collision? $\frac{1}{2}(3)(0)^2 + \frac{1}{2}(1)(4)^2 = 8 J$

(b) What is the total kinetic energy after the collision? $\frac{1}{2}(3)(2)^2 + \frac{1}{2}(1)(2)^2 = 8 J$

(c) How much energy is transferred from the small ball to the large ball?

6 J

Special Relativity Worksheet

1. A spaceship is travelling at 0.7c on a trip to the Andromeda galaxy and back. The ship is gone for 25 Earth years. How many years have passed on the ship?

$t = \frac{t_0}{\sqrt{1-v^2}}$ $t_0 = 25\sqrt{1-.7^2} = 17.9$ years.

2. A 16 year old girl sends her 48 year-old parents on a vacation trip to the centre of the Universe. When they return, the parents have aged 10 years, and the girl is the same age as her parents. How fast was the ship going?

$t = \frac{t_0}{\sqrt{1-v^2}}$ $42 = \frac{10}{\sqrt{1-v^2}}$ $v = 0.97c$

$v = 0.97\left(3 \times 10^8 \frac{m}{s}\right)$

$v = 2.91 \times 10^8 \frac{m}{s}$

Physics 11 – Wave Worksheet

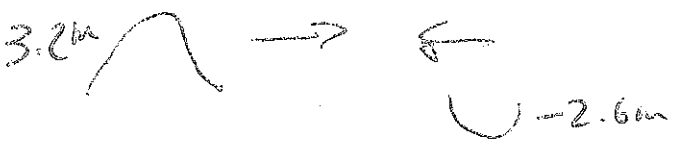
1. A physics student sitting on the beach notices that a wave hits the beach every 5.0 seconds, and the waves seem to be about 15m apart. What is the speed of these waves?

$v = \lambda f = 15m\left(\frac{1}{5}\right) = 3\ m/s$

2. What is the frequency of laser light that has a wavelength of 623nm?

$v = \lambda f \qquad f = \frac{v}{\lambda} = \frac{3\times10^{8}\ m/s}{623\times10^{-9}\ m} = 4.8\times10^{14}\ Hz$

3. Out in the ocean, a wave crest 3.2m high meets a wave trough from another direction which is 2.6m deep. How high is the resulting wave?



$3.2m + (-2.6m) = \boxed{0.6m}$

4. Fill out the following table with the correct name of the wave phenomena:

Reflection	A wave hits the beach at a 30 degree angle, and a wave is observed leaving the beach at 30 degrees.
Refraction	A wave enters shallow water and the wavelength decreases
Diffraction	A sailboat seeks shelter behind an island in a storm, but finds that there are still waves behind the island
Refraction	A fisherman throws his spear directly at a fish seen in the water, but misses.
Doppler	A student walking beside the E&N railway track notices that the pitch of the train sound increases as the train approaches
Polarization	A student puts on a pair of sunglasses when snowboarding, and notices that it is now easier to see the moguls.
Refraction	A laser light shines into a beaker of water. The beam is seen to bend at the point where the light enters the water.
Interference (Constructive)	A rogue wave capsizes a small freighter in the North Sea.

5. Ocean waves enter a harbour through two entrances 50m apart. On the seawall which is 200m from the entrances, an observer notices very large waves hitting the wall every 35s. What is the wavelength of these waves?

$f = \frac{1}{35}\,Hz$

$\lambda = \frac{v}{f} = 200\ m$

$v = \frac{200m}{35s} = 5.7\frac{m}{s}$

6. A beam of light travels from air into diamond at an angle of 35°. What is the angle of refraction of the light in the diamond?

$n_i \sin\theta_i = n_r \sin\theta_r$

$(1.0003)\sin 35° = (2.42)\sin\theta_r$

$\theta_r = 13.7°$

10. Light traveling in a space with a wavelength of 710nm enters a plexiglass window on the space station at an angle of 65°. The index of refraction for plexiglass is 1.50

a) What is the frequency of this light in a space?

$v = \frac{c}{n} = \frac{3\times10^8\ m/s}{1.5} = 2\times10^8\frac{m}{s}$

$f = \frac{3\times10^8\ m/s}{710\times10^{-9}\ m} = 4.23\times10^{14}\ Hz$

$f = \frac{v}{\lambda}$

b) What is the frequency of this light in the plexiglass?

$4.23\times10^{14}\ Hz$

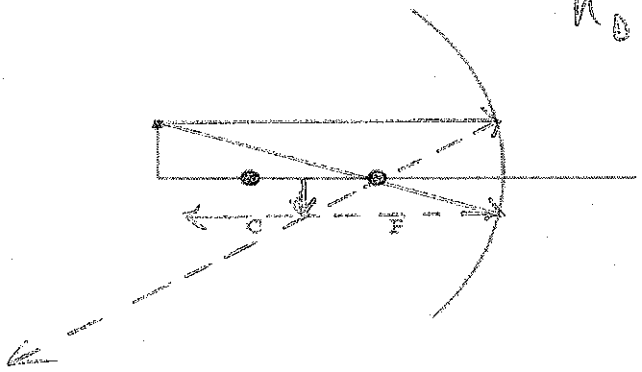
11. Draw a ray diagram and use the mirror and magnification equations to solve for the image distance and size.

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} \qquad \frac{h_i}{h_o} = \frac{-d_i}{d_o}$$

$f = 1.7\text{cm}$

$d_o = 4.65\text{cm}$

$h_o = 0.8\text{cm}$



$$\frac{1}{1.7\text{cm}} = \frac{1}{4.65\text{cm}} + \frac{1}{d_i}$$