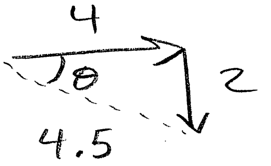
Physics 305 Exam Review #1

1. A definition of scalar

2. C total distance

3. D



$\theta = \tan^{-1}\left(\frac{2}{4}\right) = 27°$

4. B The car is slowing down. Velocity and acceleration are in opposite directions.

5. B

$V_f = V_i + at$ V_i is 0 for both.

$V_f = at$

acceleration is the same for both.

$t_B = 2t_A$

therefore the final velocity for B must be twice that of A.

6. B At the top of the path, the ball stops. Gravity, however is allways acting downwards.

7. C

$V_i = 100$

$V_f = 160$

$a = 15$

$t = ?$

$V_f = V_i + at$

$a = \frac{V_f - V_i}{t} = \frac{160-100}{15}$

8. A

$v_i = 160$

$v_f = ?$

$a = 20.5$

$t = 9$

$$v_f = v_i + at$$
$$= 160 + 20.5(9)$$
$$= 344.5$$

9. B

$v_i = 2$

$v_f = ?$

$t = 2.5$

$d = 34$

$$d = \left(\frac{v_i + v_f}{2}\right)t$$
$$v_f = \frac{2d}{t} - v_i$$
$$v_f = \frac{2(34)}{2.5} - 2 = 25.2$$

10. C

<u>Car 1</u>		<u>Car 2</u>
$v_i = 0$		$v_i = 0$
$a = 3$		$a = 5$
d	$\xleftrightarrow{\text{equal}}$	d
$t_1 = t$		$t_2 = t - 6$ ← the car starts 6s later therefore it travels for 6s less than car 1

$$d = v_i t + \frac{1}{2} a t^2$$

$$d_1 = \frac{1}{2} a_1 t^2 \qquad d_2 = \frac{1}{2} a_2 (t-6)^2$$

$$\cancel{\tfrac{1}{2}} a_1 t^2 = \cancel{\tfrac{1}{2}} a_2 (t-6)^2$$
$$3t^2 = 5(t-6)^2$$
$$3t^2 = 5(t^2 - 12t + 36)$$
$$3t^2 = 5t^2 - 60t + 180$$
$$0 = 2t^2 - 60t + 180$$
$$0 = t^2 - 30t + 90$$
$$t = \frac{-(-30) \pm \sqrt{(-30)^2 - 4(1)(90)}}{2(1)}$$
$$t = 27, 3$$

so to catch up car 2 needs

$t_2 = t - 6$

$= 27 - 6 = \underline{21 s}$

or

$3 - 6 = -3$

↑ this answer can't work.

11. B

$v_i = 19.6$

$v_f = ?$

$a = -9.8$

$t = 3$

$$v_f = v_i + at$$

$$= 19.6 - 9.8(3)$$

$$= \underset{\substack{\uparrow \\ \text{down}}}{-9.8}$$

12. A

$V_i = 0$

$V_f = -3.7$

$t = 1$

$a = ?$

$$V_f = V_i + at$$

$$a = \frac{V_f - V_i}{t} = \frac{-3.7}{1} = -3.7 \text{ m/s}^2$$

13. C

$V_i = 5$

$a = 2$

$t = 6$

$d = ?$

$$d = v_i t + \frac{1}{2}at^2$$

$$= 5(6) + \frac{1}{\cancel{2}}(\cancel{2})(6)^2$$

$$= 30 + 36 = 66 \text{ m}$$

14. A

$V_i = 500$

$V_f = 0$

$d = .1$

$a = ?$

$$V_f^2 = V_i^2 + 2ad$$

$$a = \frac{-V_i^2}{2d} = \frac{-(500)^2}{2(.1)}$$

$$a = -1.25 \times 10^6 \text{ m/s}^2$$

15. C

$V_i = 0$

$V_f = 42$

$t = 2$

$d = ?$

$$d = \left(\frac{V_i + V_f}{2}\right)t$$

$$= \left(\frac{42}{\cancel{2}}\right)\cancel{2} = 42 \text{ m}$$

16. A

constant speed is a straight line with a slope greater than 1

17. C

average speed is the slope of the line from the first point to the last.

$$\text{slope} = \frac{(20-0)}{(20-0)} = 1$$

18. C

the speed should increase ignoring the direction

19. C

displacement is area

0 - 3 s $\quad \text{area} = (2\times5) + \left(\frac{1\times5}{2}\right) = 12.5$

4 - 8 s $\quad \text{area} = \left(\frac{4+2}{2}\right)(-2) = -6$

total $= 12.5 - 6 = 6.5$ m

20. B

definition

21. D

Newton's first law of motion

22. A

Newton's third law of motion

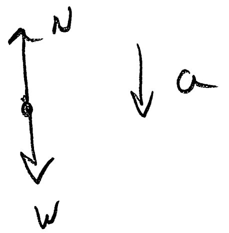
23. B

$F = ma$

$$m = \frac{F}{a} = \frac{16}{2} = 8 \text{ kg}$$

24. C definition

25. B



using down as positive

$\Sigma F = ma$

$-N + W = ma$

$-N = ma - W$

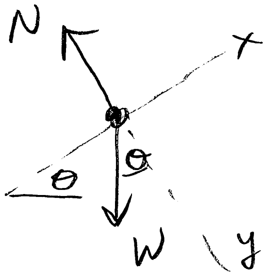
$-N = ma - mg$

$= m(a - g)$

$= 63(1.3 - 9.8)$

$-N = -535.5$

26. A



$\underline{x}$

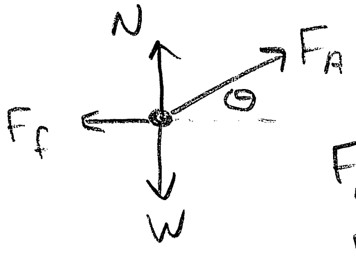
$\Sigma F = ma$

$W \sin\theta = ma$

$\cancel{m} g \sin\theta = \cancel{m} a$

$a = 9.8 \sin 30 = 4.9$

27. A



$\underline{x}$

$\Sigma F = ma$

$F_A \cos\theta - F_f = 0$

$F_f = F_A \cos\theta$

$\underline{y}$

$\Sigma F = ma$

$F_A \sin\theta + N - W = 0$

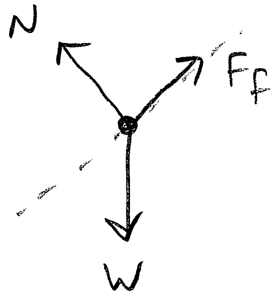
$N = W - F_A \sin\theta$

$$\mu = \frac{F_f}{N} = \frac{F_A \cos\theta}{W - F_A \sin\theta}$$

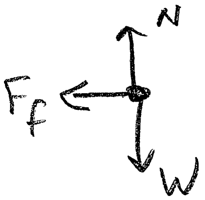
$$= \frac{200 \cos 30}{50(9.8) - 200 \sin\theta}$$

$= 0.4$

28. D



29. C



x

$\Sigma F = ma$

$F_f = ma$

y

$\Sigma F = ma$

$N - W = 0$

$N = W$

$F_f = \mu N$

$\mu N = ma$

$\mu W = ma$

$\mu \cancel{m} g = \cancel{m} a$

$a = .5(9.8) = 4.9 \ m/s^2$

$V_i = ?$

$V_f = 0$

$a = -4.9$

$d = 90$

$V_f^2 = V_i^2 + 2ad$

$V_i = \sqrt{-2ad}$

$= \sqrt{-2(-4.9)(90)}$

$V_i = 29.7$

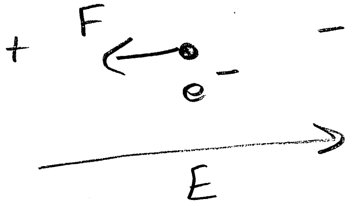
30. A definition.

31. C

electric field (force) points from positive to negative.

32. B

$$E = \frac{F_E}{q} = \frac{2\times10^{-16}}{1.6\times10^{-19}} = 1250\ N/C$$



33. A

magnetic field lines point from North to South.

34. C

right hand rule.

35. A

right hand rule

36. C

$$F = BIL\cancel{\sin\theta}$$

$$= 4(3)(1.5) = 18\ N$$

direction using right hand rule.

37. B

$$\Sigma F = ma$$

$$F_m - W = 0$$

$$F_m = W$$

$$BIL = mg$$

$$I = \frac{mg}{BL} = \frac{(.25\times10^{-3})(9.8)}{(3.5)(.03)}$$

$$= .023\ A$$

direction from right hand rule.

38. D

distance from crest to equilibrium

$7 - 4 = 3$

39. B

definition

40. C

$$\frac{15 \text{ waves}}{60 \text{ seconds}} = 0.25 \text{ Hz}$$

41. B

angle of reflection = angle of incidence.

42. A

$$\frac{\sin\theta_1}{\sin\theta_2} = \frac{n_2}{n_1}$$

$$\frac{\sin 30}{\sin\theta_2} = \frac{1.55}{1}$$

$$\theta_2 = \sin^{-1}\left(\frac{\sin 30}{1.55}\right) = 18.8$$

43. C

definition

44. A

doppler effect

45. A

$$f_4 = \frac{4v}{2L} = 1200$$

$$v = \frac{1200L}{2} = \frac{1200(1.2)}{2} = 720 \text{m/s}$$

Sample Free Response Questions

1. Jenny goes for a ride on a waterslide. She starts at 1 m/s and accelerates at 2.3 m/s^2 all the way down.

   (a) If it takes her 5 seconds to reach the bottom, how fast is she going at the bottom of the slide?

$V_i = 1$

$V_f = ?$

$a = 2.3$

$t = 5$

$$V_f = V_i + at$$

$$= 1 + 2.3(5)$$

$$V_f = 12.5 = \underline{12\ m/s}$$

   (b) What is Jenny's average speed during her ride down the waterslide?

Since acceleration is constant.

$$V_{avg} = \frac{V_i + V_f}{2} = \frac{1 + 12.5}{2} = 6.75 = \underline{6.8\ m/s}$$

2. A woman on a bridge 75.0 m high sees a raft floating at a constant speed on the river below. Trying to hit the raft, she drops a stone from rest when the raft has 7.00 m more to travel before passing under the bridge. The stone hits the water 4.00 m in front of the raft. Calculate the speed of the raft.

Stone

$v_i = 0$

$d = -75$

$a = -9.8$

$t = ?$

$$d = \cancel{v_i t} + \frac{1}{2}at^2$$

$$t = \sqrt{\frac{2d}{a}} = \sqrt{\frac{2(-75)}{-9.8}}$$

$t = 3.9\,s$ (3.9 s for g = 10)

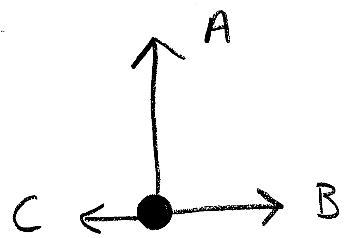
the raft travels 7 - 4 = 3 m during this time.

The speed of the raft is

$$v = \frac{d}{t} = \frac{3.}{3.9} = \underline{0.77\ m/s}$$

3. Three dogs are pulling on a doggie toy. Dog A pulls with a force of 75 N to the North, dog B pulls with a force of 55 N East, and dog C pulls with a force of 35 N West.

   (a) The dot represents the center of mass of the toy. Draw a free-body diagram showing and labeling all the forces exerted on the toy.



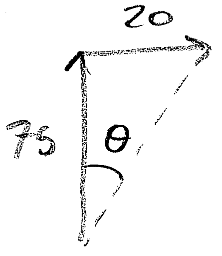
   (b) Calculate the net force acting on the toy.

X

$F_B - F_C = 55 - 35 = 20N$ east

y

$F_A = 75\ N$ north



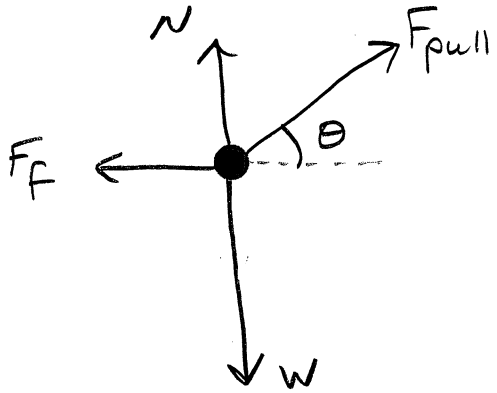
$$F_{net} = \sqrt{75^2 + 20^2} = 77.6\ N$$

$$\theta = \tan^{-1}\left(\frac{20}{75}\right) = 14.93°$$

The net force is 78 N 15° East of North

4. A boy pulls a sled of mass 25 kg along a horizontal snow-covered surface. He pulls with a force of 62 N at an angle of 35° above the horizontal. The coefficient of kinetic friction between the sled and the snow is 0.20.

(a) The dot represents the center of mass of the sled. Draw a free-body diagram showing and labeling all the forces exerted on the sled.



(b) Calculate the acceleration of the sled.

$\underline{x}$

$\sum F = ma$

$F_p \cos\theta - F_f = ma$

$F_p \cos\theta - \mu(W - F_p \sin\theta) = ma$

$$a = \frac{F_p \cos\theta - \mu(mg - F_p \sin\theta)}{m}$$

$\underline{y}$

$\sum F = ma$

$N + F_p \sin\theta - W = 0$

$N = W - F_p \sin\theta$

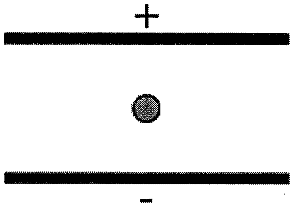
$F_f = \mu F_N$

$F_f = \mu(W - F_p \sin\theta)$

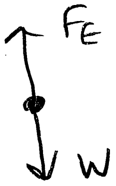
$$= \frac{62\cos 35 - .2(25(9.8) - 62\sin 35)}{25}$$

$\underline{a = 0.36\ m/s^2 \quad (0.32\ m/s^2 \text{ for } g = 10)}$

5. An oil drop of mass 1.96×10^{-15} kg is suspended between two parallel plates creating an electric field of 24 000 N/C down as shown.



Calculate the charge on the oil drop.



Charge must be negative for electric force to be up.

$$\Sigma F = ma$$
$$F_E - W = 0$$
$$F_E = W$$
$$qE = mg$$
$$q = \frac{mg}{E} = \frac{(1.96 \times 10^{-15})(9.8)}{24000}$$

$$\underline{q = -8.0 \times 10^{-19} C}$$

$(-8.0 \times 10^{-19} C$ for $g = 10)$

6. An 8.0 m length of current carrying wire is placed in a magnetic field of 0.40 T West. If the wire experiences a force of 8.3 N down, what is the magnitude and direction of the current in the wire?

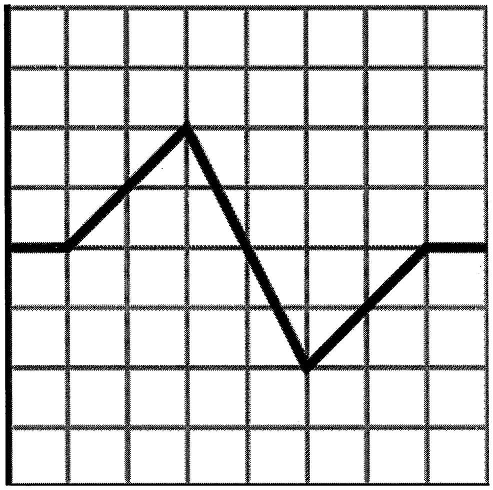
$F_m = BIL \sin\theta$

$I = \frac{F_m}{BL} = \frac{8.3}{(0.4)(8)}$

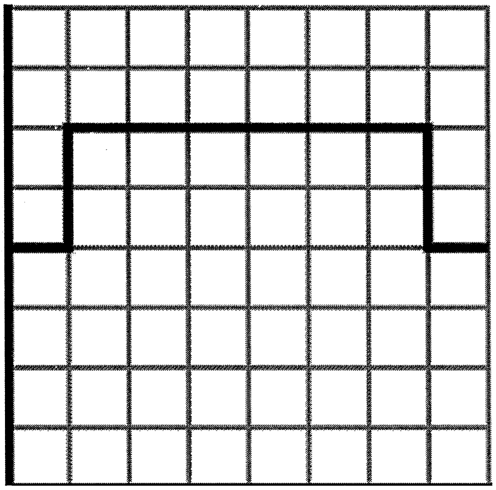
$\underline{I = 2.6\ A \quad \text{South}}$

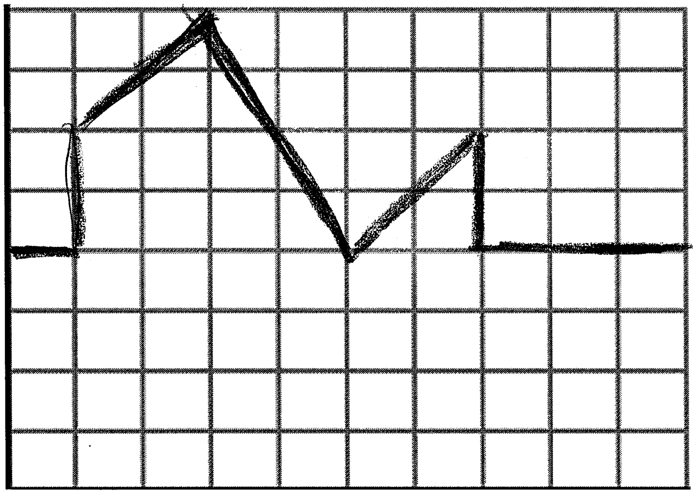
7. Sketch the superposition of wave pulses A and B when they completely overlap.

Wave Pulse A



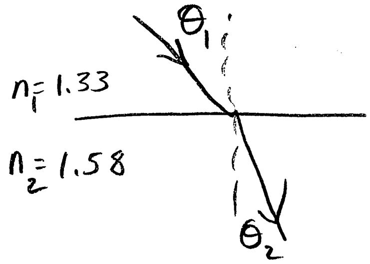
Wave Pulse B





8. The light from an aquarium bulb travels from water (n = 1.33) to glass (n = 1.58). The light strikes the glass at an angle of 15°.

(a) What is the angle of refraction?



$$\frac{\sin\theta_1}{\sin\theta_2} = \frac{n_2}{n_1}$$

$$\theta_2 = \sin^{-1}\left(\frac{n_1 \sin\theta_1}{n_2}\right)$$

$$= \sin^{-1}\left(\frac{1.33 \sin 15}{1.58}\right)$$

$$\underline{\theta_2 = 12.6} = \underline{13^\circ}$$

(b) Calculate the speed of light in the glass.

compare air to glass.

$$\frac{n_1}{n_2} = \frac{V_2}{V_1}$$

$$V_2 = \frac{V_1 n_1}{n_2} = \frac{3\times10^8 (1)}{(1.58)}$$

$$\underline{V_2 = 1.9\times10^8 \text{ m/s}}$$

9. A closed tube has a third harmonic at 660 Hz. The speed of sound is 344 m/s.

(a) What is the length of the tube.

$$f_3 = \frac{3v}{4L} = 660$$

$$L = \frac{3v}{4(660)} = \frac{3(344)}{4(660)}$$

$$L = \underline{0.39\ m}$$

(b) What is the frequency of the next highest harmonic.

$$f_3 = 3f_1$$

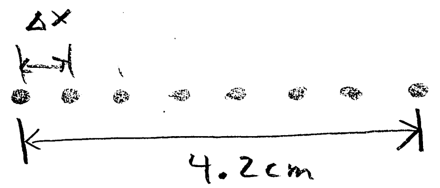
$$f_1 = \frac{f_3}{3} = \frac{660}{3} = 220$$

$$f_5 = 5f_1 = 5(220)$$

$$f_5 = \underline{1100\ Hz}$$

10. In a Young's Double Slit experiment 680 nm light is shone through two slits. The interference pattern appears on a screen 2.0 m away. The distance between 8 consecutive bright spots on the screen is 4.2 cm.

(a) What is the distance between the slits?



$$\Delta x = \frac{0.042}{7} = 6 \times 10^{-3}\ \text{m}$$

$$\lambda = \frac{\Delta x\, d}{L}$$

$$d = \frac{\lambda L}{\Delta x} = \frac{(680 \times 10^{-9})(2.0)}{6 \times 10^{-3}}$$

$$d = \underline{2.3 \times 10^{-4}\ m}$$

(b) If light of a higher frequency was used, would the spacing of the bright spots on the screen increase or decrease? Justify your answer.

The spots would be closer together.

Higher frequency light has a shorter (smaller) wave length $v = f\lambda$

A shorter wave length will result in a smaller distance between spots.

$$\Delta x = \lambda \frac{L}{d}$$