EXAM 1, PH111 2/8/19 STRONG/CHRONIS

NAME KEY '19

Please PRINT your name as it appears in my class roster.

Exam Instructions:

1. Circle one answer for each problem.
2. Enter your answer using your clicker.
3. Since the problems have imbedded partial credit, you should not leave any problems blank either on your paper or on your clicker!
4. Turn in exam and all scratch paper used during exam.

1. A go-cart traveling with constant acceleration increases its speed from 1.50 m/s to 4.3 m/s over a distance of 18 m. How long does this take?

3 ***A.*** 3.1 s
(***B.***) 6.2 s
3 ***C.*** 12.8 s
D. 5.1 s
E. 4.0 s

know $v_f^2 = v_0^2 + 2a(x_f - x_0) \Rightarrow a = \frac{v_f^2 - v_0^2}{2}$ ($x_0 = 0$)

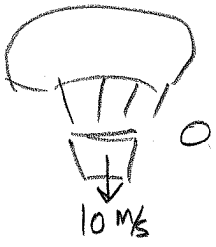
then use $v_f = v_0 + at$ and solve for t

OR use

$x_f - x_0 = \frac{1}{2}(v_0 + v_f)t \Rightarrow t = \frac{2x_f}{(v_0+v_f)} = \frac{2(18\text{m})}{(1.5+4.3)\text{m/s}} = 6.2\text{s}$ ($x_0 = 0$)

2. A stone is released from a balloon that is descending at a constant speed of 10.0 m/s. Neglecting air resistance, after 8.0 s the speed of the stone is:

A. 170 m/s
4 ***B.*** 108 m/s
2 ***C.*** 98 m/s
(***D.***) 88 m/s
E. 245 m/s



$v_{fy} = v_{oy} - gt = -10\text{m/s} - (9.8\frac{\text{m}}{\text{s}^2})(8\text{s})$

$= -88.4\text{ m/s}$

Speed $= |-88.4| = 88.4\text{ m/s}$

3. A baseball is hit straight upward. If the catcher catches the ball at the same level that it was hit and the ball was in the air 2.3 seconds, what was the maximum height of the ball?

A. 9.3 m
4 ***B.*** 5.6 m
(***C.***) 6.5 m
4 ***D.*** 13 m
3 ***E.*** 26 m

2.3 s in air $\Rightarrow$ $\frac{2.3\text{s}}{2}$ up, then $\frac{2.3\text{s}}{2}$ down

drop from top: $y_0 = 0$

$y_f - y_0 = v_{0y}t - \frac{1}{2}gt^2$

$y_f = -h$

$\Rightarrow h = \frac{1}{2}gt^2 = \frac{1}{2}(9.8\text{m/s}^2)(\frac{2.3}{2}\text{s})^2 = 6.5\text{ m}$

4. A racing car travels with constant acceleration over a distance of 180 m and a time of 5.5s. If the car's final velocity was 53 m/s, what is its initial velocity?

3 ***A.*** 118 m/s
B. 20.1 m/s
(***C.***) 12.5 m/s
D. 40.1 m/s
4 ***E.*** 6.25 m/s

though acc. is constant, not given value, best choice:

$x_f - x_0 = \frac{1}{2}(v_0 + v_f)t$ solve for v_0

$\Rightarrow v_0 = \frac{2}{t}(x_f - x_0) - v_f$

$= \frac{2}{5.5s}(180m) - 53\frac{M}{s} = 12.45 \cong 12.5\ m/s$

5. If $\vec{A} = 4\hat{\imath} - 3\hat{\jmath} + 2\hat{k}$ and $\vec{B} = -2\hat{\imath} - 1\hat{\jmath}$, then find $2\vec{A} - \vec{B}$.

(***A.***) $10\hat{\imath} - 5\hat{\jmath} + 4\hat{k}$
4 ***B.*** $6\hat{\imath} - 2\hat{\jmath} + 2\hat{k}$
1 ***C.*** $2\hat{\imath} + 1\hat{\jmath}$
D. $6\hat{\imath} - 5\hat{\jmath} + 4\hat{k}$
4 ***E.*** $4\hat{\imath} - 7\hat{\jmath} + 2\hat{k}$

$2\vec{A} = 8\hat{\imath} - 6\hat{\jmath} + 4\hat{k}$

$-\vec{B} = 2\hat{\imath} + 1\hat{\jmath}$

$10\hat{\imath} - 5\hat{\jmath} + 4\hat{k}$

6. A vector in the second quadrant of the xy-plane has an x-component of -20.0 and a y-component of $+15.0$. The angle it makes with the positive x-axis is:

(***A.***) 143°
4 ***B.*** −36.9°
C. 56.1°
3 ***D.*** 36.9°
E. −5.0°

x component -20

y component $+15$

$\tan^{-1}\left(\frac{+15}{-20}\right) = -36.87°$ but this is 4th quadrant

$+\ 180°$

$143.13°$ correct quadrant

7. Over a short interval, starting at time $t = 0$, the coordinate of an automobile in meters is given by: $x(t) = 4.0t - 27t^3$, where t is in seconds. The magnitudes of the velocity and acceleration of the auto at $t = 1$ s are, respectively:

A. 23 m/s; 77 m/s²
2 ***B.*** 23 m/s; 81 m/s²
3 ***C.*** 77 m/s; 0 m/s²
4 ***D.*** 77 m/s; 81 m/s²
(***E.***) 77 m/s; 162 m/s²

$x(t) = 4t - 27t^3$

$\frac{dx}{dt} = v = 4 - 81t^2 \Rightarrow v = 4 - 81(1s)^2 = -77\frac{m}{s}$

$\frac{dv}{dt} = a = 0 - 162t \Rightarrow a = -162(1s) = -162\frac{m}{s^2}$

drop signs for magnitudes

8. The value of $3\hat{k} \cdot (\hat{k} \times \hat{\imath})$ is:

But $\hat{\imath} \times \hat{\jmath} = \hat{k}$, $\hat{\jmath} \times \hat{k} = \hat{\imath}$, $\hat{k} \times \hat{\imath} = \hat{\jmath}$

(A.) zero
B. +1
C. −1
D. 3
E. $\sqrt{3}$

So this reduces to:

$3\hat{k} \cdot \hat{\jmath}$

dot Product of $\hat{k} \cdot \hat{\jmath} \Rightarrow |1||1| \cos 90° = \boxed{0}$

9. A stone is thrown down from a bridge at a velocity of 20 m/s. If the stone lands at a time t = 6 s later, what is the final speed of the stone?

A. −17 m/s
B. −39 m/s
C. 39 m/s
D. −50 m/s
(E.) −79 m/s

$v_i = -20\,m/s$ $\quad y = 0$ @ $t = 6s$ $\quad v_f = ?$

$v_f = v_0 + at \Rightarrow \underbrace{v_0 - gt}_{\text{free fall}} = (-20\,m/s) - (9.8\,m/s^2)(6s)$

$v_f = -78.8\,m/s$

10. A stone is launched toward a cliff with initial velocity $v_0 = 45$ m/s and at an angle of $\theta_0 = 55°$ with respect to the horizontal. The stone lands on the top of the cliff 4.8 s later. How high is the cliff?

A. 290 m
(B.) 64 m
C. 153 m
D. 73 m
E. 113 m

$y_f - \cancel{y_0}^{0} = v_0 \sin\theta_0\, t - \frac{1}{2} g t^2$

$y_f = (45\,m/s)\sin(55°)(4.8s) - \frac{1}{2}\left(9.8\,\frac{m}{s^2}\right)(4.8s)^2$

$= 64.0\,m$

11. A heavy ball falls freely, starting from rest. Between the second and fourth second of time it travels a vertical distance of:

A. 19.6 m
B. 54.1 m
C. 78.4 m
(D.) 58.8 m
E. 83.3 m

$t = 2s$ $\quad y_f - \cancel{y_0}^{0} = \cancel{v_0}^{0} t - \frac{1}{2} g t^2$

$y_f = -\frac{1}{2}(9.8\,m/s^2)(2s)^2 = -19.6\,m$

$t = 4s$ $\quad y_f = -\frac{1}{2}(9.8\,m/s^2)(4s)^2 = -78.4\,m$

then $78.4 - 19.6 = 58.8\,m$ difference

12. The two vectors $\hat{x} + 4\hat{y}$ and $3\hat{y} - 2\hat{z}$ define a plane. Which of the following vectors is perpendicular to that plane?

need cross product!

(A) $-8\hat{x} + 2\hat{y} + 3\hat{z}$
B. $3\hat{z}$
C. $-8\hat{x} - 2\hat{y} + 3\hat{z}$
D. $\hat{x} + 7\hat{y} - 2\hat{z}$
E. $3\hat{x} - 2\hat{y} + 4\hat{z}$

$$\begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ 1 & 4 & 0 \\ 0 & 3 & -2 \end{vmatrix} = \hat{x}(4(-2)-0) - \hat{y}(-2-0) + \hat{z}(3-0)$$

$$= -8\hat{x} + 2\hat{y} + 3\hat{z}$$

13. A stone is tied to a string and whirled at constant speed in a horizontal circle. The speed is then tripled without changing the length of the string. Afterward, the magnitude of the acceleration of the stone is:

$a_c = \frac{v^2}{r}$ OR $\frac{v^2}{\text{length}}$

(A.) nine times as great
B. one-third as great
C. one-ninth as great
D. the same
E. three times as great

Before $a_c = \frac{v^2}{r}$ After $a_c = \frac{(3v)^2}{r} = \frac{9v^2}{r}$

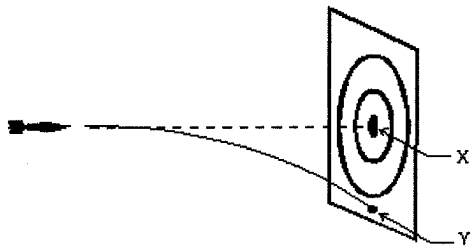
14. A dart is thrown horizontally toward X at 10 m/s as shown. It hits Y a distance of 0.18 m below X. The time of flight is:

$y_f - y_0 = v_{0y}t + \frac{1}{2}gt^2$ ($v_{0y} = 0$)

A. 0.13 s
(B.) 0.19 s
C. 0.04 s
D. 0.02 s
E. 0.31 s

$$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2(0.18\text{m})}{(9.8\text{m/s}^2)}}$$

$$= 0.1917\text{s} \text{ OR } 0.19\text{s}$$



15. A snipe shooter on the edge of a vertical cliff of height h shoots a bullet horizontally outwards with a speed of v_0 m/s. Ignoring friction, the bullet strikes the ground at what horizontal distance x from the foot of the cliff?

$\theta_0 = 0°$, $y_0 = h$, $y_f = 0$

A. $x = v_f h/g$
B. $x = hv_0$
C. $x = v_0\sqrt{g/2h}$
D. $x = h^2/g$
(E.) $x = v_0\sqrt{2h/g}$

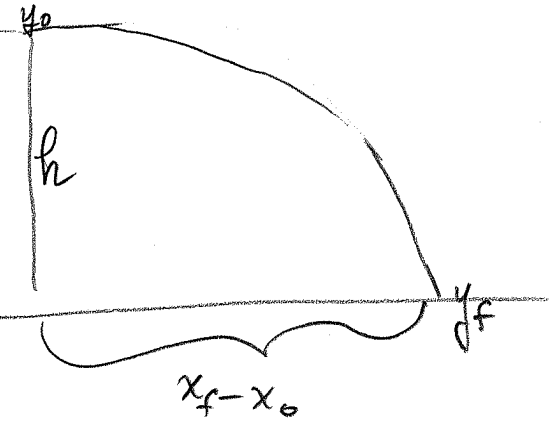
$x_f - x_0 = v_0 \cos\theta_0 \, t$

$= v_0 t$

but t? as in #14

$t = \sqrt{\frac{2h}{g}}$

$x_f - x_0 = v_0\sqrt{\frac{2h}{g}}$



16. An object is moving on a circular path of radius 3π meters at a constant speed of 4.0 m/s. The time required for one revolution is:

A. $6\pi^2$ s
B. $3\pi^2/2$ s
C. $3\pi/4$ s
D. π^2 s
E. $2/\pi$ s

$v = 4\,m/s$, $r = 3\pi\,m$, Circumference $= 2\pi(r) = 6\pi^2 m$

$d = vt \Rightarrow t = \frac{d}{v} = \frac{6\pi^2 m}{4\,m/s} = \frac{3\pi^2}{2}\,s$

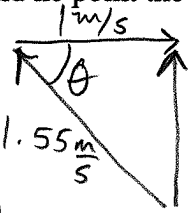
17. A boy wishes to row straight across a river. He can row at 1.55 m/s in still water and the river is flowing at 1 m/s. At what angle θ should he point the bow (front) of his boat?

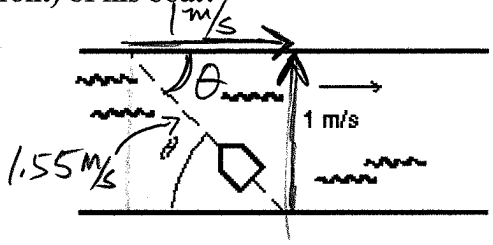
A. 50°
B. 40°
C. 33°
D. 10°
E. 0°

$\cos\theta = \frac{1}{1.55}$

$\theta = \cos^{-1}\left(\frac{1}{1.55}\right)$

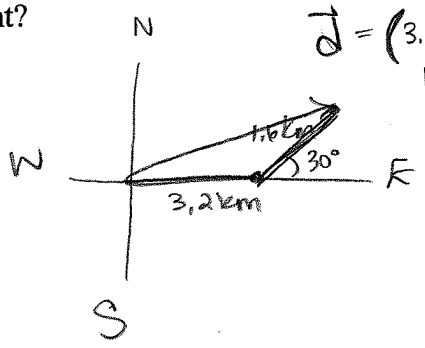
$\theta = 49.8°$





18. A man walks 3.2 km east then continues for half that distance at 30° north of east. What is the magnitude and direction of his displacement?

A. 0.8 km north
B. 4.7 km at 10° north of east
C. 4.6 km at 80° north of east
D. 21 km at 30° north of east
E. 4.8 km directly east



$\vec{d} = (3.2\,km + 1.6\,km\cos 30°,\ 1.6\,km\sin 30)$

$|d| = \sqrt{(3.2\,km + 1.6\cos 30°)^2 + (1.6\sin 30°)^2}$

$= \sqrt{291 + 64}$

$= \sqrt{21 + 0.8}$

$= 4.66$

19. A biological sample in a centrifuge has a centripetal acceleration of $20g$. If its tangential speed is 11 m/s, what is the radius of the centrifuge? *(Hint:* $20g$ *means* 20 *times acceleration of gravity.)*

A. 6.1 m
B. 0.62 m
C. 0.03 m
D. 0.06 m
E. 12 m

$a_c = 20g = \frac{v^2}{r}$

$r = \frac{v^2}{20g} = \frac{11^2}{20g} = \frac{121}{200}$

20. A plane travels in still air at 250 km/h. If the plane travels a distance of 550 km against a wind of 80 km/hr and returns to the starting point flying with the wind, how long does the round trip take?

A. 1.7 hr
B. 2.2 hr
C. 3.2 hr
D. 4.4 hr
E. 4.9 hr

$t_1 = \frac{550\ km}{(250\ \frac{km}{hr} - 80\ \frac{km}{hr})} = \frac{550}{170}\ hr = 3,235\ h$

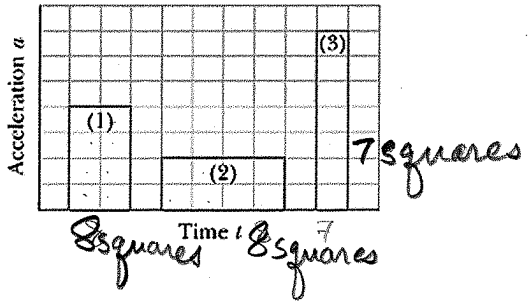
$t_2 = \frac{550\ km}{(250 + 80\ km/hr)} = \frac{550}{330}\ hr = 1,667\ hr$

$\Rightarrow t = t_1 + t_2 \simeq 4,9\ hr$

21. (2points extra credit)
The figure shows that a particle moving along an x axis undergoes three periods of acceleration. Without written computation, rank the acceleration periods according to the increases they produce in the particle's velocity, greatest first.

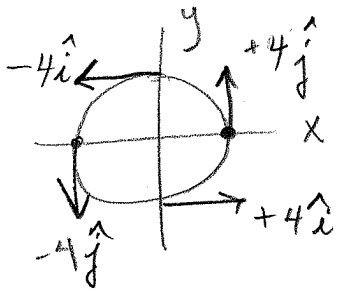
A. **I don't care to answer this question**
B. 1 and 2 tie, then 3
C. 2, 1, 3
D. 3, 1, 2

$v = at$



22. (2points extra credit) An object moves at a constant speed along a circular path in a horizontal xy-plane, with a path center aligned to the xy origin. When the object is at $x = -2$ m, its velocity is $-\left(4\frac{m}{s}\right)\hat{j}$. What is the object velocity at $y = +2$ m?

A. **I don't care to answer this question**
B. $\vec{v} = +\left(4\frac{m}{s}\right)\hat{i}$
C. $\vec{v} = +\left(4\frac{m}{s}\right)\hat{j}$
D. $\vec{v} = -\left(4\frac{m}{s}\right)\hat{i}$



23. (2points extra credit) A bullet shot horizontally from a gun:

A. never strikes the ground
B. strikes the ground at approximately the same time as one dropped vertically from the same point at the same instant
C. travels in a straight line
D. strikes the ground much later than one dropped vertically from the same point at the same instant
E. strikes the ground much sooner than one dropped from the same point at the same instant

EXAM KEY, PH111 – 1ST EXAM, SPRING 2019

Problem	Answer	4pts	3pts	2pts
1.	B		A, C	
2.	D	B		C
3.	C	B, D	E	
4.	C	E	A	
5.	A	B, E	D	C
6.	A	B	D	
7.	E	D	C	B
8.	A			
9.	E		B, C	
10.	B		A, C	
11.	D		C, A	
12.	A	C		
13.	A			C, E
14.	B		A, C	
15.	E		C	
16.	B			A, C
17.	A		B, C	
18.	B			C, E
19.	B	D		A
20.	E		A, C	
21 Bonus				B-2, D-1
22 Bonus				D-2
23 Bonus				B-2

PUT EXAMS IN ALPHABETICAL ORDER and then we eat!!