جامعة الحسين التقنية
Al Hussein Technical University

Department of Basic Sciences

Functional Physics

Exam 1

Name: ---------- **Section:**----------

Key Answers

Formula sheet

$v = \frac{dx}{dt}$	$a = \frac{dv}{dt}$
$v_{avg} = \frac{\Delta x}{\Delta t}$	$a_{avg} = \frac{\Delta v}{\Delta t}$
$v = v_0 + at$ $v^2 = {v_0}^2 + 2a(x - x_0)$ $x - x_0 = v_0 t + \frac{1}{2}at^2$	
$\vec{r} = x\hat{\imath} + y\hat{\jmath} + z\,\hat{k}$	$\vec{v} = \vec{v}_0 + \vec{a}t$
$\vec{r} - \vec{r}_0 = \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$	
$H = \frac{v_0^2 sin^2\theta_0}{2g}$	$R = \frac{v_0^2 sin2\theta_0}{g}$
$a_r = \frac{v^2}{r}$	$T = \frac{2\pi r}{v}$

1)

The period in the uniform circular motion is giving by $T = \frac{2\pi R}{v}$, where ***R*** is the radius of the circle, and ***v*** the speed of the particle. Show that this equation is dimensionally correct.

$[T] = \frac{[L]}{[L/T]} = \frac{[L]}{[L]}[T]$

5 points

P_level

2)

A car is driving at ***70 miles/hour***. Express this speed in ***m/s***, assuming that ***1mile*** = ***5280 ft***, and ***1m = 3.3 ft***.

$70\ \frac{mil}{hr} = 70\ \frac{mil}{hr} \times \frac{5280\ ft}{mil} \times \frac{1\ m}{3.3\ ft} \times \frac{1\ hr}{3600\ sec}$ 5 points

P_level

$70\ \frac{mile}{hr} = \frac{70 \times 5280}{3.3 \times 3600}\ \frac{m}{sec} = 31.11\ m/sec$

P

3)

At time $t = 0$, a particle had a speed of 20 m/s in the positive x direction. At time $t =$ 2.5 s, its speed was 40 m/s in the opposite direction. Find the average acceleration of the particle during the 2.5 s interval.

5 - points

P - level

$t_i = 0 \qquad v_i = 20\ m/s$

$t_f = 2.5\ sec \qquad v_f = -40\ m/s$

$$a_{avg} = \frac{\Delta v}{\Delta t} = \frac{-40-20}{2.5-0} = -24\ m/s^2$$

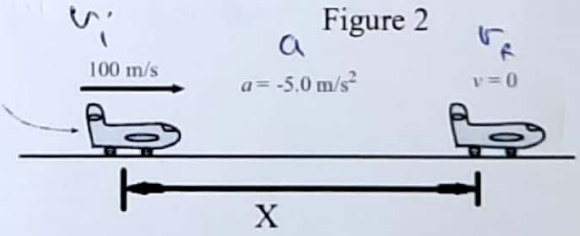
or $24\ m/s^2$ to the left

4)

A jet plane lands with a speed of 100 m/s and decelerates with $a = -5.00\ m/s^2$ as it comes to rest. From the instant it touches the runway; it moves a distance X and stops, as shown in **Figure 2**. What is the distance X, measured in meters?

M

Figure 2



5 - points

P - level

$$v_f^2 = v_i^2 + 2a(x - x_0)$$

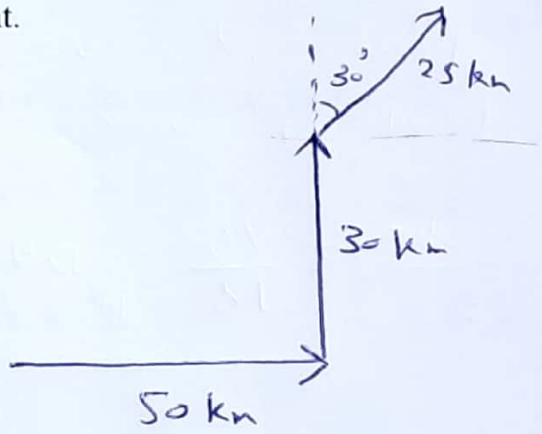
$$x - x_0 = \frac{v_f^2 - v_i^2}{2a} = \frac{(0)^2 - (100)^2}{2(-5)} = 1000\ m$$

M

5)

A car is driven east for a distance of 50 km, then north for 30 km, and then in a direction 30° east of north for 25 km. Sketch the vector diagram and determine (a) the magnitude and (b) the angle of the car's total displacement from its starting point.

a)



10-Points

M-level

b) $\vec{r} = 50\hat{i} + 30\hat{j} + 25\sin 30\,\hat{i} + 25\cos 30\,\hat{j}$

$= 50\hat{i} + 30\hat{j} + 12.5\hat{i} + 21.7\hat{j}$

$\vec{r} = 62.5\hat{i} + 51.7\hat{j}$, $|\vec{r}| = \sqrt{(62.5)^2 + (51.7)^2}$

$= 81$ km

$\theta = \tan^{-1}\left(\frac{51.7}{62.5}\right) = 39.57°$

North of East

P

6)

Two vectors are given by

$$\vec{a} = (4.0\ \text{m})\hat{i} - (3.0\ \text{m})\hat{j} + (1.0\ \text{m})\hat{k}$$

and $$\vec{b} = (-1.0\ \text{m})\hat{i} + (1.0\ \text{m})\hat{j} + (4.0\ \text{m})\hat{k}.$$

In unit-vector notations, find $\vec{a} - 2\vec{b}$?

5 - Points

P - level

$2\vec{b} = -2\hat{i} + 2\hat{j} + 8\hat{k}$

$\vec{a} - 2\vec{b} = 6\hat{i} - 5\hat{j} - 7\hat{k}$

P

7)

A particle moves so that its position (in meters) as a function of time (in seconds) is $\vec{r} = \hat{i} + 4t^2\hat{j} + t\hat{k}$. Find its acceleration when $t = 2$ second.

5 - Points

P - level

$V = \frac{dr}{dt} = 8t\,\hat{j} + \hat{k}$

$a = \frac{dV}{dt} = 8\hat{j}$

$a(2) = 8\ m/s^2$

D

$v_i = v_{ix}$ $(v_{iy}=0)$

8)

A projectile's launch speed is five times its speed at maximum height. Find launch angle (θ_i)?

$v_i = 5v_{ix}$

$v_i = 5v_i \cos\theta_i$

10 - points

D - level

$\cos\theta_i = \frac{1}{5}$

$\theta_i = \cos^{-1}\left(\frac{1}{5}\right) = 78.5^\circ$

9)

M

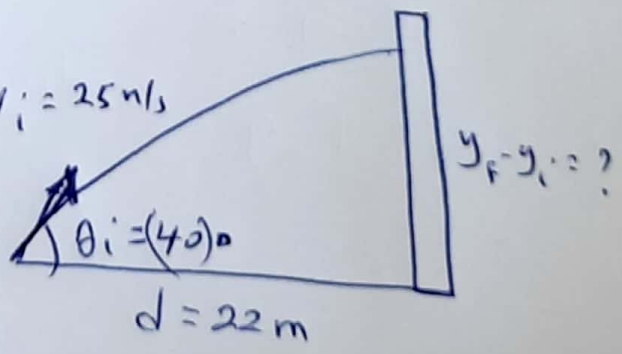
You throw a ball toward a wall at speed ***25.0 m/s*** and at angle $\boldsymbol{\theta_i = 40.0^\circ}$ above the horizontal (Fig. 4-35). The wall is distance $\boldsymbol{d = 22.0\ m}$ from the release point of the ball. How far above the release point does the ball hit the wall?

10 - points

M - level

$y_f - y_i = v_i \sin\theta_i t - \frac{1}{2} g t^2$

But t is unknown !!



$x_f - x_i = v_i \cos\theta_i t$

$t = \frac{x_f - x_i}{v_i \cos\theta_i} = \frac{22}{25 \cos 40} = 1.12\ sec$

$\Rightarrow y_f - y_i = 25 \sin 40 \times 1.12 - \frac{1}{2} \times 9.8 \times (1.12)^2$

$y_f - y_i = 11.85\ m$ ✳

10)

M

A rotating fan completes **1200 revolutions** every **60 second**. Consider the tip of a blade, at a radius of **0.15 m**. What is the magnitude of its acceleration?

10 - Points

M - level

1200 rev ⟶ 60 sec

1 rev ⟶ ?

~~for each rev~~

for each rev we need $\frac{60}{1200} = 0.05$ sec

$$T = \frac{2\pi r}{v}$$

$$0.05 = \frac{2\pi * 0.15}{v} \Rightarrow v = 18.85 \text{ m/s}$$

$$a = \frac{v^2}{r} = \frac{18.85}{0.15}$$

Good Luck!

$$a = 2368.8 \text{ m/s}^2$$