**Physic… Exam 1, Spring 2014, Version B**

**Name (…** [redacted] **4 Digit ID:** 6544 **Section:** 141

**Honor…** …easons all students are pledged to comply with the provisio… …ust answer the exam questions entirely by yourself. **Turn o…** …**unication devices**. Use only your own calculator.

**B**

**Instru…**

- Firs… …he Scantron card and this exam sheet.
- Use… …o other materials.
- Buc… …ems.
- For… …will be difficult to arrive at the correct answer without showing you… …wever, partial credit will **not** be awarded on the multiple choice pro…
- Ans… …pencil. Also circle your answers on question papers.
- Do… …estion, if needed, from your proctor or Professor.

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**1.** The volume of an object is given as a function of time by $V = A + \frac{B}{t} + Ct^2$.

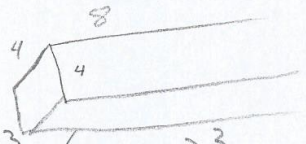
Find the dimension of constant C.

A) $T / L^3$
B) $L^2 T$
C) $L^3 / T^2$
D) $L^3$
E) $T / L^2$

$\frac{L^3}{T^2}$ $\frac{L^3}{T^2} \cdot T^2$ $\frac{L^3}{T^2} \cdot T^2$

**2.** A cord is a volume of cut wood equal to a stack 8 feet long, 4 feet wide, and 4 feet wide. How many cords are in 1 $m^3$?

A) 0.117 cords
B) 3.54 cords
C) 2.33 cords
D) 1.38 cords
E) 0.276 cords

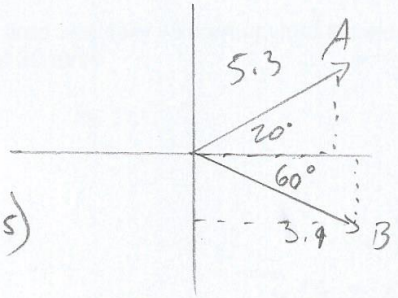



$8 \cdot 4 \cdot 4 = 32 \cdot 4$ $128 ft^3$

$128 ft^3 \cdot \left(\frac{12 in}{1 ft}\right)^3 \cdot \left(\frac{2.54 cm}{1 in}\right)^3 \cdot \left(\frac{10^{-2} m}{1 cm}\right)^3$

**3.** Vector **A** is 5.3 cm long and is $20.0^0$ above the x-axis in the first quadrant. Vector **B** is 3.9 cm long and is $60.0^0$ below the x-axis in the fourth quadrant. Find the magnitude of **A** - **B**.

A) 7.1 cm
B) 3.4 cm
C) 2.6 cm
D) 8.6 cm
E) 6.0 cm




$5.3 \sin(20) = A_y = 1.812$
$5.3 \cos(20) = A_x = 4.98$
$3.9 \sin(-60) = B_y = -3.3775$
$3.9 \cos(-60) = B_x = 1.95$

$4.98 - 1.95$, $(1.812 + 3.3775)$

$3.03, 5.1895$

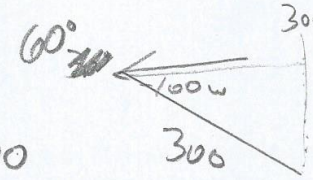
50 or -250, -259.808

4. A spelunker is surveying a cave. She follows a passage 100 m straight west, then 300 m in a direction $30^0$ east of south. After a third unmeasured displacement, she finds herself back where she started. The direction of the third displacement is closest to:

A) $10^0$ West from North
B) $40^0$ North from West
C) $40^0$ West from North
D) $10^0$ East from South
E) $40^0$ South from East

B

300 Sin -60 = Bx
300 cos -60 = Bx




Ax = -100
Ay = 0

By = -259.808
Bx = 150

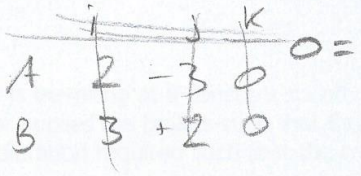
5. The angle between the vector $\vec{A} = 2\hat{i} - 3\hat{j}$ and the vector $\vec{B} = 3\hat{i} + 2\hat{j}$ is closest to:

A) $109^0$
B) $90^0$
C) $71^0$
D) $55^0$
E) $-19^0$

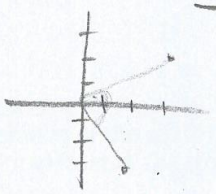
B = 3i + 2j

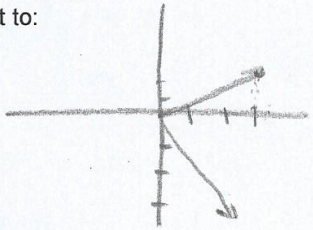
6i - 1j

6i - 6 = 0









0i 0j 2 + 9

11 =

6. Given that $\vec{A} = 2\hat{i} - 3\hat{j}$, $\vec{B} = 4\hat{i} - 1\hat{j}$, and $\vec{C} = 2\hat{i} + 2\hat{j}$, calculate $\vec{A} + \vec{B} - 2\vec{C}$

A) $6\hat{i} - 4\hat{j}$
B) -6
C) $10\hat{i}$
D) $2\hat{i} - 8\hat{j}$
E) None of the other answers

A B C

2i + 4i - (2i)2

2i - 8j

-3j - 1j - (2j)2

2i + 4i - 4i = 2

-3j - 1j - 4j

7. A rocket, initially at rest, is fired vertically with an upward acceleration of 10 m/s$^2$. How long does it take for the rocket to reach a speed of 30 m/s?

A) 3.0 s
B) 0.33 s
C) 1.5 s
D) 150 s
E) 0.67 s

$v_i = 0$
$a = 10\ m/s^2$
$v_f = 30\ m/s$

$30 = 0 + 10 \cdot T$

**8.** A ball thrown vertically from ground level with an initial speed of 12 m/s. What maximum height does the ball reach before it falls back to Earth?

A) 0.82 m
B) 14.7 m
C) 1.22 m
D) 0.41 m
E) 7.3 m

$V_i = 12\ m/s$
$a = -9.8$
$V_f = 0$
$\Delta d = ?$


$0 = 12 + 2(-9.8) \cdot d$

**B**

**9.** A particle starts from the origin at $t$ = 0 with a speed of 5 m/s in the POSITIVE x direction and moves with a constant acceleration of 2 m/s$^2$ in the NEGATIVE x direction. What is the speed of the particle at $t$ = 2.0 s?

A) none of the other answers
B) 9 m/s
C) 5 m/s
D) 1 m/s
E) 6 m/s

| X | Y |
|---|---|
| $V_i = 5$ | $V_i = 0$ |
| $a = -2$ | |
| $\Delta T = 2$ | |
| $V_f = ?$ | |

$? = V_i + aT$

**10.** A car is travelling at a constant speed of 15m/s on a level roadway. At a distance of 25 m from a stop sign, driver applies the brakes such that the deacceleration of the car is constant. What is the magnitude of the deacceleration required such that the car stops 5m in front of the stop sign?

A) none of the other answers
B) 4.5 m/s$^2$
C) 5.6 m/s$^2$
D) 3.8 m/s$^2$
E) 9.8 m/s$^2$

$V_i = 15$
$\Delta d = 20$
$a = ?$
$V_f = 0$

$0^2 = 15^2 + 2a(20)$

$0 = 15^2 + 2a(20)$

**11.** The position (in units of meters) of an object is given by $x = -2.0t^3 + 4.0t^2$ where $t$ is in seconds. At $t$ = 2.0 s, what is the magnitude of the particle's acceleration?

A) 30 m/s$^2$
B) 16 m/s$^2$
C) 25 m/s$^2$
D) none of the other answers
E) 8 m/s$^2$

$x = -2T^3 + 4T^2$

$V = -6T^2 + 8T$

$a = -12T + 8$

$a = -12(2) + 8$

$-24 + 8 = -16 = 16$

$-6T^2 + 8T$

$-12T + 8$

$-24 + 8 = 16$

**12.** A particle moving with a constant acceleration has a speed of 20 cm/s in the NEGATIVE x direction when its position is $x$ = -15 cm. Its position 7.0 s later is $x$ = 10 cm. What is the acceleration of the particle?

A) 6.7 cm/s$^2$
B) -4.7 cm/s$^2$
C) -5.9 cm/s$^2$
D) 5.5 cm/s$^2$
E) none of the other answers

$V_i = -20$

$X_0 = -15$

$\Delta T = 7$

$X_f = 10$

$10 = -15 + (-20.7) + .5a(7^2)$

$25 = -140 + 5.49a$

$24.5a$

**B**

**13.** At $t$ = 0, a particle leaves the origin and moves along some path in the $xy$ plane, arriving at t=2s at a point $6\mathbf{i} - 8\mathbf{j}$ (in meters). What is the magnitude of the average velocity in m/s? – select the closest answer.

A) Insufficient information
B) 5
C) 4
D) 3
E) 2

| X | Y |
|---|---|
| $\Delta T = 2$ | $\Delta T = 2$ |

(6, -8) (0, 0)

$\frac{0+8}{2}$ , $\frac{0-6}{2} = -3$

-3, 4

(0, 0) (6, -8)

**14.** A particle starts with a velocity of $(5\hat{\mathbf{i}} - 2\hat{\mathbf{j}})$ m/s and moves in the $xy$ plane with a constant acceleration of $\vec{\mathbf{a}} = 2\hat{\mathbf{j}}$ m/s$^2$. What is the speed of the particle at $t$ =7.0 s?

A) 3 m/s
B) 52 m/s
C) 39 m/s
D) 26 m/s
E) 13 m/s

| X | Y |
|---|---|
| $V_i = 5$ | $V_i = -2$ |
| $\Delta T = 7$ | $a = 2$ |
| $a = 0$ | $\Delta T = 7$ |

$V_{fx} = 5$

$V_{fy} = 12$

$-2 + 2 \cdot 7$

**15.** A heavy object is dropped from a plane which is flying horizontally at an altitude 500m with speed of 200m/s. Ignoring air resistance, find the horizontal distance where the object hits the ground – **select the closest answer.**

A) 0.5 km
B) 1 km
C) 2 km
D) 3 km
E) 4 km

500

$D_x$

| X | Y |
|---|---|
| $V_i = 200$ | $V_i = 0$ |
| $a = 0$ | $a = -9.8$ |
| $d = ?$ | $d = 500$ |
| $\Delta T = 10.01$ | $\Delta T = 10.01$ |
| $V_f = 200$ | $V_f = -98$ |

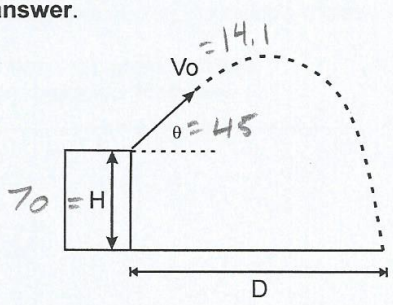
**16.** For the previous problem, calculate the speed upon impact, and the location of the object relative to the plane at the instance of impact

A) Can not be determined since it depends on mass of the object
B) 310 m/s, exactly under the plane
C) 220 m/s, behind the plane
D) 310 m/s, behind the plane
E) 220 m/s, exactly under the plane

**17.** A rock is projected from the edge of the top of a tall building of height H=70m with an initial velocity of 14.1 m/s at an angle of 45° above the horizontal. The rock strikes the ground a horizontal distance D from the base of the building, as shown in the diagram. Find D – **select the closest answer**.

A) 10 m
B) 20 m
C) 30 m
D) 40 m
E) 50 m

| X | Y |
|---|---|
| $V_i = 9.97$ | $V_i = 9.97$ |
| $d = ?$ | $d = 70$ |
| $a = 0$ | $a = -9.8$ |
| $\Delta T = 4.93$ | $\Delta T =$ |




$$\frac{+9.97 \pm \sqrt{1471.4}}{9.8}$$

$$70 = 9.97T - 4.9T^2$$

$$4.9T^2 - 9.97T - 70 = 0$$

**18.** It takes a bike racer 1min to complete one full circle on a circular track with radius R=200m. What is the magnitude of his centripetal acceleration?

A) 5 m/s$^2$
B) 4 m/s$^2$
C) 3 m/s$^2$
D) 2 m/s$^2$
E) 1 m/s$^2$

$\Delta T = 60 sec$
$R = 200 m$
$a =$

$$60 = \frac{2\pi 200}{V}$$

$$60V = 2\pi 200$$

$$V = 20.944$$

**B**