Physics 504
September 28th, 2012

Name: Answers

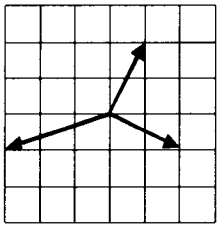
Test: Vectors

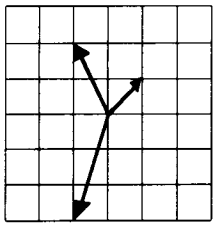
Each question is worth 4 marks. Show all your work.

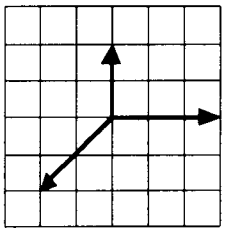
Part A: Multiple Choices

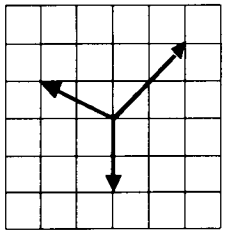
1) Four objects are each subjected to three forces.

For which of the following shows three forces for which the resultant will be zero?

A) 

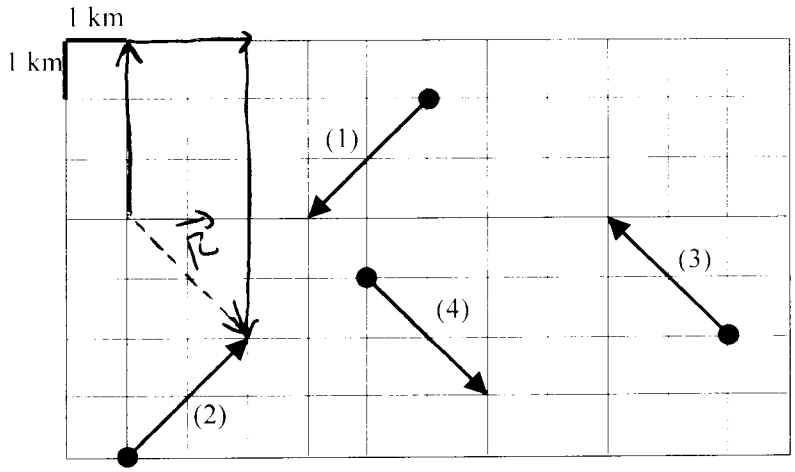
C) 

B) 

D) 

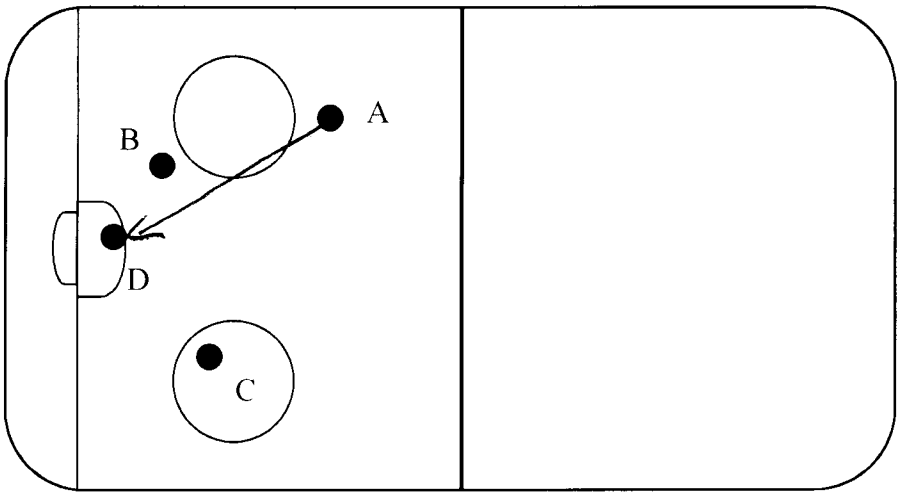
2) A cyclist rides along several streets in a section of town. He travels 3 km north, 2 km east, then 5 km south.

Which of the vectors below represents the resultant displacement?



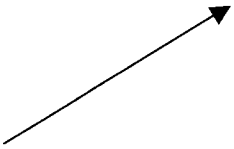
A) 1
B) 2
C) 3
D) 4

3) During a power play attack in a hockey game, player A passes the puck to player C, who passes the puck to player B, who shoots the puck at the net and the goalie (D) catches it.



Which vector best represents the displacement of the puck?

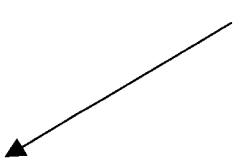
A)



B)

C)

D)



Part B: Extended Answers (Show all your work.)

4) Consider the vectors below.

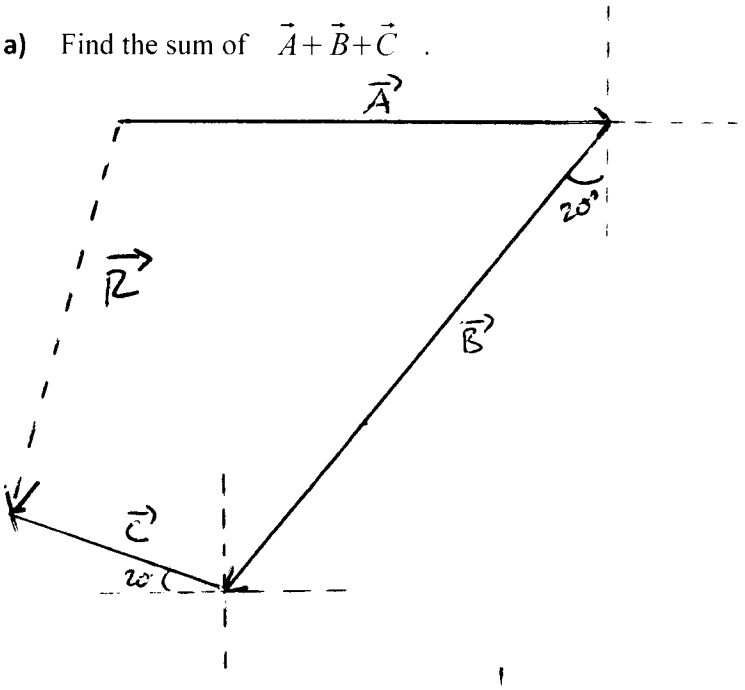
$\vec{A}$ = 6.5 km [E]

$\vec{B}$ = 8.0 km [S 40° W]

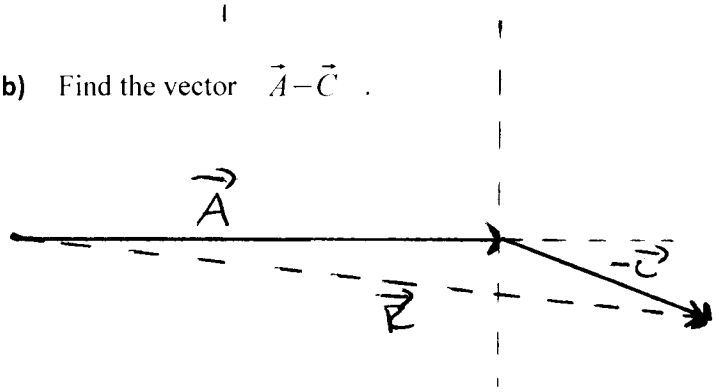
$\vec{C}$ = 3.0 km [W 20° N]

Using the scale 1.0 cm : 1.0 km (and solve graphically.)

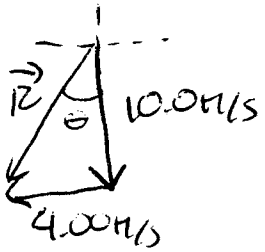
a) Find the sum of $\vec{A}+\vec{B}+\vec{C}$.



b) Find the vector $\vec{A}-\vec{C}$.



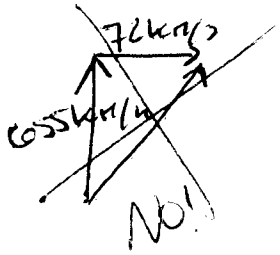
5) A weak bird is trying to head south for the winter. The bird flies at 10.0 m/s, keeping its little body ~~perpendicular~~ parallel to the direction in which it wishes to go. There is a 4.00 m/s wind blowing from the east. What is the resultant velocity of the bird?

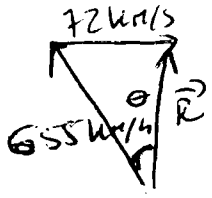


$$R_{mag} = \sqrt{(10.0\,m/s)^2 + (4.00\,m/s)^2}$$
$$= 10.8\,m/s$$
$$\theta = \tan^{-1}\left(\frac{4.0\,m/s}{10.0\,m/s}\right)$$
$$= 22°$$

10.8 m/s [S22°W] or [W68°S]

6) A plane must reach a destination located directly North of its departure point. The plane can fly at a maximum speed of 655 km/h. On this particular day, there is a crosswind blowing from the West (toward the East) at a velocity of 72 km/h. What heading should the plane take in order to reach its destination?





$$\theta = \sin^{-1}\left(\frac{72\,km/h}{655\,km/h}\right)$$
$$= 6.3°$$

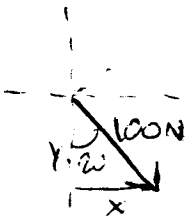
[N6.3°W]

7) During a family activity at the outdoor rink, three children are pulling their younger sibling, who is sitting on a sled.

- The first child is pulling with a force of 50 N in the [S] direction.
- The second child is pulling with a force of 100 N in the [W] direction.
- The third child is pulling with a force of 100 N in the [S 20° E] direction.

What is the resultant force on the sled?

F#3

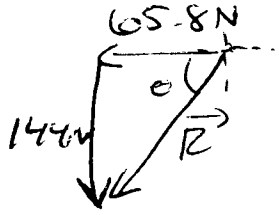


$X = 100N \sin 20°$
$= 34.2N$
$Y = 100N \cos 20°$
$= 94.0N$

$(0, -50)N$
$(-100, 0)N$
$(34.2, -94)N$
$(-65.8, -144)N$

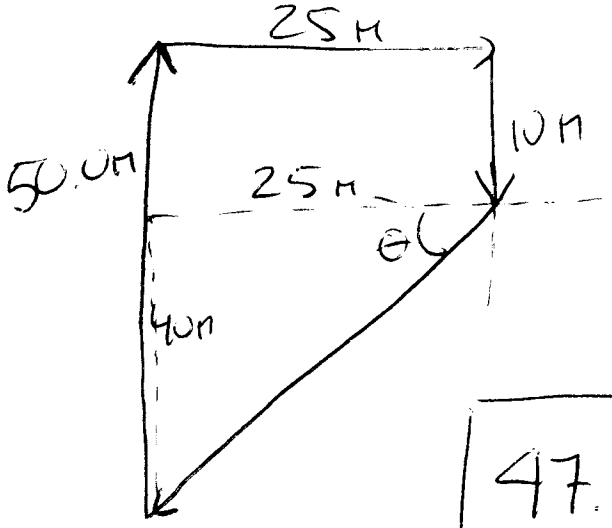
$M_{res} = \sqrt{(65.8N)^2 + (144N)^2}$
$= 158N$

$\theta = \tan^{-1}\left(\frac{144N}{65.8N}\right)$
$= 65°$



158N [W65°S] or [S 25°W]

8) During a soccer training exercise, players do an agility drill. The players run 50.0 m North, then shuffle East for 25.0 m, then run backwards (South) for 10.0 m. At that point, the drill is over and the players return to the their starting point. Give the vector that would properly describe the displacement of the players as they return to the back of the line (from the end-point of the drill).



$M_{res} = \sqrt{(25m)^2 + (40m)^2}$
$= 47.2m$

$\theta = \tan^{-1}\left(\frac{40m}{25m}\right)$
$= 58°$

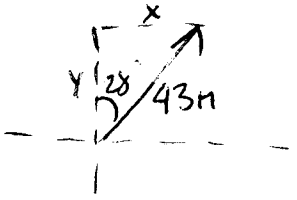
47.2m [W58°S] or [S 32°W]

9) At the dog park, a dog runs 43 m [N 28° E], then 12 m [W] and then 62 m [E 58 ° S].

a) What is the distance traveled by the dog?

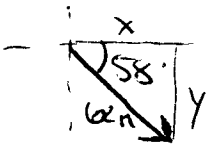
dist = 43m + 12m + 62m = **117m**

b) What is the resultant displacement of the dog?



$x = 43m \sin 28°$
$= 20.2m$

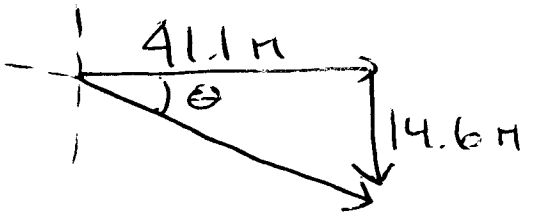
$y = 43m \cos 28°$
$= 38.0m$



$x = 62m \cos 58°$
$= 32.9m$

$y = 62m \sin 58°$
$= 52.6m$

$(20.2, 38.0)_m$
$(-12, 0)_m$
$+ (32.9, -52.6)_m$
$(41.1, -14.6)_m$



$M_{res} = \sqrt{(41.1m)^2 + (14.6m)^2}$
$= 43.6m$

$\theta = \tan^{-1}\left(\frac{14.6m}{41.1m}\right)$

$= 20°$

43.6m [E20°S]
or
[S70°E]