

MOTION, FORCES AND PROJECTILES - CHAPTER REVIEW

- 1 A car is moving at a speed of 100 km h^{-1} and a truck is moving at 90 km h^{-1} in the opposite direction. The relative velocity of the car with respect to the truck is:
- A 10 km h^{-1} in the direction of the truck B 10 km h^{-1} in the direction of the car
C 190 km h^{-1} in the direction of the truck D 190 km h^{-1} in the direction of the car
- 2 On his way home from training, Mitch walks along three streets. He walks 150 m north, 300 m east and 250 m north. The magnitude of Mitch's resultant displacement is:
- A 200 m B 400 m C 500 m D 700 m
- 3 Three forces are acting simultaneously in the same plane on an object. The resultant force is $\underline{F} = 520 \text{ N}$ due east. Which of the following combinations of forces will give this resultant force?
- A $\underline{F}_1 = 350 \text{ N}$ west, $\underline{F}_2 = 270 \text{ N}$ east, $\underline{F}_3 = 440 \text{ N}$ west
B $\underline{F}_1 = 350 \text{ N}$ east, $\underline{F}_2 = 270 \text{ N}$ west, $\underline{F}_3 = 440 \text{ N}$ east
C $\underline{F}_1 = 350 \text{ N}$ east, $\underline{F}_2 = 270 \text{ N}$ west, $\underline{F}_3 = 440 \text{ N}$ west
D $\underline{F}_1 = 350 \text{ N}$ west, $\underline{F}_2 = 270 \text{ N}$ east, $\underline{F}_3 = 440 \text{ N}$ east

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- 4 A soccer ball is struck with a force of 420 N in the direction N22°E. The northerly and easterly components of this force are F_1 and F_2 respectively. The magnitudes of these forces are:
- A $F_1 = 87 \text{ N}$, $F_2 = 411 \text{ N}$ B $F_1 = 411 \text{ N}$, $F_2 = 87 \text{ N}$
C $F_1 = 157 \text{ N}$, $F_2 = 389 \text{ N}$ D $F_1 = 389 \text{ N}$, $F_2 = 157 \text{ N}$

- 5 Forces are acting on an object. Calculate the resultant force acting on the object for each of the following:
- (a) $F_1 = 250 \text{ N}$ north, $F_2 = 450 \text{ N}$ south, $F_3 = 125 \text{ N}$ north (b) $F_1 = 100 \text{ N}$ east, $F_2 = 100 \text{ N}$ south

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- 6 A particle of mass 50 kg is suspended by two strings attached to two points in the same horizontal plane. If the two strings each make angles of 30° respectively to the horizontal, find the magnitude of the tension in each string, in newtons, given that $\sin 30^\circ = \frac{1}{2}$.

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- 7 Jaide paddles her canoe in a direction perpendicular to the riverbanks. The river is 120 m wide. The canoe's speed in this direction is 1.5 m s^{-1} . The water in the river is flowing at 0.8 m s^{-1} and you can assume that the riverbanks are parallel straight lines.
- (a) Calculate the velocity of the canoe relative to the bank. Give the angle correct to two decimal places.
 - (b) At what distance, in the direction downstream from the starting point, will Jaide get to the other riverbank?
 - (c) Calculate Jaide's final displacement from the starting point.
 - (d) Jake is going to cross the river in another canoe. He can paddle at the speed of 1.8 m s^{-1} relative to the water's flow. At what direction should Jake row to get to the same end-point as Jaide, and how much time will this take?

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- 8 A particle is projected with a velocity whose horizontal and vertical components are 6 m s^{-1} and 4 m s^{-1} respectively. Use $g = 10 \text{ m s}^{-2}$.
- (a) Draw a diagram to show this information.
 - (b) What is the angle of projection?
 - (c) Find expressions for $y(t)$ and $x(t)$.
 - (d) Find the greatest height reached.
 - (e) Find the horizontal range.

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- 9 A cricketer hits a cricket ball off the ground towards a fielder who is 65 m away. The ball reaches a maximum height of 4.9 m and the horizontal component of the velocity is 28 m s^{-1} . Use $g = 9.8 \text{ m s}^{-2}$.
- (a) Find expressions for $\underline{v}(t)$ and $\underline{r}(t)$.
 - (b) How much time does it take for the ball to reach its greatest height?
 - (c) How far has the ball travelled horizontally when it has descended to a height of 1.3 m?
 - (d) Find the constant speed with which the fielder must run forward, starting at the instant the ball is hit, in order to catch the ball at a height of 1.3 m above the ground.

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- 10** A particle is projected from a point 15 m above horizontal ground. At its highest point it just clears the top of a wall 26.25 m high and 30 m away. Use $g = 10 \text{ m s}^{-2}$.
- (a) Draw a diagram to show this information.
 - (b) Find expressions for $\underline{v}(t)$ and $\underline{r}(t)$.
 - (c) Find the speed and the angle of projection of the particle.

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- 11** A tennis ball is struck with a force of 300 N in the direction S40°W. The southerly and westerly components of this force are $\underline{F}_1$ and $\underline{F}_2$ respectively. The magnitudes of these forces are:
- | | |
|---|---|
| A $\underline{F}_1 = 230 \text{ N}, \underline{F}_2 = 230 \text{ N}$ | B $\underline{F}_1 = 193 \text{ N}, \underline{F}_2 = 230 \text{ N}$ |
| C $\underline{F}_1 = 230 \text{ N}, \underline{F}_2 = 193 \text{ N}$ | D $\underline{F}_1 = 150 \text{ N}, \underline{F}_2 = 260 \text{ N}$ |