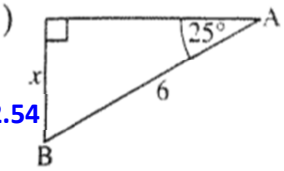
TUTORIAL QUESTION

TOPIC 1 PHYSICAL QUANTITIES & UNITS

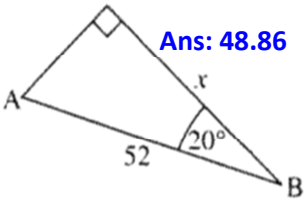
1.) Find the value of x.

(a)



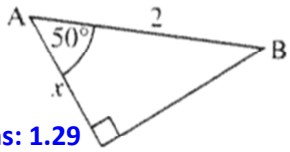
Ans: 2.54

(c)



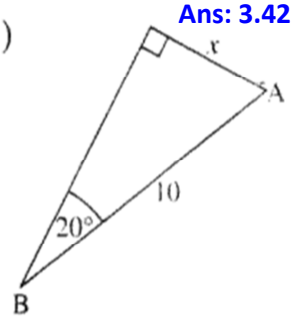
Ans: 48.86

(e)



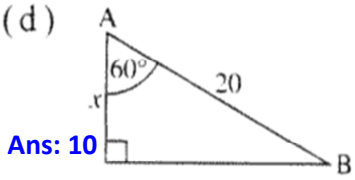
Ans: 1.29

(b)



Ans: 3.42

(d)



Ans: 10

(f)

Ans: 5.14

2.) Find the resultant vector for part (a.) to (e.)

a.) A displacement of 12 km south followed by a displacement of 5 km east. ***(Ans: 13 km S 22.6^{o}E)***

b.) A displacement of 5 km east followed by a displacement of 12 km south. Is there any difference between your answer to this question and the answer to question 1? ***(Ans: No difference)***

c.) A velocity of 24 ms^{-1} north and a velocity of 7 ms^{-1} east. ***(Ans: 25 ms^{-1} , N16.3^{o}E)***

d.) A force of 12 N west and a force of 16 N south. ***(Ans: 20 N, W53.1^{o}S)***

e.) Displacements of 10 m east and 12 m north east. ***(Ans: 20.3 m, E24.7^{o}N)***

3.) An aircraft, flying with an engine speed of 400 kmh^{-1}, is set on a course due north, in a wind of speed 60 kmh^{-1} from the south west. At what speed and in what direction is the aircraft covering the ground? ***(Ans: 444 kmh $^{-1}$, N5.5 ^{o}E)***

4.) A stone is thrown up at an angle of 20^{o} to the vertical with an initial velocity of 35 ms^{-1}. what are the initial horizontal and vertical components of the velocity of the stone? ***(Ans: 12 ms^{-1}, 32.9 ms^{-1})***

5.) A train is travelling at 125 mph on a railway line that runs N24^{o}E. Find the horizontal and vertical components of the velocity of the train. ***(Ans: 114.2 mph, 50.8 mph)***

6.) The drag coefficient C_D of a car moving with speed v through air of density ρ is given by $C_D = \frac{F}{(\frac{1}{2}\rho v^2 A)}$

where F is the drag force exerted on the car and A is the maximum cross-sectional area of the car perpendicular to the direction of travel. Show that C_D is dimensionless.

Ans: C_D = (kg m s^{-2}) / (kg m^{-3})(m s^{-1})^2(m^2)

= 1 (dimensionless)

7.) The experimental measurement of the heat capacity C of a solid as a function of temperature T is to be fitted to the expression $C = \alpha T + \beta T^3$. What are possible units for α and β?

Ans: α = J K^{-2} & β = J K^{-4}

8.) a.) The kilogram, metre and second are base units. Name two other base units. **Ans: Ampere & Kelvin**

b.) Explain why the unit of energy is said to be a derived unit.

Ans: it can be expressed as product or quotient of base units

c.) The density, *ρ* and pressure, p of a gas are related by the expression

$$c = \sqrt{\frac{\gamma p}{\rho}}$$

where c and γ are constants.

i.) Determine the base unit for density *ρ* **Ans: kg m^{-3}**

ii.) Show that the units for pressure p are $kgm^{-1}s^{-2}$ **Ans: p = F / A = $kgms^{-2}$ / m^2**

iii.) Given that constant γ has no unit, determine the unit of c. **Ans: c = ms^{-1}**

iv.) Suggest what quantity may be represented by the symbol c. **Ans: speed / velocity**

9.) Which expression could be correct for the velocity v of ocean waves in terms of ρ the density of sea-water, g the acceleration of free fall, h the depth of the ocean and λ the wavelength?

A.) $\sqrt{g\lambda}$ B.) $\sqrt{\frac{g}{h}}$ C.) $\sqrt{\rho g h}$ D.) $\sqrt{\frac{g}{\rho}}$

10.) If p is momentum of an object of mass m, the expression p^2 / m has base units identical to

A.) energy B.) force C.) power D.) velocity

11.) Which quantity has different units from the other three?

A.) density x volume x velocity

B.) rate of change of momentum

C.) the Young Modulus x area

D.) weight