Vectors physics notes pdf

Those physical quantities requiring size as well as direction for their entire representation and following vector laws are called vectors. Vector can be divided into two types 1. Polar Vectors These are vectors that have a starting point or a point of application as displacement, force, etc. 2. Axial vectors These are those vectors that represent the rotation effect and work along the rotation axis in accordance with the rule of the right screw as angular speed, torque, impulse moment, etc. Scalars Those physical amounts that require only size but no direction for their full representation are called scalars. Distance, speed, work, mass, density, etc are the examples of scalars. Scalars can be added, deducted, multiplied or divided by simple algebraic laws. Tensors Tensors are those physical amounts that have different values in different directions at the same point. Moment of inertia, radius of gyration, modulus of elasticity, pressure, stress, conductivity, resistance, refractive index, wave speed and density, etc, are the examples of tensors. Size of tensor is not unique. Different types of Vectors (i) Equal Vectors Two vectors of equal size, in the same direction are called equal vectors. (ii) Negative vectors Two vectors of equal size, but in opposite directions, are called negative vectors. (iii) Zero Vector or Null Vector A vector whose size zero is known as a zero or null vector. The direction is not defined. It is referred to as 0. Speed of a stationary object, acceleration of an object that moves at uniform speed and resulting from two equal and opposite vectors are the examples of null vector. (iv) Unit Vector A vector with unit size shall be called a unit vector. A unit vector in the direction of vector A is given by $\hat{A} = A/A$ A A unit vector is unitless and dimensionless vector and represents direction only. (v) Orthogonal unit vectors The unit vectors along the direction of the orthogonal axis, i.e., X – axis, Y – axis and Z – axis are called orthogonal unit vectors. They are represented by (vi) Co-initial Vectors Vectors with a common initial point, called co-initial vectors. (vii) Collinear Vectors Vectors of equal or unequal proportions, but which work along the same or Ab parallel lines, are called collinear vectors. (viii) Coplanar Vectors Vectors operating in the same plane are called coplanar vectors. (ix) Localized Vector A vector whose original point has been identified is called a localized vector. (x) Unlocalized or Free Vector A vector whose original point has not been established is called a non-localized or free vector. xi) Position Vector A vector which is the straight line distance and direction of a point or object related to the origin, is called position vector. Addition of Vectors 1. Triangular right of vectors If two vectors operating at a point are represented in size and direction by the two sides of a triangle taken in one order, then their result is result taken by the third side of the triangle in the opposite order. If two vectors A and B working at one point are angled at an angle, then their resulting $R = \sqrt{A2 + B2 + 2AB \cos \gamma}$ If the resulting vector R β an angle with vector A, then $\tan \beta = B \sin \gamma / A + B \cos \gamma$ 2. Parallelogram Law of Vectors If two vectors acting at a point in size and direction are represented by the two adjacent sides of a parallelogram pulling of a point, then their resulting is represented in size and direction by the diagonal of the parallelogram pulling of the same point. The resulting vectors A and B are given by $\sqrt{A2 + B2 + 2AB \cos \gamma}$ If the resulting vector R β an angle with vector A, then $\tan \beta = B \sin \gamma / A + B \cos \gamma$ Polygon Law of Vectors It states that if the number of vectors that occur on a particle at a time are represented in size and – direction by the different sides of an open polygon in the same order, their resulting vector E in size and direction is represented by the closing side of polygon in opposite order. In fact, the polygon law of vectors is the result of triangular right of vectors. R = A + B + C + D + E OE = OA + AB + BC + CD + DE Properties of Vector Addition (i) Vector addition is commutative, i.e. A + B = B + A (ii) Vector addition is associative, i.e. A+(B + C)= B + (C + A)= C + (A + B) (iii) Vector addition is distributive, i.e. m (A + B) = m A+m B Rotation of a Vector (i) If a vector is rotated through an angle 0, which is not an integral multiple of 2 π, the vector changes. (ii) If the frame of reference is rotated or translated, the given vector does not change. However, the components of the vector may change. Resolution of a vector in rectangular components If a vector A undergoes an x-axis angle, then the horizontal component Ax = Ax γ Vertical component Ay = A sin γ Magnitude of vector $A = \sqrt{Ax2 + Ay2}$ tan γ = Ay / Ax Direction Cosines of a Vector As a vector A subtend angles α, β and γ with x – axis, y - axis and z – as respectively and the components along these axes are Ax, Ay and Az, dan cos α= Ax/A, cos β = Ay/A, cos γ = Az/A and cos2 α + cos2 β + cos2 γ = 1 Subtracction of VectorS Subtracction from a vector B from a vector A is defined as the addition of vector -B (negative of vector B) to vector A , A – B = A + (-B) Multiplication of a Vector 1. By a real number When a vector A is multiplied by a real number n, the size becomes n times, but direction and unit remains unchanged. 2. By a Scalar When a vector A is multiplied by a scalar S, its size becomes S times, and unit is the product of units of A and S, but the direction remains the same as that of vector A. Scalar or Dot Product of two vectors The scalar product of two vectors is equal to the of their greats and the cosine of the smaller corner between them. It shall be indicated by . (dot). A *B = AB cos γ The scalar or point product of two vectors is a scalar. Scalar Product Properties (i) Scalar Scalar is commutative, i.e. A*B = B* A (ii) Scalar product is distributive, i.e. A* (B + C) = A*B + A*C (iii) Scalar product of two perpendicular vectors is zero. A * B = AB cos 90° = O (iv) Scalar product of two parallel vectors is equal to the product of their magnitudes, i.e. A * B = AB cos 0° = AB (v) Scalar product of a vector with itself equals the square of its size, i.e. A * A = AA cos 0° = A2 (vi) Scalar product of orthogonal unit vectors and (vii) Scalar product in cartesian coörcoör = AyBy + AzBz Vector or Cross Product of Two Vectors The vector product of two vectors The vector product The vector product of two vector vectors vectors is equal to the product of their greats and the sine of the smaller angle between them. It is indicated by * (cross). A * B = AB sin γ n The direction of unit vectors can be obtained from the right thumb rule. If fingers of the right hand are curled from A to B by a smaller angle between them, then thumb will be the direction of vector (A*B). The vector or cross product of two vectors is also a vector. Vector product properties (i) Vector product are not commutative, i.e. A*B ≠ B*A [∵ (A* B) = — (B* A)] (ii) Vector product is distributive, i.e. A* (B + C) = A *C (iii) Vector product of two parallel vectors is zero, i.e. A * B = AB sin O° = 0 (iv) Vector product of a vector itself is zero. A * A = AA sin O° = 0 (v) Vector product of orthogonal unit vectors (vi) Vector product in cartesic coordinates Towards vector cross product When C = A *B, the direction of C is at right angles to the plane with vectors A and B. The direction is determined by the right screw rule and the right thumb rule. (i) Right screw rule Turn a right-handed screw from the first vector (A) to the second vector (B). The direction in which the right-handed screw moves indicates the direction of vector (C). (ii) Right thumb rule Curl the fingers of your right hand from A to B. Then the direction of the straight thumb will point in the direction of A*B. All CBSE Notes for class 11 Physics Maths Notes Chemistry Notes Biology Notes To get the fastest exam alerts and government alerts in India, join our Telegram channel. Download India's Best Exam Preparation App Class 9-10, JEE & NEET 1,50,000+ Students Download eSaral App eSaral Offers free detailed Vector Physics Notes that will help you with exams such as IIT JEE, NEET and Board Preparation. Vector in physics is a quantity that has both size and direction. When expressing a quantity we give it a number and a unit (e.g. 12 kg), this reduces the amount of the quantity. Some quantities also have direction, a quantity that has both a size and direction is called a vector. On the other hand, a quantity that has only one size is called a scalar quantity. Vectors appear in print as bold and cursn F). Below is a table with some vector and scalar quantities: Scalars Vectors Speed Velocity Temperature Temperature Temperature Temperature Distance Displacement Area Force Entropy Momentum Volume Drag Table 1.3.1 - Vector and scalar quantites Note that some amounts seem to be the same, such as speed and speed, both represent distance over time, the difference being that the speed has one direction while the speed does not. The difference of two vectors When adding vectors, we need to take into account both the size and the direction. Often we will have situations where two vectors have opposite directions, in this case we simply pull the smallest magnitude off the largest. This is shown in Figure 1.3.1 below: Figure 1.3.1 - Resulting force of two opposing vectors The sum of two vectors Sometimes we will have situations where two forces act in the same direction. In the situations, we simply add the greats of both vectors together. This is shown in Figure 1.3.2 below: Figure 1.3.2 - Resulting force of two simultaneous vectors Adjacent vectors In certain situations, we need to work out the angle between two adjacent vectors. To do this graphically, we draw a scale diagram with the tail from one vector to the head of the other, then we draw a line that connects the other head and tail. To get the size of the new vector, we just measure it. This is shown in the diagram below: Figure 1.3.3 - Graphic method for solving adjacent vectors Alternatively, we can use trigonometry for a faster and more accurate result. This is shown in Figure 1.3.4 below: Figure 1.3.4 - Trigonometry method for dissolving adjacent vectors Scalar multiplicationWe can also multiply vectors (and divide) by scalars. In doing so, we follow a set of rules: Multiplying by 1 does not change vector 1 v = v Multiply by 0 gives the null vector 0 v = 0 Multiply by -1 gives the additive inverse -1 v = -v Left distribution : (c + d)v = cv + dv Correct distribution: c(v + w) = cv + cw Associativity: (CD)v = c(dv) Scalar multiplication is shown in Figure 1.3.5 below : Figure 1.3.5 - Scalar multiplication and distribution of vectors When working with adjacent vectors that do not form a 90° angle, it is often useful to inhibit certain vectors in component vectors so that they are simultaneous with the other vectors. To do this, we draw two vectors, one horizontal and the other vertical to our reference plane. Next, we use trigonometry to work out the size of each new vector and figure out the resulting force. This can be seen in Figure 1.3.6 and 1.3.7: Figure 1.3.6 shows a diagram of the forces working on a block pushed along a smooth surface: Figure 1.3.6 - Forces on a block figure 1.3.7 shows the same diagram, but with the surface and pushing forces split into their components: Figure 1.3.7 - those on a block broken in their components Sometimes the reference plane will not parallel the page, as shown and example is shown in Figure 1.3.8 below: Figure 1.3.8 - Component forces of a block on a slope slope slope