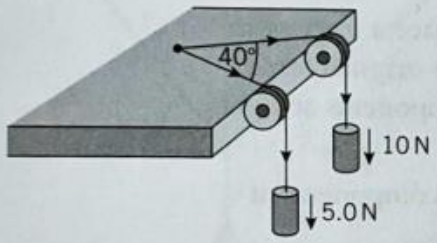
Bridging the Gap: GCSE to A Level Physics

Lesson 1: Vectors

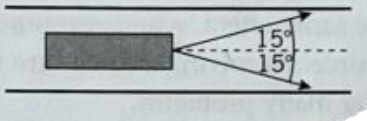
Low demand questions

2 For each of these situations draw a triangle or polygon of forces to determine the resultant force:

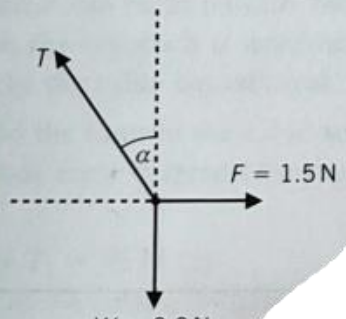
a



b Two forces of 5 kN towing a boat



3 These three forces are in equilibrium.
Draw a triangle of forces to find T and α.



4 Find the resultant force for these pairs of forces at right angles:
a 3.0 N and 4.0 N **b** 5.0 N and 12.0 N

You might have to look up 'normal reaction force' again for this, but it is GCSE Level

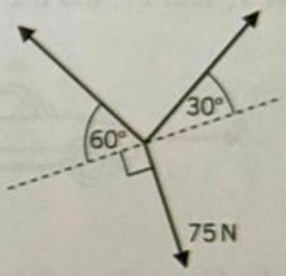
1 A force of 550 N is applied to a box at an angle of 30° to the horizontal. Calculate the horizontal and vertical components of the force.

2 Calculate the normal reaction and the friction for a box of weight 85 N in equilibrium on a slope of angle 15°.

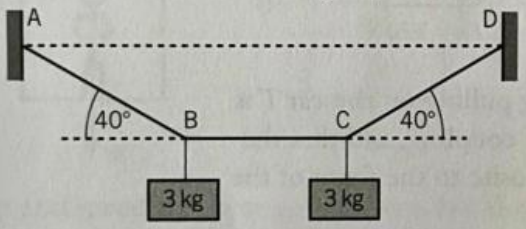
Medium demand questions

PRACTICE QUESTIONS

3 The three strings in the diagram are in tension and in equilibrium. Calculate the tension in each string.



4 Two masses are supported by three strings. BC is horizontal. What is the tension in string AB, BC, and CD?



5 A cable, parallel to a slope 30° to the horizontal, pulls a block up the slope at a steady speed. The block weighs 65 N and the friction with the slope is 12 N. What is the tension in the cable, and the normal reaction force?

High demand questions

42. (I) Draw the vector $3\mathbf{i} + 4\mathbf{j}$ by first drawing the x-component vector, then the y-component vector, then adding them graphically. Multiply the vector by a factor of two and repeat the exercise.

43. (I) A drunken sailor stumbles 4 paces north, 6 paces northeast, 2 paces east, and 5 paces west. Describe the final location from the initial position by a single displacement vector.

44. (I) What is the resultant vector when the vectors $\mathbf{A} = 6\mathbf{i} - 5\mathbf{j}$ and $\mathbf{B} = 8\mathbf{i} + 3\mathbf{j}$ are added together? When $\mathbf{B}$ is subtracted from $\mathbf{A}$?

45. (II) A football player catches the kickoff on the 5-yd line and runs straight up the field for 20 yd, turns left for 15 yd, goes straight up the field for 10 yd, turns right for 25 yd, reverses his field (makes a 180° turn) for 10 yd, and then streaks straight up the field for a touchdown. Define a coordinate system and list the entire path in vector form.

46. (II) Draw a vector $\mathbf{V}$ that points in the northwesterly direction, making an angle α with the northerly direction, as in Fig. 1–27. If north is chosen as the $+y$-direction and east as the $+x$-direction, what is the x-component of $\mathbf{V}$?

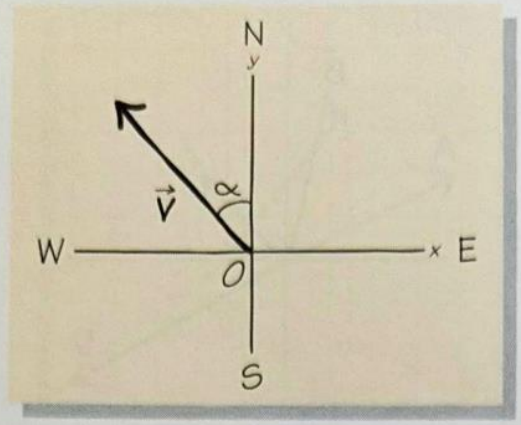


FIGURE 1–27 Problem 46.

47. (II) Suppose that in Problem 46 you choose north as the $+x$-direction and west as the $+y$-direction. What is the x-component of **V** in this case?

48. (II) Refer to the situation outlined in Problems 46 and 47. Choose the $+x$-axis as the line that makes an angle of 45° with the northerly direction and is inclined to the east, and the $+y$-axis as the line that makes a 45° angle with the westerly direction and is inclined to the north. What is the x-component of **V** in this case?

50. (II) Consider the following vectors: $\mathbf{A} = -2\mathbf{i} - 3\mathbf{j}$; $\mathbf{B} = \mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$; $\mathbf{C} = 3\mathbf{j} + 3\mathbf{k}$; and $\mathbf{D} = -2\mathbf{i} - \mathbf{k}$. Find (a) $\mathbf{A} + \mathbf{B} + \mathbf{C} + \mathbf{D}$; (b) $\mathbf{A} - \mathbf{D}$; (c) $\mathbf{A} + \mathbf{D} - \mathbf{B}$; and (d) $|\mathbf{A} - \mathbf{C}|$.

51. (II) Vectors **A**, **B**, **C**, and **D** are shown in Fig. 1–29. (a) Give the vectors in component form. (b) Determine the following quantities both algebraically and graphically: $2\mathbf{A} + \mathbf{C} - \mathbf{D}$, $\mathbf{B} + \mathbf{C}/2$, $|\mathbf{D} - \mathbf{B}|$.

52. (II) Suppose that you have three vectors, $\mathbf{A} = 3\mathbf{i} + 4\mathbf{j}$, $\mathbf{B} = 2\mathbf{i} - 2\mathbf{j} + 4\mathbf{k}$, and $\mathbf{C} = -\mathbf{i} + 5\mathbf{j} - 3\mathbf{k}$. Show that the sum of these three vectors can alternatively be computed by first summing **A** and **B** and then summing the resultant with **C**, or by first summing **B** and **C** and then summing the resultant with **A**.