Unit 22 · Statics

WORKSHEET

Full marks 35

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 35

1 Key words [3]

Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

composition	**concurrent**	**coplanar**	**equilibrium**	**impulse**	**line of action**	**resolution**
resultant						

The straight line through a force's point of application, along the force, is its _____. Forces whose lines of action pass through one point are _____. The single force that has the same effect as several forces together is their _____; finding it is the _____ of forces, and replacing one force by two along chosen directions is its _____. When the resultant of the forces at a point is zero, the point is in _____.

2 True or false [3]

Write ✓ for a true statement and ✗ for a false one. Correct the false ones.

i. Forces of 3 N and 4 N acting at a point can have a resultant of 5 N. ☐

ii. The resultant of two forces is always bigger than each of them. ☐

iii. The resultant of two equal forces bisects the angle between them. ☐

iv. Two components of a force can never add up, as numbers, to more than the force. ☐

v. A body of weight W on a slope at θ to the horizontal has the part $W\cos\theta$ of its weight down the slope. ☐

vi. Forces at a point are in equilibrium when the sums of their parts along two perpendicular directions are both zero. ☐

3 Multiple choice [6]

Choose the correct option for each of the following questions.

i. A force F acts at an angle θ to OX. Its resolved parts along OX and OY are: [1]

a. $F\cos\theta$, $F\sin\theta$ **b.** $F\sin\theta$, $F\cos\theta$

c. F, $F\tan\theta$ **d.** $F\cos\theta$, $F\cos\theta$

ii. Two forces of 7 N and 4 N act at a point. Their resultant **cannot** be: [1]

a. 3 N **b.** 8 N

c. 11 N **d.** 2 N

iii. Two equal forces have a resultant equal to either of them. The angle between them is: [1]

a. 60° **b.** 90°

c. 120° **d.** 150°

iv. A box of weight 20 N rests on a smooth slope at 30° to the horizontal. The part of its weight acting down the slope is: **[1]**

a. 10 N
b. $10\sqrt{3}$ N
c. 20 N
d. $\frac{20}{\sqrt{3}}$ N

v. Forces of 3 N and 5 N act at a point with 60° between them. Their resultant is: **[1]**

a. 7 N
b. 8 N
c. $\sqrt{19}$ N
d. $\sqrt{34}$ N

vi. The resultant of forces P and Q ($Q > P$) is at right angles to P. Its magnitude is: **[1]**

a. $\sqrt{P^2 + Q^2}$
b. $\sqrt{Q^2 - P^2}$
c. $Q - P$
d. P

4 Spot the error **[2]**

Find the mistake in the working and correct it.

For some forces acting at a point, Sabin finds $X = -6$ N and $Y = -8$ N. He writes:

"$R = \sqrt{36 + 64} = 10$ N, and $\tan\alpha = \frac{-8}{-6} = \frac{4}{3}$, so the resultant makes **53.1**° with OX."

5 Short questions **[10]**

Answer the following questions. Show your working.

a. Forces of 6 N and 10 N act at a point with an angle of 120° between them. **[5]**

a. Find the magnitude of their resultant and the angle it makes with the 6 N force. [3]
b. The 6 N force is now reversed. Find the new resultant. [2]

Answer:

b. Forces of 5 N, 10 N, 15 N and 20 N act at a point towards the east, north, west and south. **[5]**

a. Find the sums X and Y of their parts towards the east and the north. [2]

b. Find the magnitude and direction of their resultant. [2]

c. What single force, added at the point, would put it in equilibrium? [1]



Answer: _____

6 Long question **[8]**

Answer the following question. Show your working.

The resultant of two forces P and Q is R. If Q is doubled, the resultant is doubled; if Q is reversed, the resultant is again doubled.

a. Show that $P^2 : Q^2 : R^2 = 2 : 3 : 2$. [5]

b. Find the angle between P and Q. [3]

Science Playground, Katunje, Bhaktapur
https://science-playground.com/learn/grade-11-math/statics

7 Think [3]

Anjali hangs a wet shirt of weight 10 N at the middle of a long clothesline. Each half of the line then sags at a small angle θ below the horizontal. By resolving, show that the pull in the line is $T = \dfrac{10}{2\sin\theta}$ N. Find T when $\theta = 10^\circ$ and when $\theta = 2^\circ$. Can the line ever be pulled perfectly straight with the shirt on it?

8 Activity: Two strings, one bag (not marked)

You need: a bag with a load of about 2 kg, two strings and a spring balance (or a luggage scale). Hang the bag from the hook of the balance by one string and read its weight W. Then hang it from two strings tied to its handle, one held by the balance and one by a friend, with the angle between the strings about 0°, 60°, 90° and 120°.

Angle between the strings	0°	60°	90°	120°
Balance reading				
$\dfrac{W}{2\cos(\theta/2)}$				

Do the readings follow $\dfrac{W}{2\cos(\theta/2)}$? At what angle does each string carry the whole weight?