



## S5 MECHANICS REVISION QUESTIONS 2026

### QUESTION 1

If  $\underline{a} = 2\underline{i} + 5\underline{j}$ ,  $\underline{b} = -7\underline{i} + 7\underline{j}$  and  $\underline{c} = 14\underline{i}$ , find:

- (a) the resultant of  $\underline{a}$  and  $\underline{b}$
- (b) the resultant of  $\underline{a}$ ,  $\underline{b}$  and  $\underline{c}$
- (c)  $|\underline{a}|$
- (d)  $|\underline{b}|$
- (e)  $|\underline{c}|$
- (f)  $|\underline{a} + \underline{b} + \underline{c}|$
- (g) the unit vector of  $\underline{a}$  and  $\underline{b}$
- (h) a vector that is parallel to  $\underline{a}$  and has a magnitude of  $5\sqrt{29}$  units
- (i) a vector that is parallel to  $(\underline{a} + \underline{b} + \underline{c})$  and has a magnitude of 90 units.
- (j) Is  $|\underline{a} + \underline{b} + \underline{c}| = |\underline{a}| + |\underline{b}| + |\underline{c}|$ ?

### QUESTION 2

Find the scalar product of each of the following vectors and get the angle between them correct to the nearest degree

- (a)  $2\underline{i} + \underline{j}$  and  $5\underline{i} - 12\underline{j}$
- (b)  $3\underline{i}$  and  $-2\underline{j}$
- (c)  $\begin{pmatrix} 3 \\ 1 \end{pmatrix}$  and  $\begin{pmatrix} 1 \\ -2 \end{pmatrix}$
- (d)  $\begin{pmatrix} 5 \\ 2 \\ 7 \end{pmatrix}$  and  $\begin{pmatrix} 1 \\ 2 \\ -2 \end{pmatrix}$
- (e)  $-4\underline{i} + 2\underline{j} - 4\underline{k}$  and  $2\underline{i} - \underline{j} + 2\underline{k}$

### QUESTION 3

- (a) Find the value of  $\lambda$  if  $\lambda\mathbf{i} + 2\mathbf{j} - \mathbf{k}$  and  $5\mathbf{i} - \lambda\mathbf{j} + \mathbf{k}$  are perpendicular vectors.
- (b) Find the possible values of  $t$  given that the vectors  $\mathbf{a} = t\mathbf{i} + 2\mathbf{j} + t\mathbf{k}$  and  $\mathbf{b} = t\mathbf{i} - 3\mathbf{j} + \mathbf{k}$  are perpendicular vectors.

### QUESTION 4

- (a) A boat travels  $6\text{ km}$  due east followed by  $2.5\text{ km}$  due north. Find the distance the boat is then from its original position and the course it should set if it is to return by the shortest route.
- (b) Tom walked  $800\text{ m}$  on a bearing of  $320^\circ$  and then  $500\text{ m}$  on a bearing of  $200^\circ$ . Find how far Tom is from the original position and the course he must set in order to return to his starting point by the shortest route.
- (c) An aeroplane flies from airport A to airport B  $90\text{ km}$  away and on a bearing of  $N70^\circ E$ . From B the aeroplane flies to airport C,  $100\text{ km}$  from B on a bearing  $S60^\circ W$ . How far and on what course must the aeroplane now fly in order to return to A direct?
- (d) Find the magnitude and direction of the resultant of the velocities  $16\text{ ms}^{-1}$  due east and  $10\text{ ms}^{-1}$  in a direction  $N38^\circ E$ .
- (e) Calculate the magnitude and direction of the resultant of the velocities  $8\text{ kmh}^{-1}$  in a direction  $N80^\circ W$  and  $5\text{ kmh}^{-1}$  in a direction  $S25^\circ W$ .
- (f) Two airfields A and B are  $500\text{ km}$  apart with B on a bearing of  $060^\circ$  from A. An aircraft which can travel at  $200\text{ kmh}^{-1}$  in still air, is to be flown from A to B. If there is a wind of  $40\text{ kmh}^{-1}$  blowing from the west, find the course that the pilot must set in order to reach B and find, to the nearest minute, the time taken.

### QUESTION 5

In an experiment to demonstrate the effect of forces on a body, a teacher applied the following forces on a solid metallic block;  $5\text{ N}$  and  $13\text{ N}$  acting vertically upwards,  $11\text{ N}$  force acting vertically downwards,  $3\text{ N}$  and  $5\text{ N}$  acting horizontally to the left and  $14\text{ N}$  force acting horizontally to the right. The teacher tasked the students to determine a single force resulting from the effect of these six forces acting on the block.

In his further demonstration, he played a video that involved a monster truck at the centre of five (5) small cars, each connected to it using a strong cable. The cars pulled apart with forces of  $30\text{ N}$ ,  $60\text{ N}$ ,  $100\text{ N}$ ,  $70\text{ N}$  and  $20\text{ N}$  in the directions  $270^\circ$ ,  $040^\circ$ ,  $120^\circ$ ,  $330^\circ$  and  $225^\circ$  respectively. The teacher also asked the students to use the system of forces above to determine a single force which the monster truck will resultantly move and the direction it will take.

### Task

As a student of mechanics, help the students to accomplish the tasks in each of the cases above.

### QUESTION 6

A construction company is installing support cables on a tower. A cable exerts a force,  $\mathbf{F}$  of  $50\text{ N}$  on a joint, acting in the direction of the vector  $\mathbf{v} = 24\mathbf{i} + 7\mathbf{j}$ . At another point, two support cables exert forces  $\mathbf{F1}$  and  $\mathbf{F2}$ . Given that  $\mathbf{F1}$  has magnitude  $\alpha\text{ N}$  and acts in the direction  $\mathbf{i} - 2\mathbf{j}$ , and  $\mathbf{F2}$  has magnitude  $\beta\text{ N}$  and acts in the direction  $4\mathbf{i} + 3\mathbf{j}$ . The combined effect of these two cables is similar to  $\mathbf{F}$ .

### Tasks

- (a) Find the vector form of  $\mathbf{F}$ .
- (b) Show that  $\alpha = 8\sqrt{5}$ .
- (c) Find the value of  $\beta$  hence determine the angle between  $\mathbf{F1}$  and  $\mathbf{F2}$ .

**END**