1 **(a)** State **one** difference between a scalar quantity and a vector quantity.

.....

..... **[1]**

(b) Fig. 1.1 shows two sets of quantities listed as 'scalars' and 'vectors' by a student.

scalars	**vectors**
acceleration	displacement
pressure	energy
stress	power
time	velocity
volume	weight

Fig. 1.1

(i) State the one quantity that has been incorrectly listed as a scalar.

..... **[1]**

(ii) State two quantities that have been incorrectly listed as vectors.

1. .....

2. ..... **[1]**

(iii) State two quantities listed as scalars that have the same unit. Name this unit.

1. .....

2. .....

unit: ..... **[2]**

(c) Circle the correct value for the prefix tera (T) in the list below.

10^6 10^9 10^{12} 10^{15} **[1]**

(d) Rearrange the following prefixes in the order of smallest to largest.

μ c p k

..... **[1]**

[Total: 7]

2 **(a)** Define a *vector* quantity and give one example.

.....

..... **[2]**

(b) Fig. 3.1 shows a force *F* at an angle of 30° to the horizontal direction.

Fig. 3.1

(i) The **horizontal component** of the force *F* is 7.0 N. Calculate the magnitude of the force *F*.

F = ... N **[2]**

(ii) The force *F* moves an object in the horizontal direction. In a time of 4.2 s, the object moves a horizontal distance of 5.0 m. Calculate

1 the work done by the force

work done = ... J **[2]**

2 the rate of work done by the force.

rate of work done = ... W **[1]**

(c) Fig. 3.2 shows the forces acting on a stage light of weight 120 N held stationary by two separate cables.

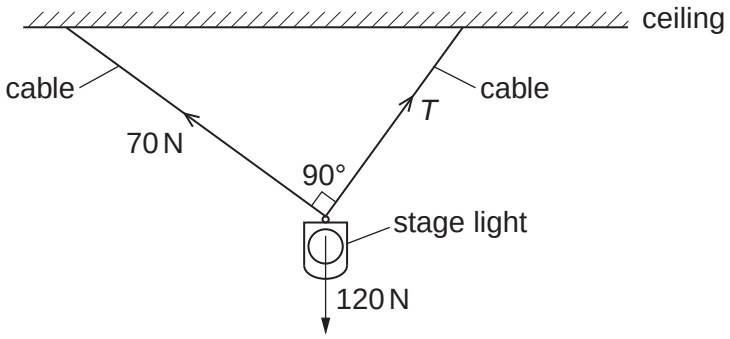


Fig. 3.2

The angle between the two cables is 90°. One cable has tension 70 N and the other has tension *T*.

(i) State the magnitude and the direction of the **resultant** of the tensions in the two cables.

magnitude .....

direction ..... **[2]**

(ii) Sketch a labelled vector triangle for the forces acting on the stage light. Hence, determine the magnitude of the tension *T*.

T = ... N **[4]**

[Total: 13]

3 **(a)** Complete the table of Fig. 1.1 by stating the value or name of each of the remaining three prefixes.

prefix	value
micro (μ)	10^{-6}
mega (M)	
	10^{-9}
tera (T)	

Fig. 1.1

[3]

(b) Circle all the scalar quantities in the list below.

density **w** **olume** **acceler**

[1]

(c) The distance between the Sun and the Earth is 1.5×10^{11} m. Calculate the time in minutes for light to travel from the Sun to the Earth. The speed of light is $3.0 \times 10^{8}\,\text{m}\,\text{s}^{-1}$.

time = ... min **[2]**

(d) The terminal velocity of a raindrop falling vertically through air is $4.0\,m\,s^{-1}$.

(i) In terms of the forces acting on the raindrop, explain why it is at terminal velocity.

.....

.....

..... **[2]**

(ii) Fig. 1.2 shows a velocity vector diagram for the falling raindrop in a horizontal crosswind of speed $1.5\,m\,s^{-1}$.

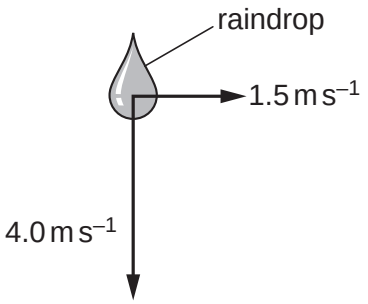


Fig. 1.2

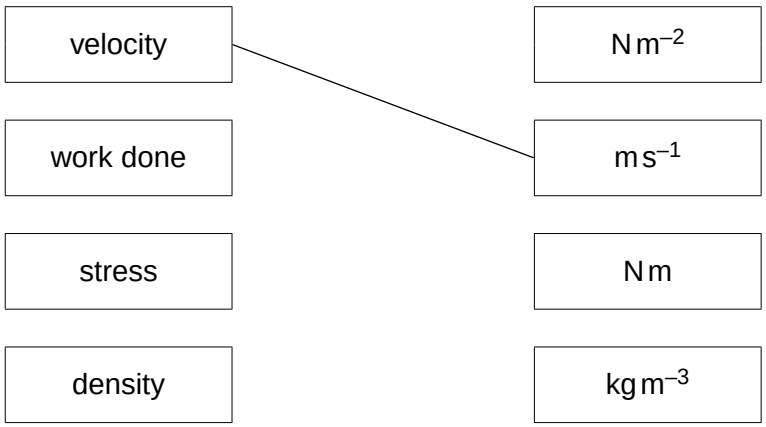
1 On Fig. 1.2, draw an arrow on the raindrop to show the **direction** in which it will travel.

2 Calculate the magnitude of the resultant velocity of the raindrop. Use the space below for your working.

resultant velocity = ... $m\,s^{-1}$ **[3]**

[Total: 11]

4 (a) Draw a straight line from each quantity on the left hand side to its correct unit on the right hand side; one has already been done for you.



[2]

(b) Fig. 1.1 shows a metal cube which rests on a table.

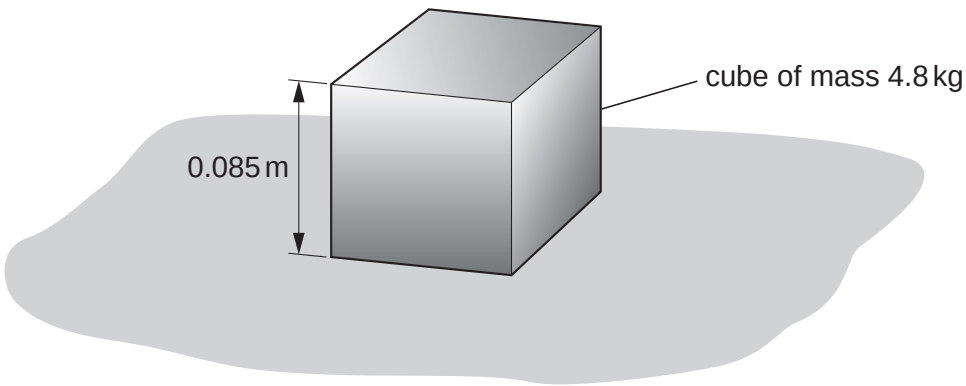


Fig. 1.1

The mass of the metal cube is 4.8 kg. Each side of the cube has length 0.085 m. The cube exerts pressure on the table.

(i) Complete the sentence below:

The force acting on the table is due to the …… of the metal cube. **[1]**

(ii) Calculate the pressure exerted on the table by the metal cube.

pressure = ... Pa **[2]**

(iii) The metal cube shown is replaced by a second cube made of the same material but with each side of double the length of the original cube.

Complete the sentences below for the second cube when compared with the original cube.

The mass of the second cube is …… times greater than the original cube.

The cross-sectional area of the base is …… times greater than the original cube.

Hence, the pressure exerted by this cube is …… times greater than the original cube.

[3]

[Total: 8]

5 **(a)** An electron in a particle accelerator experiences a constant force. According to one student, the acceleration of the electron should remain constant because the ratio of force to mass does not change. In reality, experiments show that the acceleration of the electron decreases as its velocity increases. Describe what can be deduced from such experiments about the nature of accelerated electrons.

.....

.....

.....

..... **[2]**

(b) Fig. 4.1 shows the velocity vector for a particle moving at an angle of 31° to the horizontal.

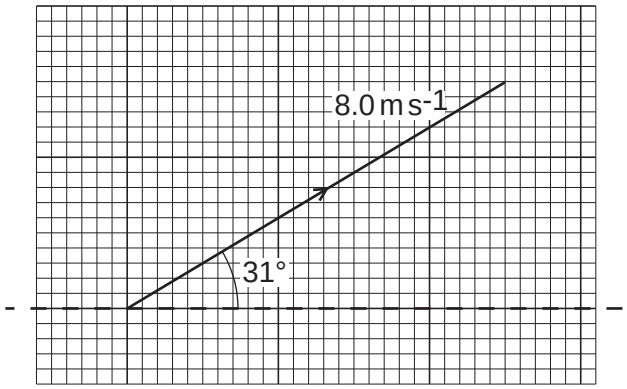


Fig. 4.1

(i) On Fig. 4.1, show the horizontal (*x*-direction) and vertical (*y*-direction) components of the velocity. **[2]**

(ii) Calculate the horizontal (*x*-direction) component of the velocity.

velocity = ... $m\,s^{-1}$ **[1]**

(c) Fig. 4.2 shows a ship **S** being pulled by two tug-boats.

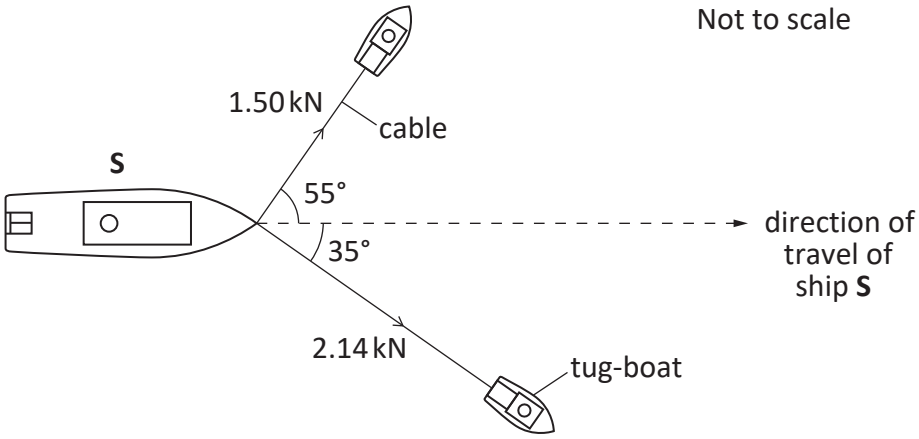


Fig. 4.2

The ship is travelling at a constant velocity. The tensions in the cables and the angles made by these cables to the direction in which the ship travels are shown in Fig. 4.2.

(i) Draw a vector triangle and determine the resultant force provided by the two cables.

resultant force = ... kN **[3]**

(ii) State the value of the drag force acting on the ship **S**. Explain your answer.

.....

.....

..... **[2]**

[Total: 10]