PARALLELOGRAM LAW

1 **(a)** In an accident, a truck goes off the road and into a ditch. Two breakdown vehicles A and B are used to pull the truck out of the ditch, as shown in Fig. 4.1.

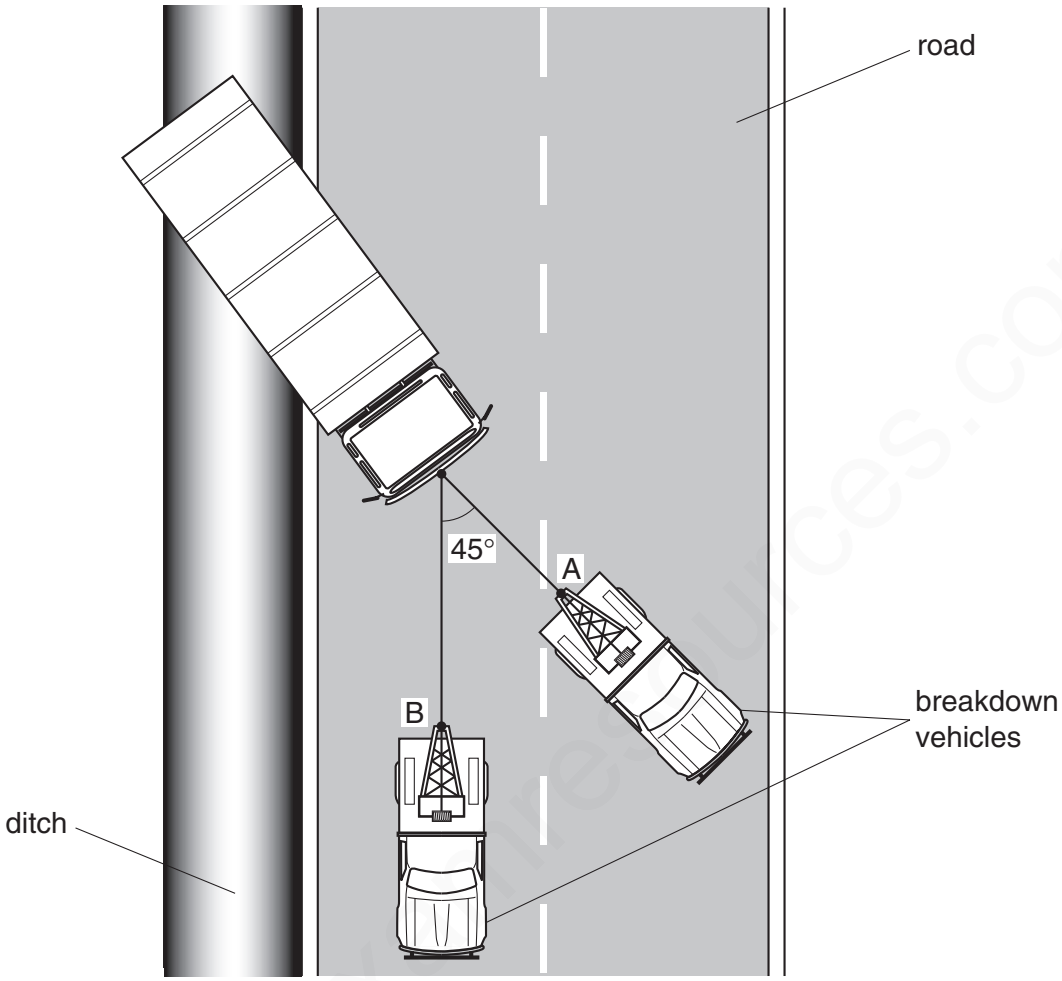

Fig. 4.1

At one point in the rescue operation, breakdown vehicle A is exerting a force of 4000 N and breakdown vehicle B is exerting a force of 2000 N.

(i) Using a scale of 1 cm = 500 N, make a scale drawing to show the resultant force on the truck.

[4]

(ii) Use your diagram to find the magnitude and direction of the resultant force on the truck.

magnitude of resultant force = ...

direction of resultant force = ... to direction of road [2]

(b) (i) State why the resultant force is an example of a vector quantity.

..... [1]

(ii) Give an example of a vector quantity that is not a force.

..... [1]

[Total: 8]

MARKING SCHEME:

(a)	**(i)**	(note: diagram may be drawn in any orientation)		
		sides correct length, by eye	B1	
		forces drawn at 45°, by eye	B1	
		parallelogram completed	B1	
		correct diagonal drawn / correct resultant if intersecting arcs shown	B1	
	(ii)	magnitude: between 5500 N and 5700	B1	
		direction: between 28° and 32°	B1	
(b)	**(i)**	it has direction (as well as magnitude)	B1	
	(ii)	any example which is clearly a vector	B1	[8]

2 Two students make the statements about acceleration that are given below.

Student A: For a given mass the acceleration of an object is proportional to the resultant force applied to the object.

Student B: For a given force the acceleration of an object is proportional to the mass of the object.

(a) One statement is correct and one is incorrect.

Re-write the incorrect statement, making changes so that it is now correct.

For a given ..... the acceleration of an object is .....

..... [1]

(b) State the equation which links acceleration *a*, resultant force *F* and mass *m*.

[1]

(c) Describe what happens to the motion of a moving object when

(i) there is no resultant force acting on it,

..... [1]

(ii) a resultant force is applied to it in the opposite direction to the motion,

..... [1]

(iii) a resultant force is applied to it in a perpendicular direction to the motion.

..... [1]

[Total: 5]

MARKING SCHEME:

(a) 2nd statement re-written to include force in first gap and inversely proportional to mass in second gap. NOT indirectly proportional — B1

(b) F = ma OR in words in any correct arrangement — B1

(c) **(i)** nothing OR continues as before OR same / constant velocity OR same / constant speed & direction OR no acceleration — B1

(ii) idea of retardation. Ignore stop. Ignore brakes. Ignore goes in opposite direction — B1

(iii) moves in (arc of a) circle or curve OR deflected OR turns OR changes direction — B1 [5]

3 Fig. 4.1 shows a heavy ball B of weight *W* suspended from a fixed beam by two ropes P and Q.

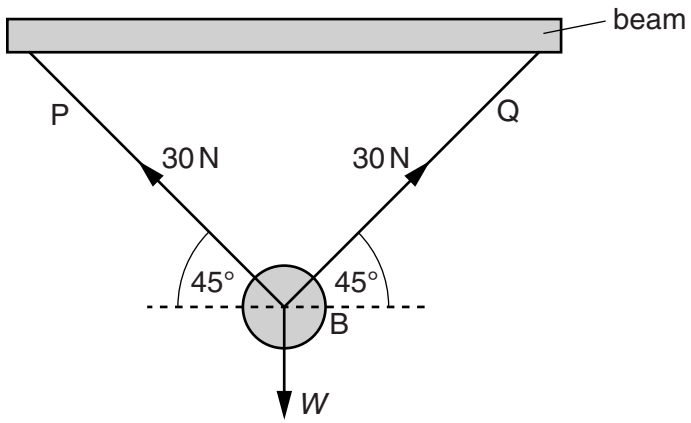

Fig. 4.1

P and Q are both at an angle of 45° to the horizontal. The tensions in P and Q are each 30 N.

(a) In the space below, draw a scale diagram to find the resultant of the tensions in P and Q. Use a scale of 1.0 cm to represent 5.0 N. Label the forces and show their directions with arrows.

resultant = ... [4]

(b) State the direction of the resultant. ..... [1]

(c) State the magnitude of *W*. magnitude of *W* = ... [1]

[Total: 6]

MARKING SCHEME:

(a) 2 lines at 90 ° to each other of same length labelled 30 N or 6 cm B1

both lines 6.0 ± 0.2 cm. B1

arrows on the two lines drawn, either head to tail B1
OR a complete square shown with diagonal and arrows on adjacent sides

resultant in range 40–45 N B1

(b) (vertically) upwards B1

(c) same as value in **(a)**, only if answer to **(a)** is a force
OR 40–45 N B1

[Total: 6]

4 An object of weight W is suspended by two ropes from a beam, as shown in Fig. 1.1.

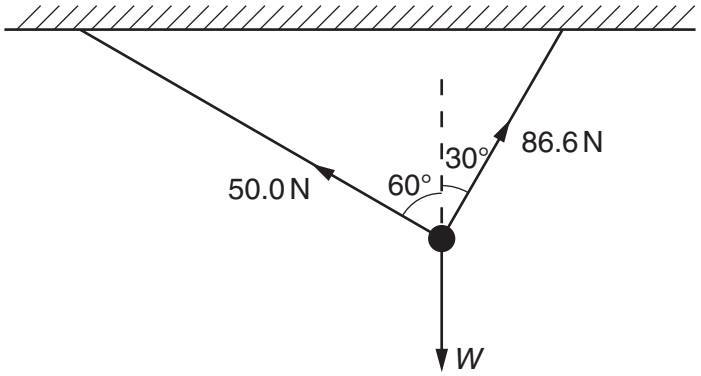

Fig. 1.1

The tensions in the ropes are 50.0 N and 86.6 N, as shown.

(a) In the space below, draw a scale diagram to find the resultant of the two tensions.

Use a scale of 1.0 cm = 10 N.

Clearly label the resultant. [3]

(b) From your diagram, find the value of the resultant.

resultant = ... [1]

(c) State the direction in which the resultant is acting.

..... [1]

(d) State the value of W. W = ... [1]

[Total: 6]

MARKING SCHEME:

(a) (parallelogram or triangle may have any orientation)
NOT a copy of Fig. 1.1
two sides at right angles, by eye B1
one side longer than the other B1
diagonal or completion of triangle drawn **and** labelled "resultant" OR R
Ignore numerical values. Condone arrows in wrong direction B1

(b) 98 N – 102 N B1
(accept value found by calculation)

(c) (vertically) up/opposite to W NOT North B1

(d) his **(b)** OR correct value calculated B1
ignore mass

[Total: 6]

5 **(a)** **(i)** State the difference between a scalar quantity and a vector quantity.

.....

.....

(ii) State one example of a vector quantity.

.....

[2]

(b) Fig. 3.1 shows the top of a flagpole.

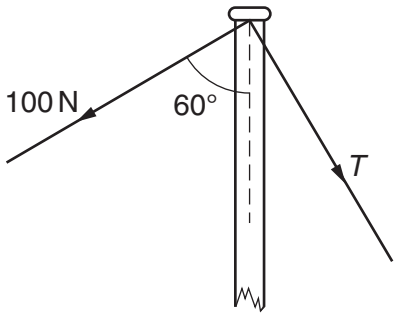

Fig. 3.1

The flagpole is held vertical by two ropes. The first of these ropes has a tension in it of 100 N and is at an angle of 60° to the flagpole. The other rope has a tension *T*, as shown.

The resultant force is down the pole and of magnitude 200 N.

In the space below, using a scale of 1 cm = 20 N, draw a scale drawing to find the value of the tension *T*. Clearly label 100 N, 200 N and *T* on your drawing.

tension *T* = ...[3]

[Total: 5]

MARKING SCHEME:

(a)	**(i)**	vector has direction OR scalar has no direction/only has size	B1	
	(ii)	any appropriate example	B1	
(b)		NOTE: accept diagram in any orientation; triangle or rectangle with hypotenuse/diagonal of length ½ that of one side	B1	
		100, 200 and *T* all correctly labelled	B1	
		value in range 165 N – 180 N inclusive	B1	[5]