Questions 1 and 2 refer to the diagram below.
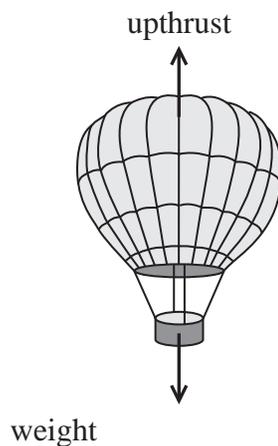
The diagram shows the forces acting on a hot air balloon when at a constant height.

upthrust

weight

1 Select the row in the table that correctly describes the situation when the air in the balloon is heated.

	Observation	Reason
☒ **A**	Balloon rises	Weight > Upthrust
☒ **B**	Balloon falls	Weight > Upthrust
☒ **C**	Balloon rises	Weight < Upthrust
☒ **D**	Balloon falls	Weight < Upthrust

(Total for Question = 1 mark)

2 Below is a free-body force diagram for the balloon when a wind is blowing.

Upthrust = 10 200 N

Force due to wind = 300 N

Weight = 9800 N
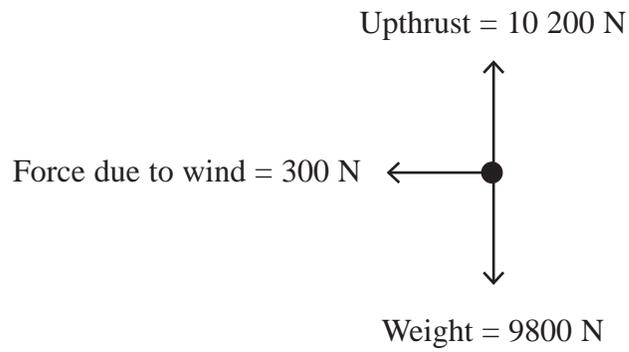
The magnitude of the resultant force acting on the balloon is
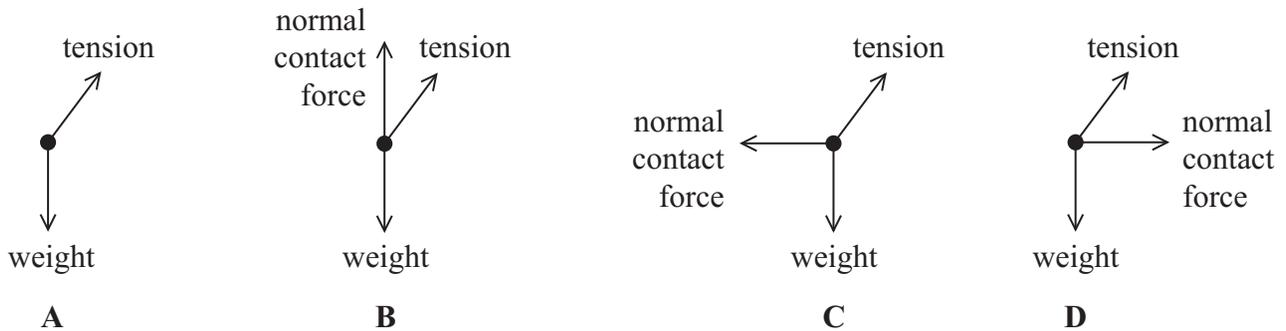
☒ **A** 400 N

☒ **B** 500 N

☒ **C** 700 N

☒ **D** 9 805 N

(Total for Question = 1 mark)

3 A climber slides down a rope attached to a rock face, as shown in the photograph.

Select a possible free-body force diagram for the climber.

A	B	C	D
tension, weight	normal contact force, tension, weight	tension, normal contact force, weight	tension, normal contact force, weight

☒ **A**

☒ **B**
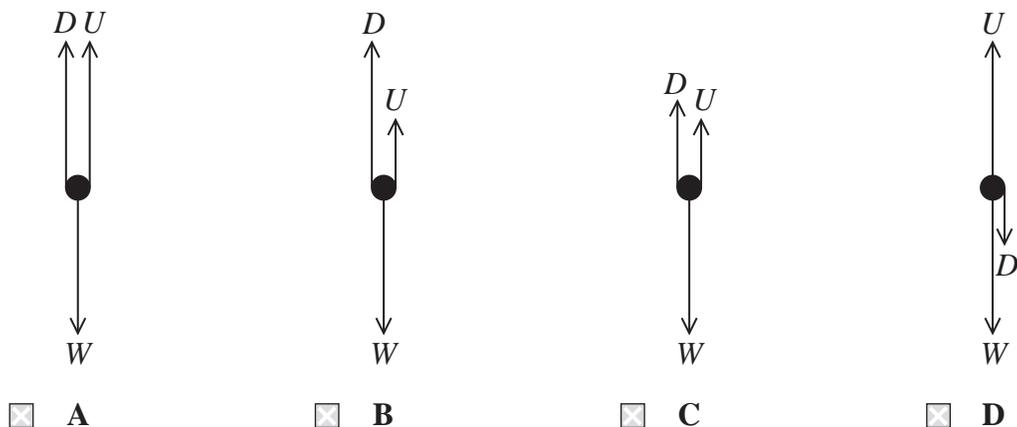
☒ **C**

☒ **D**

(Total for Question   1 mark)

4 A small object is falling at terminal velocity in a large container of oil.

Which diagram correctly represents, in magnitude and direction, the forces acting on the object as it reaches terminal velocity?
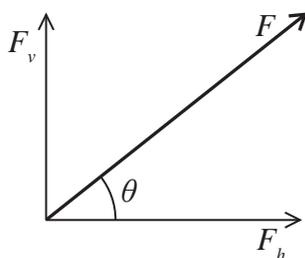
W = weight
U = upthrust
D = drag

```
   D U              D                  D U               U
   ↑ ↑              ↑                  ↑ ↑               ↑
                    U                    U
                    ↑                    ↑
    ●               ●                  ●                 ●
                                                         ↓
                                                         D
    ↓               ↓                  ↓                 ↓
    W               W                  W                 W

☒  A            ☒  B               ☒  C              ☒  D
```

(Total for Question = 1 mark)

5 A force F is resolved into two components, F_h and F_v, at right angles to one another.

```
   F_v ↑            F ↗
       │           ╱
       │         ╱
       │       ╱
       │     ╱
       │   ╱  θ
       │ ╱_____→
                   F_h
```

Which statement is **not** true?

☒ **A** Decreasing θ increases the magnitude of F_h.

☒ **B** Increasing θ increases the magnitude of F_v.

☒ **C** F_h and F_v have magnitudes that when added together give a total equal to the magnitude of F.

☒ **D** F_h and F_v have magnitudes that when added together give a total greater than the magnitude of F.

(Total for Question = 1 mark)

6 A hanging basket of weight W is supported by three chains of equal length, each at an angle θ to the vertical.

The tension, T, in each chain is given by

☒ **A** $T = \dfrac{3W}{\cos\theta}$

☒ **B** $T = \dfrac{3W}{\sin\theta}$

☒ **C** $T = \dfrac{W}{3\cos\theta}$
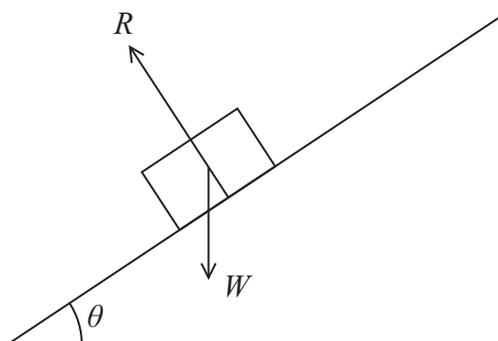
☒ **D** $T = \dfrac{W}{3\sin\theta}$

(Total for Question = 1 mark)

7 Which of the following descriptions of a material implies that it undergoes significant plastic deformation?

☒ **A** brittle

☒ **B** hard

☒ **C** malleable

☒ **D** stiff

(Total for Question = 1 mark)

8

The diagram shows an object on an inclined surface.

The component of the weight W parallel to the surface is

☒   **A** 0

☒   **B** 1

☒   **C** $W \cos \theta$

☒   **D** $W \sin \theta$

(Total for Question   1 mark)

9 A person is standing at point C in a train carriage travelling round a sharp bend to the right. The person jumps up. Nearest which marked point is the person most likely to land?
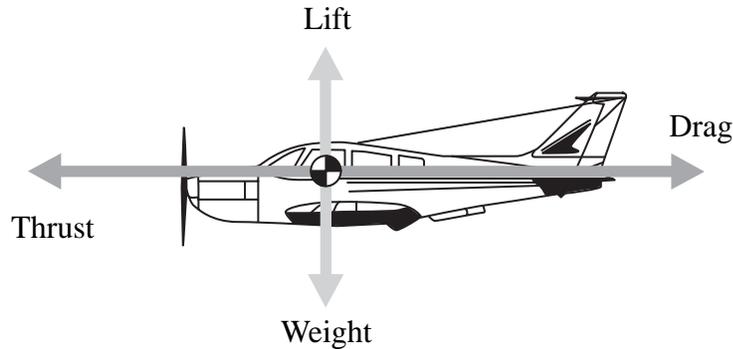
Direction of bend

● ● ●
A B C

●
D

☒   **A**

☒   **B**

☒   **C**

☒   **D**
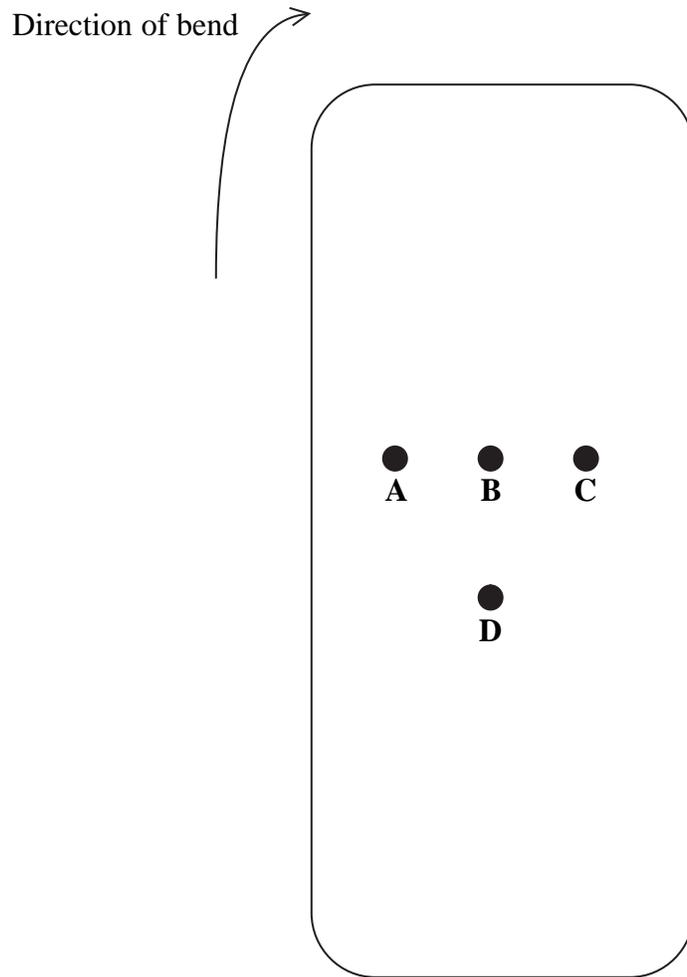
(Total for Question = 1 mark)

Use the diagram below for questions 10 and 11.

The diagram shows four forces acting on an aeroplane.

10   Which of the following shows the correct two relationships if the aeroplane is climbing at a constant velocity?

		Relationship 1	Relationship 2
☒	**A**	lift > weight	thrust > drag
☒	**B**	lift > weight	thrust = drag
☒	**C**	lift = weight	thrust > drag
☒	**D**	lift = weight	thrust = drag

(Total for Question = 1 mark)

11 The aeroplane is now flown at a constant altitude but an increasing speed.

Which of the following pairs of forces will have the same magnitude?

☒   **A** drag and weight

☒   **B** drag and thrust

☒   **C** lift and drag

☒   **D** lift and weight

(Total for Question = 1 mark)

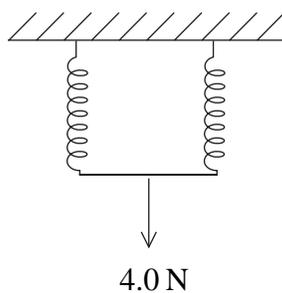**12**   A force of 24 N and a force of 15 N act at right angles to each other.

The size of their resultant force is

☒   **A** 15.8 N

☒   **B** 24.3 N

☒   **C** 28.3 N

☒   **D** 39.0 N

(Total for Question = 1 mark)

13 A spring extends by 10 cm when a force of 8.0 N is applied. The limit of proportionality is not exceeded.

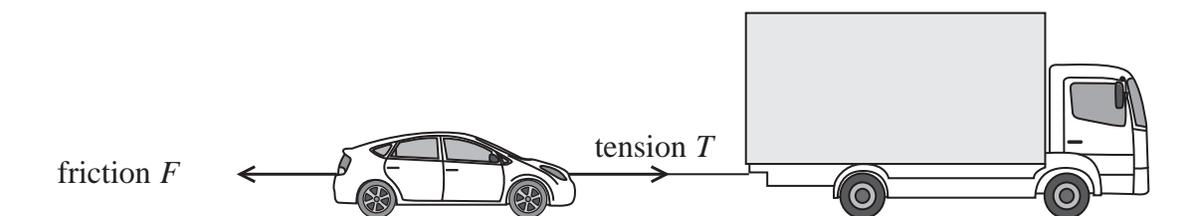Two of these springs are arranged side by side and a force of 4.0 N is applied.

4.0 N

The extension for this arrangement of springs is

☒   **A** 2.5 cm

☒   **B** 5.0 cm

☒   **C** 10 cm

☒   **D** 20 cm

(Total for Question = 1 mark)

14 A car is towed by a truck using a rope. The car is pulled at a constant speed creating a tension T in the rope.

The horizontal forces acting on the car are shown.

friction F ←   →   tension T

The magnitude of the force exerted by the truck on the car is

  ⊠ **A** $T + F$

  ⊠ **B** $T - F$

  ⊠ **C** T

  ⊠ **D** zero

(Total for Question = 1 mark)

15 A car travels 90 m east then 50 m north. A vector diagram is drawn with a dashed line representing the resultant displacement.
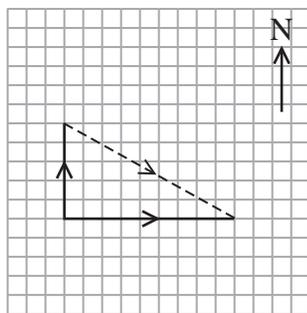
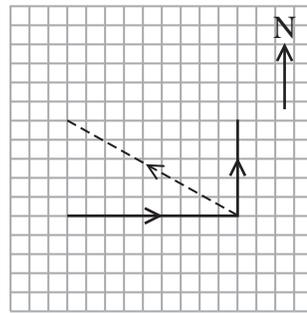Which is a correct vector diagram for the displacement of the car?
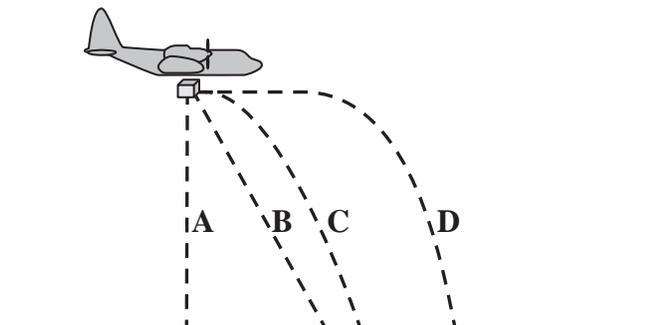
☒ **A**

☒ **B**

☒ **C**

☒ **D**
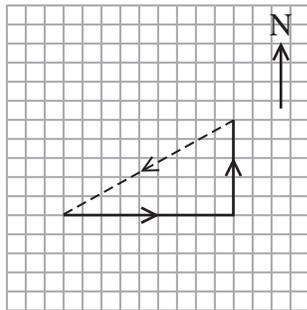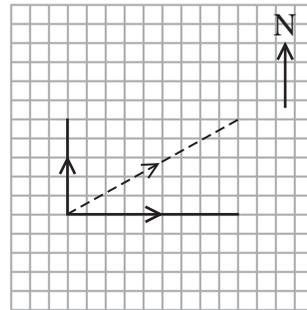
(Total for Question = 1 mark)

16 A plane is travelling horizontally at a constant speed. It releases a package of supplies when in the position shown.

Which of the following shows the path of the package after release?

☒ **A**

☒ **B**
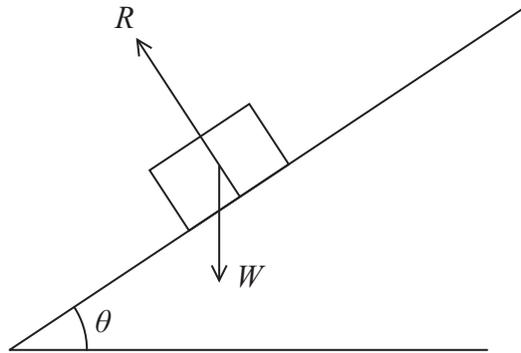
☒ **C**

☒ **D**

(Total for Question = 1 mark)

17 A model boat is crossing a stream. The stream is travelling east at a speed of 1.5 m s^{-1}. The boat is heading north at a speed of 0.5 m s^{-1}.

The magnitude of the resultant velocity is

☒   **A** $(1.5 + 0.5)$ m s^{-1}

☒   **B** $(1.5^2 + 0.5^2)$ m s^{-1}

☒   **C** $\sqrt{(1.5 + 0.5)}$ m s^{-1}

☒   **D** $\sqrt{(1.5^2 + 0.5^2)}$ m s^{-1}

(Total for Question   1 mark)

Questions 18 and 19 refer to the diagram below.

The diagram shows the forces acting on an object on an inclined surface.

18   The component of R parallel to the inclined surface is

⊠   **A** 0

⊠   **B** 1

⊠   **C** $R \cos \theta$

⊠   **D** $R \sin \theta$

(Total for Question   1 mark)

19   The object in the diagram would

⊠   **A** remain at rest on the surface.

⊠   **B** move down the surface at constant speed.

⊠   **C** accelerate down the surface.

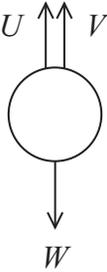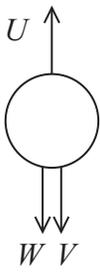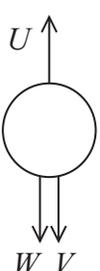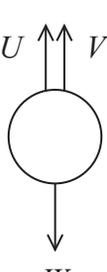⊠   **D** move up the surface at constant speed.

(Total for Question   1 mark)

20 A small bubble is rising through a liquid at a constant speed.

Which row of the table correctly summarises the forces in both the diagram and the equation?

V viscous drag, U upthrust, W weight

The force arrows are not drawn to scale.

☒	**A**	U ↑↑ V ○ ↓ W	W $V + U$
☒	**B**	U ↑ ○ ↓↓ W V	W $V + U$
☒	**C**	U ↑ ○ ↓↓ W V	U $W + V$
☒	**D**	U ↑↑ V ○ ↓ W	U $W + V$

(Total for Question   1 mark)

Use the following information to answer Questions 21 and 22.

A body is acted on by a vertical force of 18 N and a horizontal force of 32 N.

21 The angle to the horizontal of the resultant force is given by

⊠ **A** cos ^{1} (18/32)

⊠ **B** tan ^{1} (18/32)

⊠ **C** sin ^{1} (32/18)

⊠ **D** tan ^{1} (32/18)

(Total for Question   1 mark)

22 The magnitude of the resultant force in N is

⊠ **A** 32 + 18

⊠ **B** $32^2 + 18^2$

⊠ **C** $\sqrt{32+18}$

⊠ **D** $\sqrt{32^2 + 18^2}$

(Total for Question   1 mark)

23 Which of the following statements is true for the two forces in a Newton's third law pair?

⊠ **A** They have different magnitudes and act in different directions.

⊠ **B** They act in different directions on the same body.

⊠ **C** They have the same magnitude and are different types of force.

⊠ **D** They are the same type of force and act on different bodies.

(Total for Question   1 mark)

24 The diagram shows the forces acting on a picture, of weight W, suspended by a cord. The tension in the cord is T.
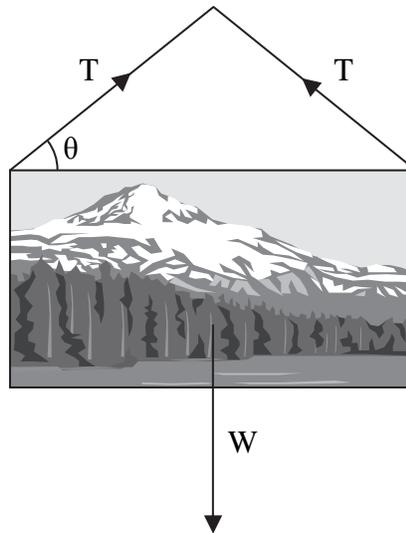
Which of the following expressions shows the correct relationship between W and T?

- ☒ **A** W = 2 T cos θ
- ☒ **B** W = T cos θ
- ☒ **C** W = T sin θ
- ☒ **D** W = 2 T sin θ

(Total for Question = 1 mark)