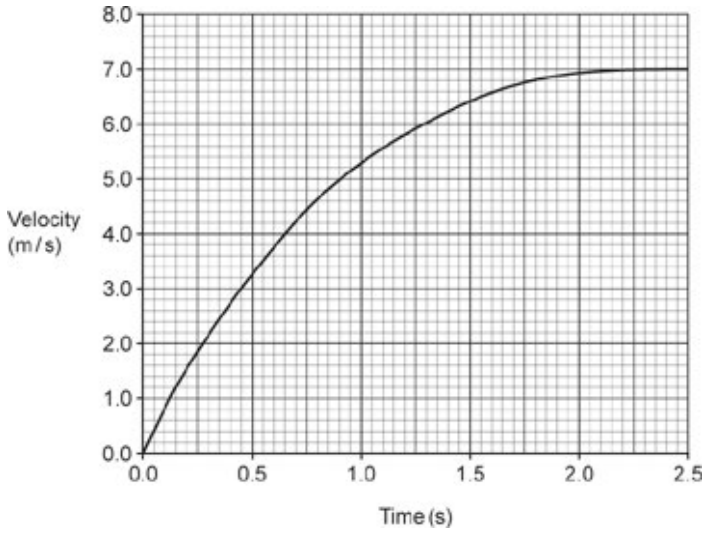
1. A badminton player investigates how the velocity of a shuttlecock varies as it falls vertically to the ground.

The player drops the shuttlecock and records the velocity of the shuttlecock as it falls.

The graph shows their results.



Explain why the shuttlecock reaches a maximum velocity.

[3]

2. An object moves in a circular path at a constant speed.

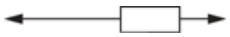
Which description is correct?

A All of the forces acting on the object are balanced.
B The object moves with a constant velocity.
C The resultant force acts away from the centre of the circle.
D The resultant force acts towards the centre of the circle.

Your answer ☐ **[1]**

3. The arrows on these scale diagrams represent forces.

Which diagram shows the **largest** net force?

A


B


C


D


Your answer ☐ **[1]**

4. A Car brakes and comes to a stop.

i. The deceleration of the car is 6 m/s^2.

The initial speed of the car is 18 m/s.

Calculate the braking distance of the car.

Use the Equation Sheet June 2024, J249-01-02-03-04

Braking distance = ... m **[3]**

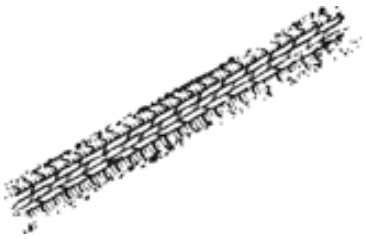
ii. Estimate the force acting on the car when it decelerates at 6 m/s^2.

Use the equation: force = mass × acceleration

For the mass in the equation, use an estimate of the mass of the car.

Force = ... N **[3]**

iii. The diagram shows a skid mark that the car's tyre makes on the road when the car brakes.



The length of the skid mark is 25 m.

Suggest **two** reasons why the braking distance and the length of the skid mark are **not** the same.

1 _____

_____

2 _____

[2]

5. A medical freezer is used to keep vaccines cool.

i. Calculate the energy required by the freezer to cool 0.50 kg of solid vaccines from –5 °C to –35 °C.

Assume the specific heat capacity of the vaccines is 1900 J / kg °C.

Use the Equation Sheet June 23 J249-01-02-03-04.

Energy = ... J **[2]**

ii. It takes 5 minutes for the freezer to cool the vaccines.

Calculate the power of the freezer.

Use the Equation Sheet June 23 J249-01-02-03-04.

Power = ... W **[3]**

iii. Suggest **two** reasons why the actual power of the freezer will be greater than that calculated in part **(a)(ii)**.

1 _____

_____

2 _____

_____

[2]

6. A teacher pulls an object with two separate forces of 2.0 N and 3.0 N.

The forces act at right angles to each other.

Fig. 18.2 shows the two forces.

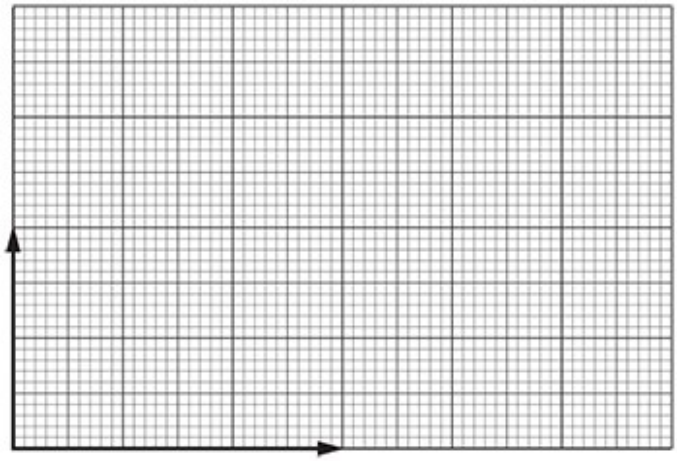


Fig. 18.2

Scale: 1 N = 2 cm

On **Fig. 18.2** draw the resultant force on the object.
Determine the magnitude of the resultant force.

Resultant force = ... N **[3]**

7. A 0.50 kg ball moving at 3.0 m / s to the right collides with a stationary 0.60 kg ball and stops.

What is the velocity of the 0.60 kg ball immediately after the collision?

Use the Equation Sheet June 23 J249-01-02-03-04.

A 0.90 m / s to the left
B 0.90 m / s to the right
C 2.5 m / s to the left
D 2.5 m / s to the right

Your answer ☐ **[1]**

8. Which sentence correctly describes an object when it is moving in a circle at a constant speed?

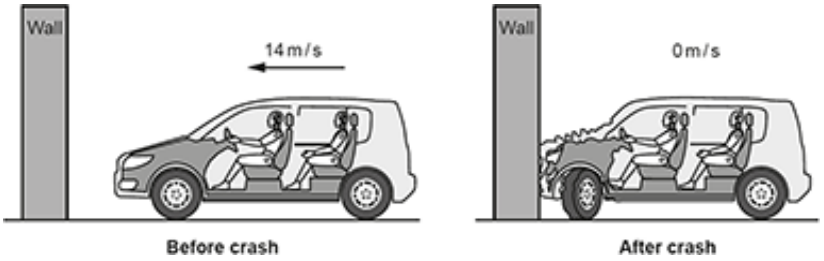
A The object is accelerating as its velocity is changing.
B The object is accelerating as its velocity is constant.
C The object is not accelerating as acceleration is a scalar quantity.
D The object is not accelerating as its speed is constant.

Your answer ☐ **[1]**

9. * A car manufacturer tests two different cars of the same length, car **A** and car **B**.

Each car is pulled along at 14 m / s and crashes into a wall.

The diagrams show car **A** before and after the crash.



Before crash After crash

After hitting the wall, the rear wheel of car **A** takes **twice** the distance to stop compared to the rear wheel of car **B**.

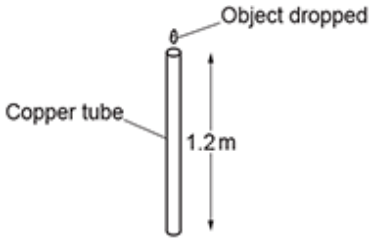
Explain why car **A** is safer than car **B**.

In your answer, estimate the deceleration of car **A** during the crash.
Use the Data sheet_J249 01/02/03/04, June 2022.

[6]

10. A student drops a piece of metal and a small magnet through a vertical copper tube. They record the time taken for each object to pass through the tube.

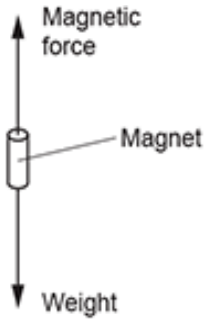
The diagram shows how they set up the experiment.



The student records their results in a table.

	Time taken to fall through the copper tube (s)					
	1	**2**	**3**	**4**	**5**	**Mean**
Magnet	1.13	1.11	1.12	1.11	1.13	
Metal	0.44	0.45	0.46	0.44	0.43	0.4444

The diagram shows a free-body force diagram for when the magnet is at a point in the middle of the tube.



Explain the motion of the magnet.

_____

_____

_____

_____ **[2]**

11(a). Two skaters are standing, at rest, opposite each other on an ice rink.

Skater **A** has a mass of 40 kg and skater **B** has a mass of 50 kg.

Skater **A** pushes against skater **B** with a force of 30 N.

i. What does Newton's third law tell us about the force that skater **A** experiences from skater **B**?

_____

_____

[2]

ii. Calculate the acceleration of skater **B** when they are pushed with the force of 30 N.

Use the equation: force = mass × acceleration

Acceleration = ... m/s^2 **[3]**

(b).

i. State the total momentum of both skaters before skater **A** pushes skater **B**.

[1]

ii. After pushing skater **B**, skater **A** has a velocity of 2 m / s.

Calculate the momentum of skater **A.**

Use the equation: momentum = mass × velocity

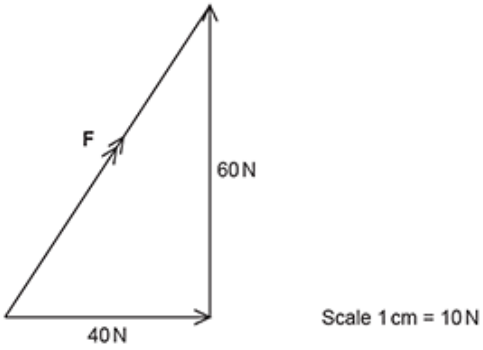
Momentum = ... kg m / s **[2]**

iii. Calculate the velocity of skater **B** after being pushed by skater **A**.

Velocity = ... m/s **[3]**

12. Two forces, of magnitude 40 N and 60 N, act on an object.

A student draws a scale-diagram to determine the net force **F** acting on the object.



What is the net force **F** acting on the object?

A 7.2 N
B 20 N
C 72 N
D 100 N

Your answer ☐ **[1]**

13. A student of mass 65 kg climbs a flight of 50 steps. Each step is 0.30 m high.

What is the gravitational potential energy gained by the student?

Use the equation: potential energy = mass × height × gravitational field strength

Gravitational field strength = 10 N / kg.

A 195 J
B 9750 J
C 19500 J
D 975000 J

Your answer ☐ **[1]**

END OF QUESTION PAPER