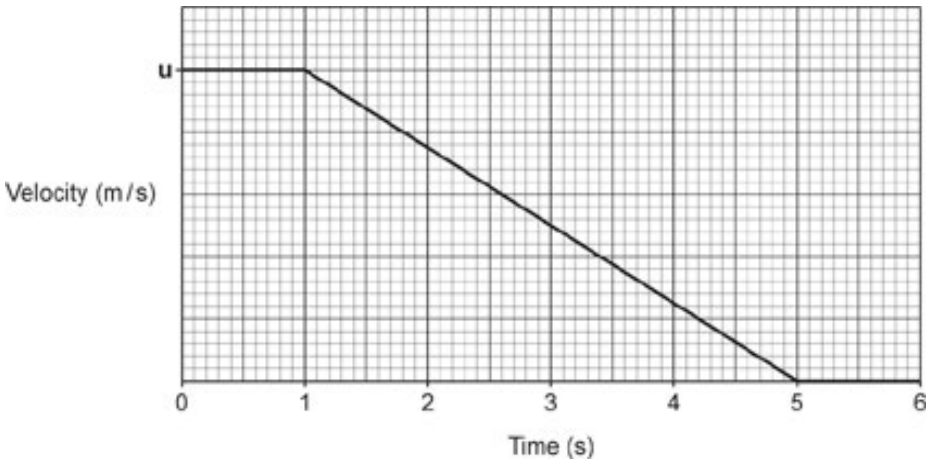
1(a). The graph shows how the velocity of car **A** changes when the driver sees a hazard in the road at time = 0 seconds.



The braking distance is 30 m.

Calculate the initial velocity **u** of car **A**.

Use the graph.

Initial velocity **u** = ... m / s **[3]**

(b). 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]**

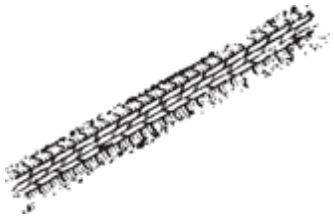
ii. Estimate the force acting on the car when it decelerates at 6 m/s^2.

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]**

2. A radio wave has a frequency of 88 MHz.

What is 88 MHz converted to kHz?

A 0.088 kHz
B 88 000 kHz
C 88 000 000 kHz
D 88 000 000 000 kHz

Your answer ☐ **[1]**

3. Which factor will **increase** the braking distance of a car travelling on a road?

A Drinking alcohol
B Driving when tired
C More people in the car
D Using new brake pads

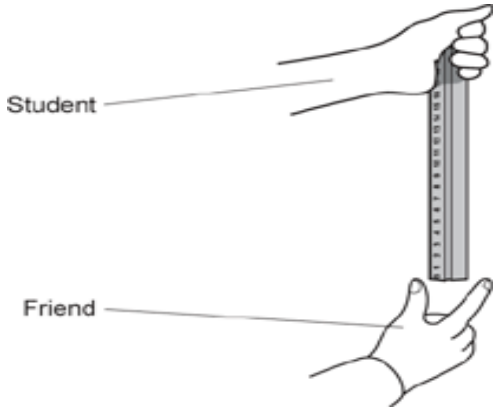
Your answer ☐ **[1]**

4. Which answer shows 800 km / h converted into m / s?

A 0.22 m / s
B 13.3 m / s
C 222 m / s
D 13 333 m / s

Your answer ☐ **[1]**

5. A student drops a ruler and a friend catches it.



The reaction time of the friend is calculated from the distance the ruler has fallen. The experiment is repeated.

What does the student do to determine an accurate value for the reaction time?

A Check the reaction time with a stopwatch
B Drop the ruler at random times
C Drop the ruler from different heights above the friend's hand
D Tell the friend when the ruler will be dropped

Your answer ☐ **[1]**

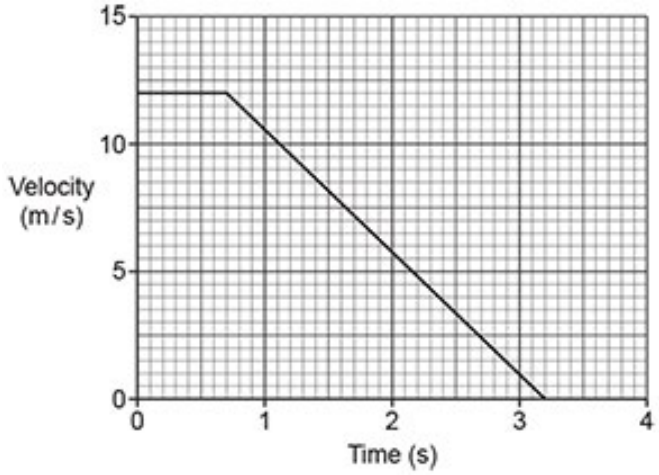
6. 1 μg of polonium-210 is enough to kill a human being.
210 g of polonium-210 has an activity of 3.57×10^{16} Bq.

Calculate the activity of a sample of 1 μg of polonium-210.

Give your answer in **standard form**.

Activity = ... Bq **[3]**

7. The velocity–time graph shows how the velocity of a car changes after the driver sees a hazard in the road.



What is the braking distance of the car?

A 8.4 m
B 15.0 m
C 17.5 m
D 23.4 m

Your answer ☐ **[1]**

8. A vehicle is travelling at 30 m / s.

The vehicle travels 75 m while decelerating to a stop.

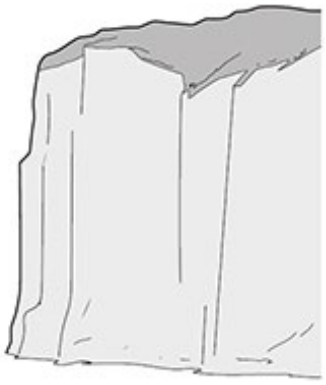
What is the deceleration of the vehicle?

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

A 2.5 m / s^2
B 6.0 m / s^2
C 12 m / s^2
D 24 m / s^2

Your answer ☐ **[1]**

9. A student is trying to calculate how far away they are from a large cliff.



The student claps loudly once.

After a short time, they hear a second clap. The second clap is quieter.

i. Explain why they hear the second clap **and** why the second clap is quieter.

_____

_____

_____

_____ **[2]**

ii. The student measures the time between the first clap and the second clap.

The time taken is 1.40 s.
The speed of sound in air is 330 m / s.

Calculate the distance from the student to the cliff.
Use the Data Sheet.

Distance = ... m **[4]**

iii. The student measures the time between the first and second clap with a stopwatch.

Suggest **two** reasons why the distance calculated in **(a)(ii)** is **not** accurate.

1 _____

2 _____

[2]

iv. Suggest how the experiment could be improved.

_____

[1]

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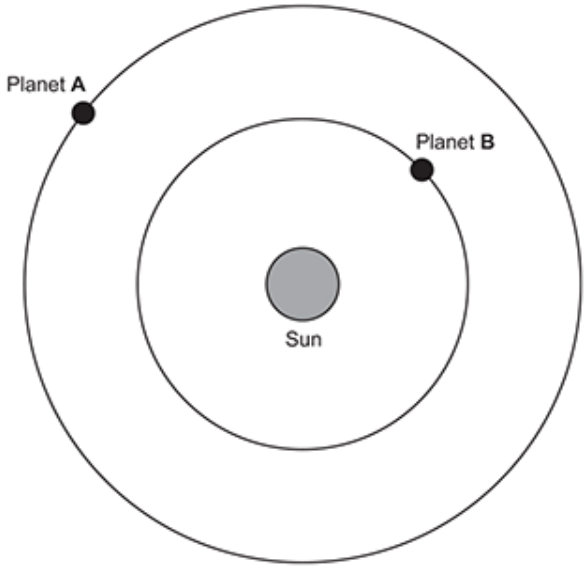
10. The diagram shows two planets orbiting the Sun in our Solar System.



The table shows data for the planets.

	Radius of orbit (metres)	Time to orbit Sun (years)	Mean orbital speed (km / s)
Planet A	2.28×10^{11}	1.88	24
Planet B	1.08×10^{11}	0.62	35

i. Explain why the speed of a planet changes when the radius of orbit changes.

_____

_____

_____

[2]

---

ii. Two students look at the data.

Student P says, 'The time to orbit the Sun is proportional to the radius of orbit.'

Student Q disagrees.

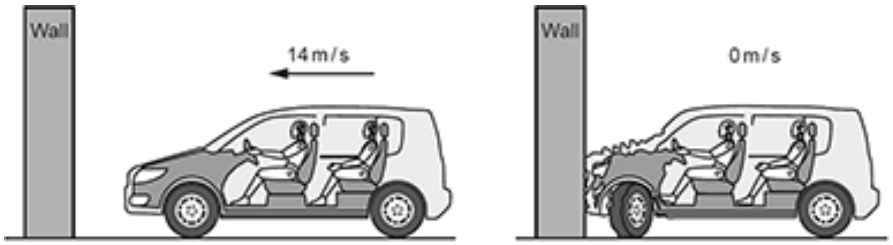
Use the data in the table to show that **Student Q** is correct.

[2]

11. * 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.



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]

12. Fig. 21.2 shows how the amount of electricity generated by wind in Europe has changed with time.

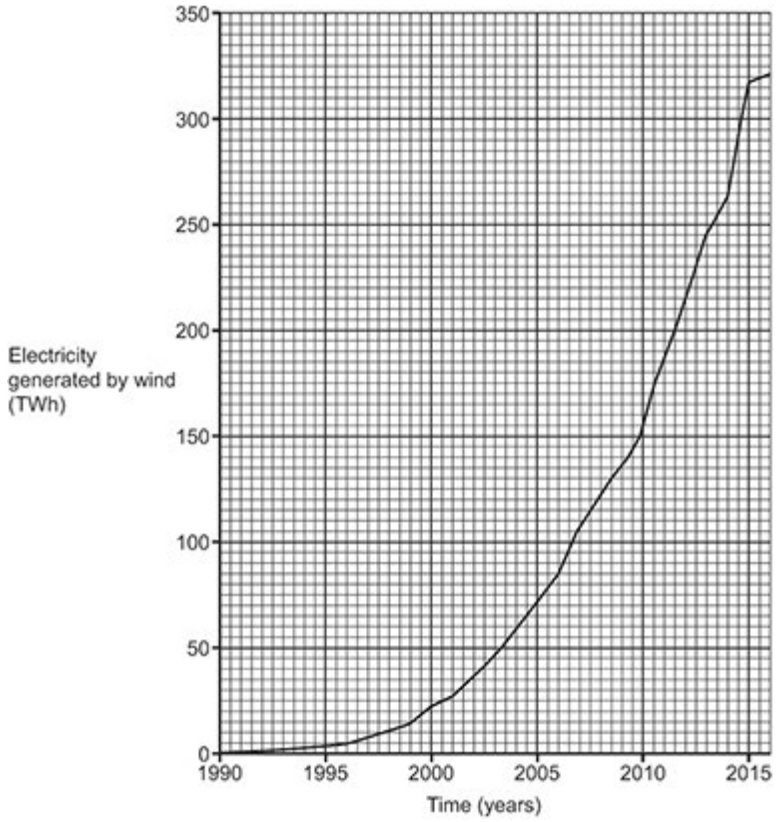


Fig. 21.2

i. State the amount of electricity generated by wind in 2012 in joules.

1TW h = 3.6×10^{15} J

Give your answer in standard form.

Electricity generated = ... J **[2]**

ii. Suggest **two** reasons for the change shown in **Fig. 21.2.**

1 _____

_____

2 _____

_____

[2]

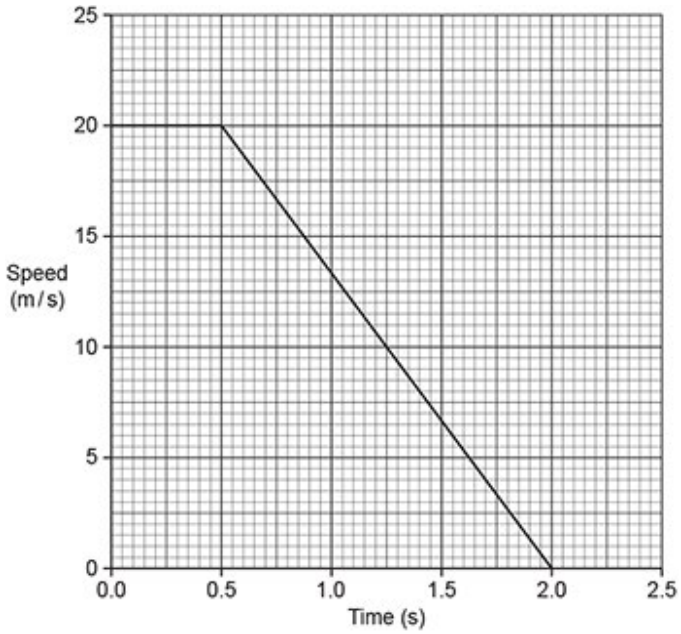
13. The energy stored in a stretched spring is 5 J.

What is the energy stored in the spring when the extension doubles?
Use the Data sheet_J249 01/02/03/04, June 2022.

A 5 J
B 10 J
C 20 J
D 25 J

Your answer ☐ **[1]**

14. The graph shows how the speed of a car varies with time.



At time = 0.0 s, the driver sees an obstruction in the road.
At time = 0.5 s, the driver presses the brakes.
At time = 2.0 s, the car stops.

What is the thinking distance of this car?
Use the graph.

A 10 m
B 15 m
C 25 m
D 40 m

Your answer ☐ **[1]**

15. Power can be measured in watts (W) or milliwatts (mW).

What is 1.5 mW converted into W?

A 1.5×10^{-6} W
B 1.5×10^{-3} W
C 1.5×10^{3} W
D 1.5×10^{6} W

Your answer ☐ **[1]**

END OF QUESTION PAPER