Mechanics 1

CORE questions

Core 1

Read the sentences below and then answer the questions which follow.

"When potatoes are bought in a market, the weight of a bag full of potatoes is affected by the density of the potatoes. A lady fills her bag when she buys 5 kg of large potatoes. A man buys 5 kg of small potatoes. He puts them in a bag of the same size as the lady's, but his bag is not filled."

(a) Which word in these sentences describes a quantity which is a force?

.....[1]

(b) What does the 5 kg measure? Tick **one** box.

the density of the potatoes	☐
the mass of the potatoes	☐
the volume of the potatoes	☐
the weight of the potatoes	☐

[1]

(c) Suggest one reason why the man's 5 kg of potatoes occupies less volume than the lady's potatoes.

Core 2

Moving cars always experience friction. A driver goes on a short journey in a car.

Fig. 1 shows the car at four places during the journey. The arrows represent the size and direction of the horizontal forces on the car.

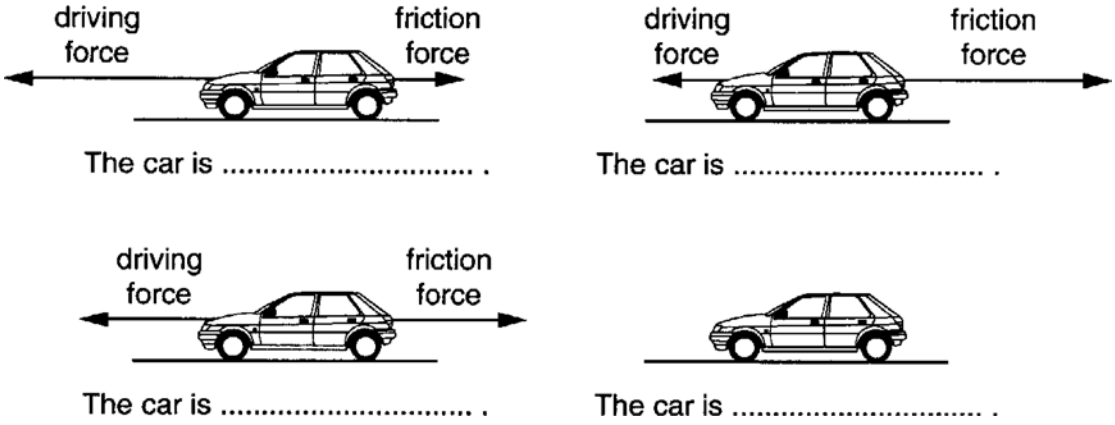


Fig. 1

On the line underneath each picture, state whether the car is

at rest,

speeding up,

going at steady speed,

slowing down. [4]

Core 3

(a) Fig. 2 shows the speed/time graph for a motorcycle.

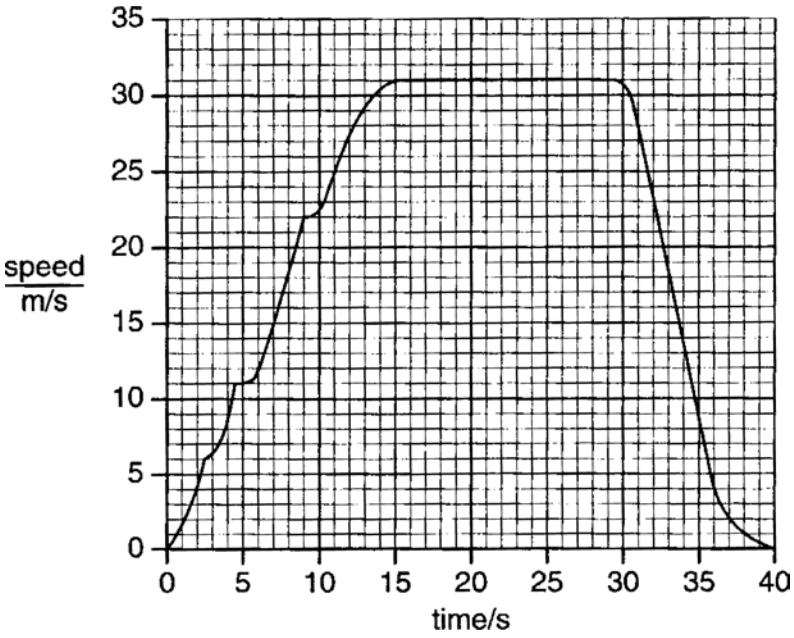


Fig. 2

(i) What is the maximum speed of the motorcycle? ..... m / s

(ii) Whilst accelerating, the motorcycle changes gear three times.

State **one** of the speeds at which the gear is changed ..... m / s

(iii) For how long is the motorcycle slowing down? ..... s

[3]

Core 3

(b) On another occasion, the motorcycle is made to increase its speed at a constant rate for 10 s. The speed / time graph for this is shown in Fig. 3:

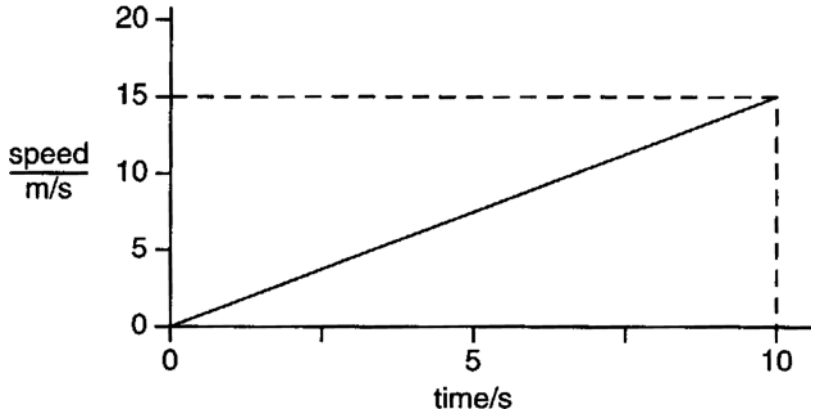


Fig. 3

How far does the motorcycle travel in these 10 s?

distance travelled = ... m [3]

ALTERNATIVE TO PRACTICAL questions

Alternative to Practical 1

The class is investigating the use of nichrome (resistance) wire instead of thin thread as part of a simple pendulum. The apparatus is shown in Fig. 4.

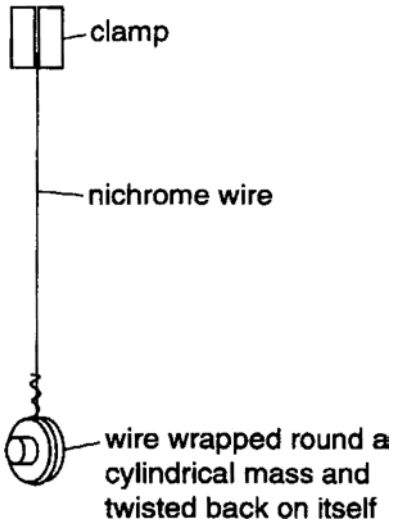


Fig. 4

Four tests are carried out.

Test A using very thin cotton thread for the suspension, (this thread is considered to have a negligible diameter).

Tests B, C and D in which nichrome wires of different diameters, d, are used.

In each test the length of the pendulum is 30.0 cm. The period, T, is determined by obtaining the total time, t, of a suitable number of oscillations. The period is given by $T = t/N$, where N is the number of oscillations.

The table gives the measurements taken by the class.

test	suspension	d / mm	N	t / s	T / s
A	cotton thread	negligible	50	54.8	
B	nichrome wire	0.31	50	53.4	
C	nichrome wire	0.56	50	50.3	
D	nichrome wire	0.91	50	43.3	

(a) For each test, determine the value T and record it in the table. [1]

(b) Suggest why 50 oscillations are used .

.....[1]

(c) **(i)** Plot a graph of T / s (y-axis) against d / mm (x-axis). Start the T / s axis at T / s = 0.7. Draw a neat thin curved line through the four points.

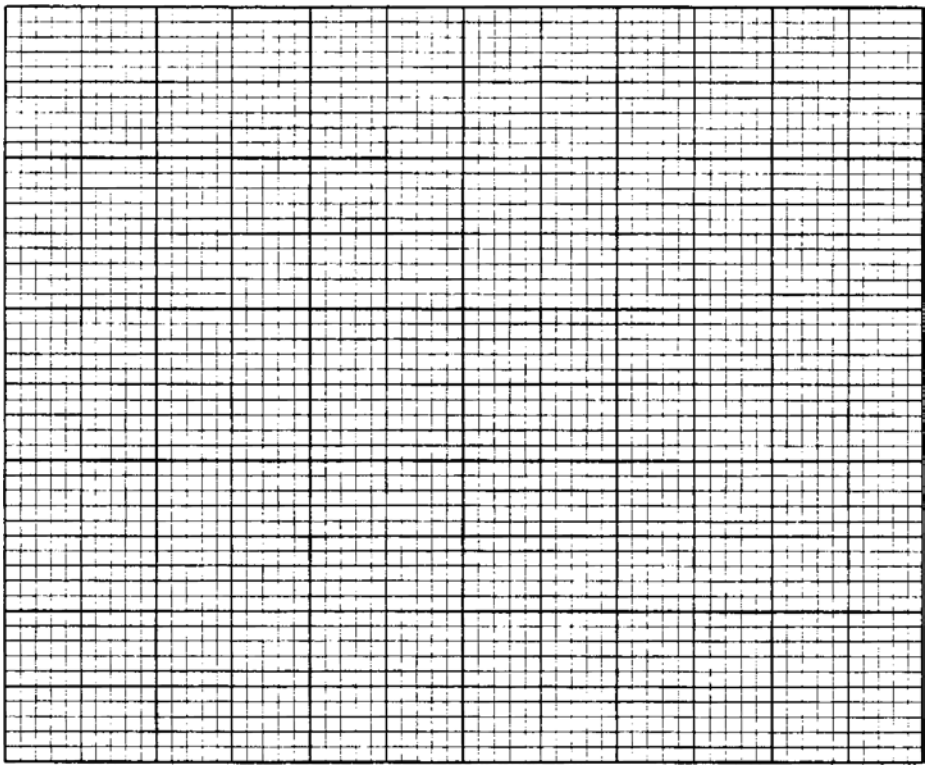
(ii) Label each plotted point with the correct test letter A, B, C or D.

Alternative to Practical 1

(iii) Describe how the values of *T* change when the values of *d*, the diameter of the wire, decrease.

.....

.....[7]



(d) In the laboratory you have enough time to take another set of measurements for one other value for the diameter of the nichrome wire. Study the shape of your graph line and then suggest an approximate value for the diameter that you think should be used. Give a reason for your choice.

choice for the value of *d* = ... mm

reason for this choice

.....

.....

.....[2]

EXTENSION questions

Extension 1

A firework leaves the ground with an initial velocity of 45 m / s, travelling vertically upwards. It reaches a maximum height of 100 m.

At this point the firework fails to explode and falls back down the same vertical path to the ground.

At any point on its path, the firework has both a velocity and a speed.

(a) Using the terms **vector** and **scalar**, explain the difference between velocity and speed.

.....

.....

.....

.....[3]

(b) Fig. 5 is a graph which shows the height of the firework above the ground during the first 5 s of its journey.

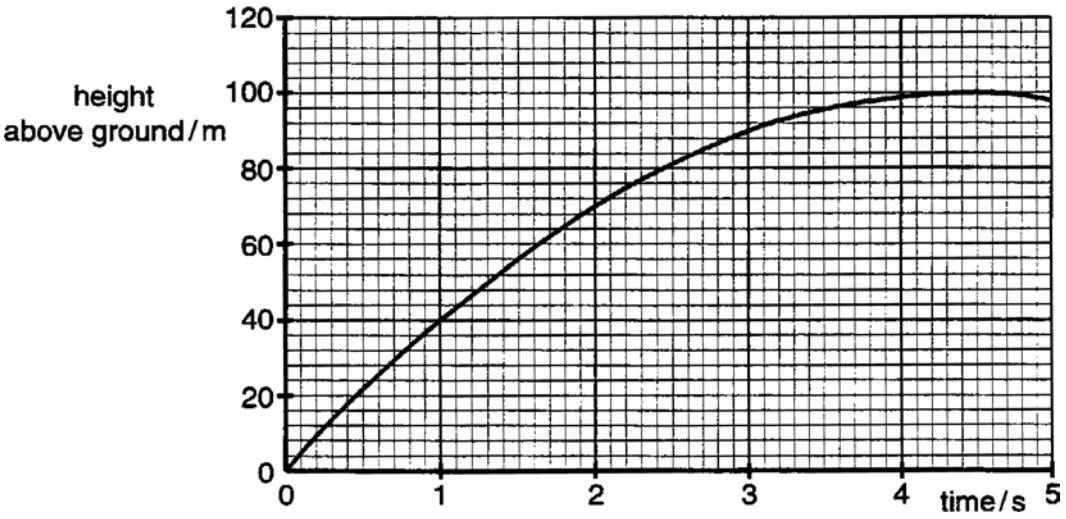


Fig. 5

(i) Use the information on the graph to

1. find the time taken for the firework to reach its maximum height above the ground,

.....

2. describe how the motion of the firework changes over the first 5 s of its journey.

.....

.....

.....

.....

Extension 1

(ii) The acceleration of free fall Is $10\,m/s^2$ and air resistance on the firework is negligible.

State

1. the deceleration of the firework as it is rising,

deceleration = ...

2. The total time taken for the firework to rise 100 m and then to fall back to the ground.

time taken= .....

(iii) State the velocity with which the falling firework hits the ground.

velocity = ...

[8]

Extension 2

Fig. 6 shows a plan view of a rotating sprayer used for the watering of crops.

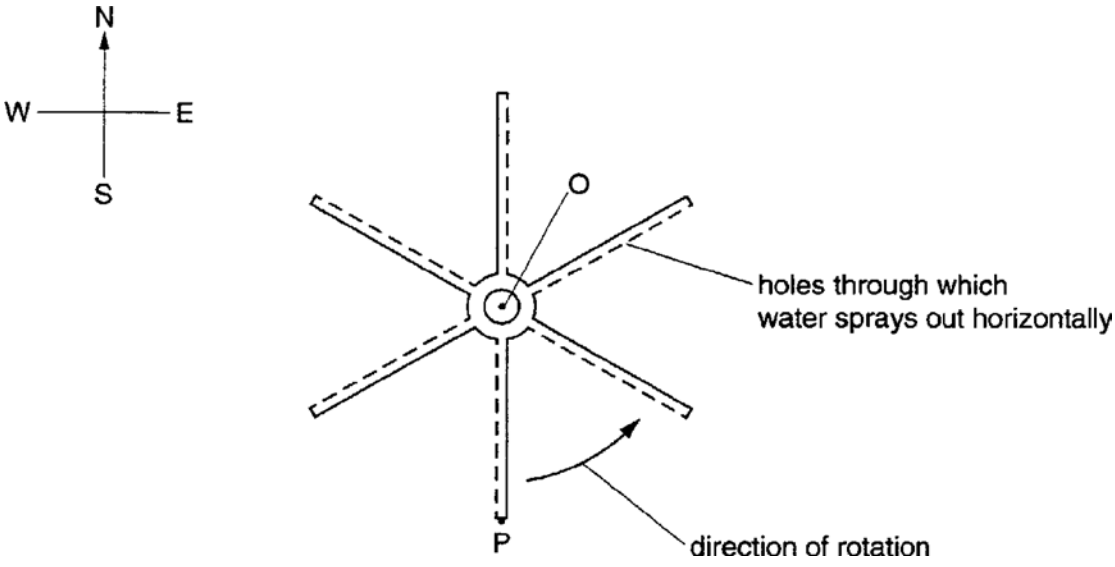


Fig. 6

(a) The device rotates about O at a constant rate of 0.2 revolutions per second. OP is 10 m long.
Calculate the speed of the point P. (The circumference of a circle is $2\pi \times$ radius.)

speed= ..... [4]

(b) **(i)** Use your answer to **(a)** to write down the **velocity** of the point P when P is at the point shown in Fig. 6

.....

.....

(ii) Explain why the **speed** of point P is constant but its **velocity** changes as the sprayer rotates.

.....

.....

.....

.....

[4]

Extension 2

(c) Explain how you know that there is a net force at the end of the arm P, acting towards O.

.....

.....

.....

.....

.....[3]

Mechanics 1 – answers

Core 1

(a) weight

(b) mass

(c) greater density or less air gaps between the potatoes

Core 2

speeding up	slowing down
steady speed	at rest

Core 3

(a) **(i)** 31 m / s

(ii) 6 or 11 or 22 m / s

(ii) 10 s

(b) distance = area under the graph or the average speed × time

= ½ × 10 × 15

= 75 m

Alternative to Practical 1

(a) 1.096 or 1.10
1.068 or 1.07
1.006 or 1.01
0.866 or 0.87

(b) greater accuracy

(c) **(i)** the graph should
show the scales the right way round
cover at least half the grid
suitable scales
scales labelled with quantity or unit
all plots correct to the nearest square

(ii) A B C D labelled

(ii) T increases

the increase is greatest for larger values of d

(d) 1.1
increased range or largest difference in T value with larger d values

Extension 1

(a) velocity is a vector and speed is a scalar
or velocity has direction and a scalar or speed has no direction or only magnitude

(b) **(i)** 1 $4.5 \pm 0.1\,s$

2 decelerates uniformly from a high velocity at zero seconds to zero velocity at 4.5 s

(ii) 1 $10\,m/s^2$

2 9.0 s

(iii) $45\,m/s \pm 1\,m/s$

Extension 2

(a) distance moved in one revolution is equal to the circumference

= 62.8 / 63 m

time for one revolution is 5 s

speed = 62.8 / 5
= 12.6 m / s

(b) **(i)** 12.6 m / s to the right / east

(ii) velocity is a vector or has direction or reverse argument for speed
P is moving in a circle / a constantly changing direction
if the direction changes the velocity changes or the speed does not

(c) rotation is taking place / direction is changing
the force is the centripetal force
it must act through the centre otherwise the motion is not circular