PHYSICS

PAPER 1P, 1PR 2020 - 2025

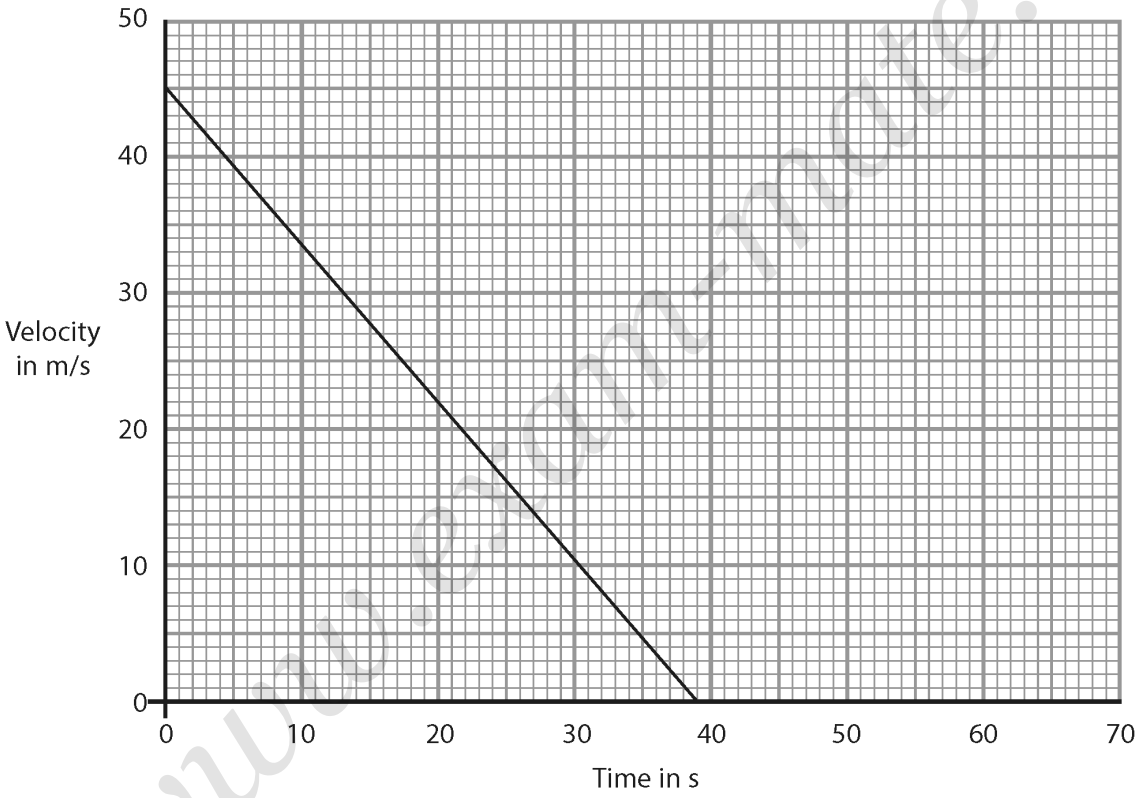
1 – (4PH1/1P_Summer_2020_Q2) – *Forces And Motion*

This question is about the movement of a train.

The diagram shows the train on a track.

The train starts braking at point P and stops moving at point Q.

The graph shows how the train's velocity changes with time as the train travels from P to Q.



(a) Calculate the acceleration of the train.

(3)

acceleration = ... m/s^2

(b) Calculate the distance travelled by the train from P to Q.

(3)

distance = ... m

(c) Draw a line on the graph to show how the train's velocity will change if its initial velocity is the same but the braking force is lower.

(2)

2 – (4PH1/1P_Summer_2020_Q4) – *Forces And Motion*

(a) (i) State Hooke's Law.

(2)

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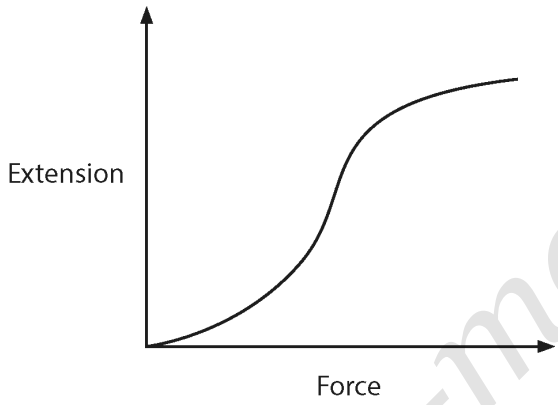
(ii) The graph shows how the extension of a rubber band varies with the force applied.



Explain how the graph shows that the rubber band does not obey Hooke's Law.

(2)

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(b) Diagram 1 shows a model aeroplane powered by a rubber band.

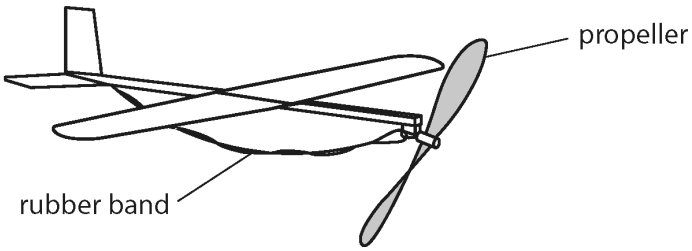


Diagram 1

A person rotates the propeller of the model aeroplane, which twists the rubber band.

He then releases the propeller and it spins.

Energy transfer occurs during this process.

The box lists words associated with energy.

kinetic	gravitational	electrostatic
mechanical	elastic	magnetic
heating	chemical	radiation

Use words from the box to complete the passage.

(3)

The person does ..... work to twist the rubber band.

As the person twists the rubber band it extends, increasing the .....

energy store of the rubber band. When the rubber band is released it does mechanical work,

increasing the ..... energy store of the propeller.

(c) Diagram 2 shows the aeroplane flying horizontally to the right.

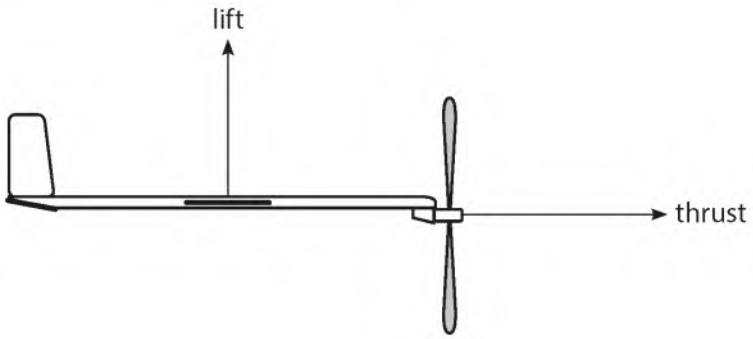


Diagram 2

The aeroplane flies at a constant speed.

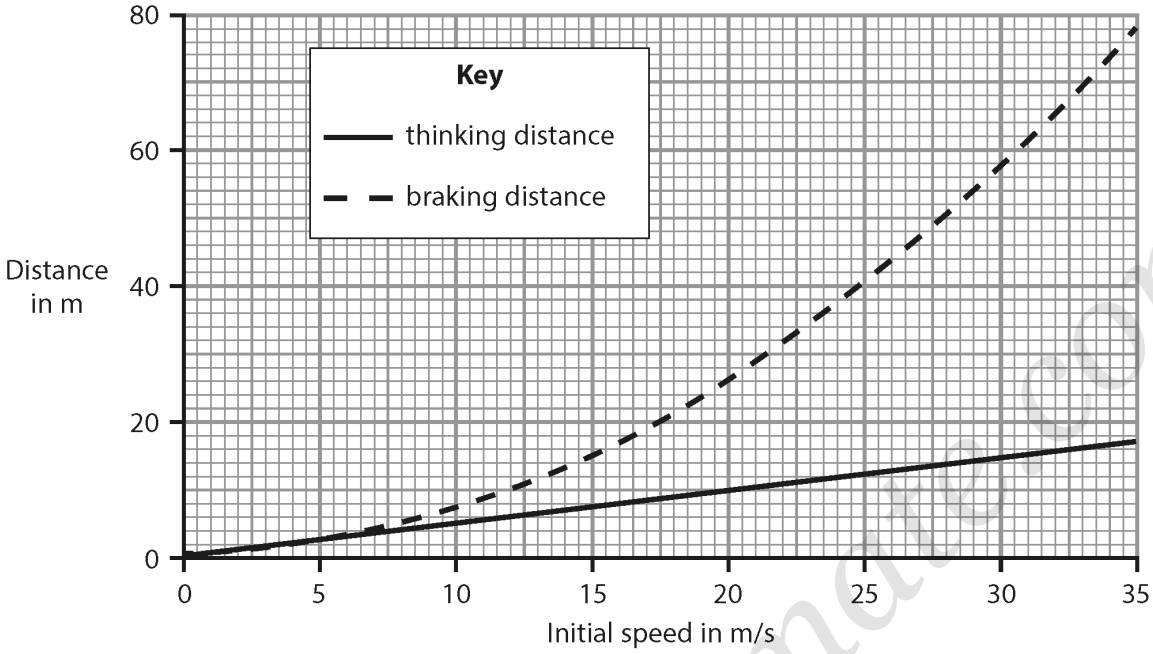
Diagram 2 shows two forces acting on the aeroplane.

Draw labelled arrows on diagram 2 to show two more forces acting on the aeroplane.

(4)

3 – (4PH1/1PR_Summer_2020_Q11) – *Forces And Motion*

The graph shows how the thinking distance and braking distance of a car vary with its initial speed.



(a) A car has an initial speed of 35 m/s.

The brakes are applied and the car comes to a complete stop in the braking distance shown by the graph.

Calculate the mean braking acceleration of the car.

(4)

braking acceleration = ... m/s^2

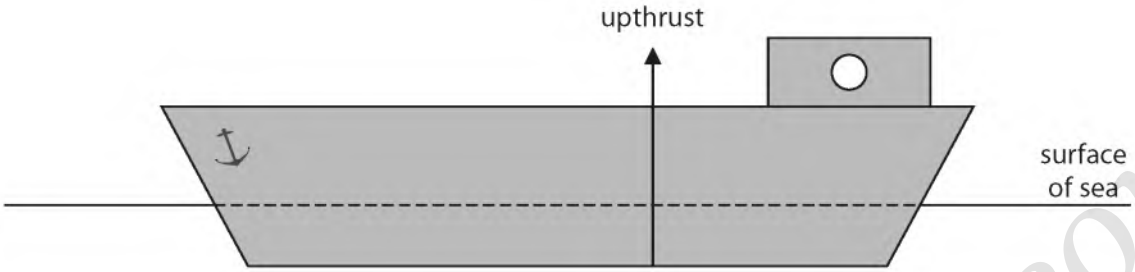
(b) Evaluate how the thinking distance and the braking distance vary for different values of initial speed.

Refer to information from the graph in your answer.

(5)

4 – (4PH1/1P_Winter_2020_Q2) – *Forces And Motion*

A ship floats on the sea.



(a) The ship floats because of the forces acting on it.

(i) The upward force acting on the ship is called upthrust.

This force is shown on the diagram.

Draw another labelled arrow on the diagram to show the other vertical force acting on the ship.

(2)

(ii) Forces are vector quantities.

State what is meant by the term **vector quantity**.

(2)

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(iii) Give another example of a vector quantity.

(1)

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(b) The upthrust force acting on the ship is proportional to the pressure difference between the bottom of the ship and the surface of the sea.

The pressure acting on the ship at the surface of the sea is 100 kPa.

(i) State the formula linking pressure difference, height, density and gravitational field strength (*g*).

(1)

(ii) The bottom of the ship is 15.8 m below the surface of the sea.

Show that the pressure acting on the bottom of the ship is approximately 260 kPa.

[density of seawater = 1030 kg/m^3]

(3)

(iii) Explain why the bottom of the ship is deeper below the surface of the sea when the ship is fully loaded with cargo.

(2)

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ANSWERS

1 – (4PH1/1P_Summer_2020_Q2) – *Forces And Motion*

(a)	any attempt at gradient/reference to correct formula; substitution of values from graph; evaluation; e.g. acceleration = change in velocity/time taken acceleration = (-)45 / 39 acceleration = (-)1.2 (m/s^2)	check graph for evidence of working ignore minus sign allow 1.1-1.2 (m/s^2)	3
(b)	any attempt at or reference to an area; correct attempt = ½ × 45 × 39; correct evaluation; e.g. distance travelled = area under graph distance = $^1/_2$ × 45 × 39 distance = 880 (m)	allow alternative method using $v^2 = u^2 + 2as$ with answer from (a) allow ECF of incorrect velocity or time reading if also used in (a) allow 878, 877.5 (m)	3
(c)	line showing decreasing velocity from same initial velocity as existing line; line drawn is less steep than existing line throughout;		2

2 – (4PH1/1P_Summer_2020_Q4) – *Forces And Motion*

(a) (i)	idea that extension is (directly) proportional to force or load; up to limit of proportionality;	condone 'mass' for force allow up to elastic limit	2
(ii)	line is not straight / eq; so, force and extension cannot be (directly) proportional;	allow line is curved	2
(b)	mechanical; elastic; kinetic / gravitational;	 allow elastic potential allow gravitational potential	3

(c)	drag force drawn horizontally left;
	
	drag force = thrust force;
	
	weight force drawn vertically downwards;
	
	weight force = lift force;
		judge by eye
		allow air resistance, friction
		judge by eye
		ignore force labels
		judge by eye
		allow gravitational force
		ignore gravity
		judge by eye
		ignore force labels
			4

3 – (4PH1/1PR_Summer_2020_Q11) – *Forces And Motion*

(a)	value of braking distance correctly read from graph; substitution into $v^2 = u^2 + 2as$; rearrangement; evaluation; e.g. braking distance = 78 m $0 = 35^2 + (2 \times a \times 78)$ $(a =) (-) 35^2 / (2 \times 78)$ $(a =) (-) 7.9$ (m/s^2)	allow 77-79 m allow ecf incorrect distance allow 7.75... - 7.95...(m/s^2)	4
(b)	any five from: MP1. thinking distance OR braking distance increases as (initial) speed increases; MP2. braking distance increases by a greater amount than thinking distance for the same increase in (initial) speed; MP3. thinking distance is (directly) proportional to (initial) speed; MP4. braking distance has a non-linear relationship with (initial) speed; MP5. idea that braking distance is proportional to (initial) speed squared; MP6. suitable use of data to justify thinking distance relationship; MP7. suitable use of data to justify braking distance relationship;	 e.g. gradient of braking distance graph larger than gradient for thinking distance e.g. when initial speed doubles, the braking distance is four times greater / eq. e.g. reading off thinking distance for two values of initial speed and showing they increase by the same factor e.g. reading off braking distance for two values of initial speed and showing they do not increase by the same factor	5

4 – (4PH1/1P_Winter_2020_Q2) – *Forces And Motion*

(a) (i)	downward arrow labelled weight; downward arrow is equal in length to upthrust arrow;	ignore starting point of arrow allow 'gravitational force', 'force due to gravity' reject 'gravity' judge by eye	2
(ii)	(a quantity with) magnitude; and direction;	allow size, amount ignore quantity, measurement	2
(iii)	any correct vector; e.g. velocity, displacement, acceleration, momentum etc.	ignore force, any named force e.g. weight, upthrust etc	1
(b) (i)	pressure (difference) = height × density × g;	allow standard symbols and rearrangements e.g. $p = h \times \rho \times g$ allow d for density ignore "gravity" for g	1
(ii)	substitution; evaluation of pressure difference in Pa OR kPa to at least 3s.f.; addition of surface pressure (100 kPa) to give answer; e.g. p = 15.8 × 1030 × 10 p = 162740 Pa OR 162.74 kPa p = 162.74 + 100 (= 260 kPa)	allow g = 9.8, 9.81 -1 for POT error unless due to physics error reject this mark if inconsistent units used allow final answer in Pa or kPa allow 262 740 (Pa)	3
(iii)	any two from: MP1. idea that {weight of ship / downwards force} is greater; MP2. larger pressure difference (when deeper in water); MP3. larger upthrust force (needed to keep forces balanced);	 allow ship is heavier, ship has more mass allow larger pressure (on bottom of ship)	2