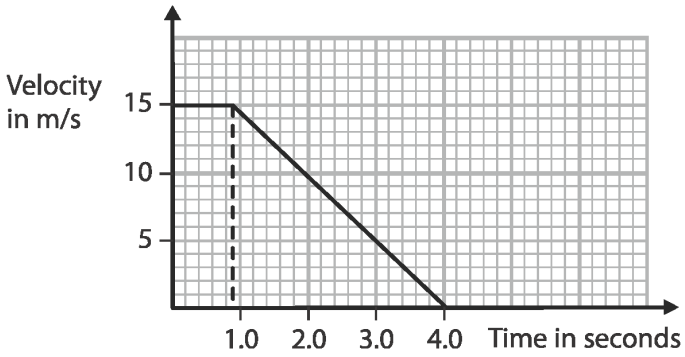
PHYSICS

PAPER 1P, 1PR 2019 - 2023

1 – (4PH1/1P_Summer_2019_Q4) – *Forces And Motion*

A car driver sees a hazard on the road ahead.

The graph shows the velocity of the car from when the driver sees the hazard.



(a) (i) Use the graph to determine the reaction time of the driver.

(1)

reaction time = ... s

(ii) Calculate the stopping distance of the car.

(4)

stopping distance = ... m

(iii) Calculate the acceleration of the car when the car is braking.

(3)

acceleration = ... m/s^2

(b) The speed of the car affects the thinking distance and the braking distance.

Discuss other factors that affect the thinking distance and the braking distance of the car.

(4)

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(Total for Question 4 = 12 marks)

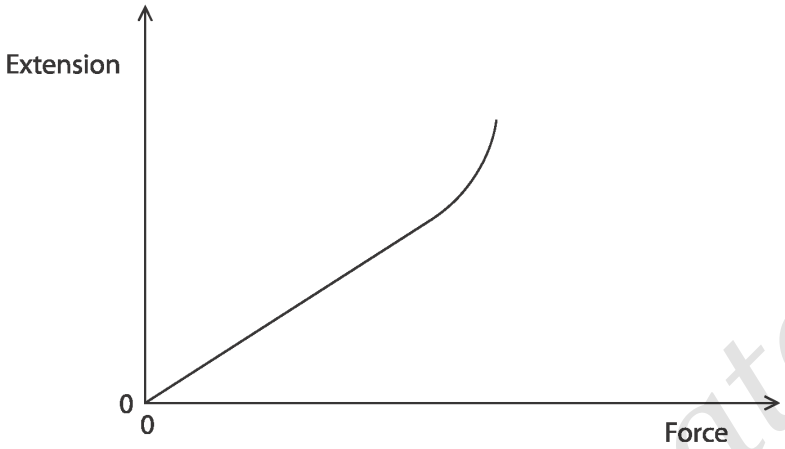
2 – (4PH1/1P_Summer_2019_Q5) – *Forces And Motion*

This question is about stretching a spring.

(a) The graph shows how the extension of a spring varies when a force is applied to the spring.

The line on the graph shows that the spring has been extended past its elastic limit.

The line has a straight section and a curved section.



(i) Draw a cross on the line to show the elastic limit of the spring.

(1)

(ii) Sketch another line to show how the extension will change when the force is decreased from its maximum value back to 0.

(2)

(b) (i) State which energy store of the spring increases when it is stretched.
Assume the spring does not reach its elastic limit.

(1)

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(ii) How is this energy transferred to the spring?

(1)

- ☐ **A** electrically
- ☐ **B** by heating
- ☐ **C** mechanically
- ☐ **D** by radiation

(Total for Question 5 = 5 marks)

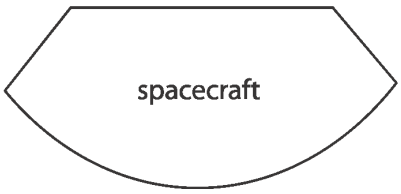
3 – (4PH1/1P_Summer_2019_Q8) – *Forces And Motion*

Schiaparelli is a spacecraft that was sent to Mars in 2016.

(a) Schiaparelli slowed down as it fell vertically through the atmosphere of Mars.

(i) Draw labelled arrows on the diagram to show the forces acting on Schiaparelli as it fell.

(3)



(ii) Schiaparelli then opened a parachute to slow down.

Explain how the spacecraft reached a low terminal velocity after opening its parachute.

Use ideas about forces in your answer.

(4)

(b) The parachute was disconnected when Schiaparelli was at a height of 2.0 m from the surface of Mars and travelling at a speed of 0.45 m/s.

Calculate the speed of the spacecraft just before it hits the surface of Mars.
[acceleration of free-fall on Mars = 3.4 m/s^2]

(4)

speed = ... m/s

(c) Suggest why Mars has a lower gravitational field strength than Earth.

(1)

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(Total for Question 8 = 12 marks)

4 – (4PH1/1PR_Summer_2019_Q6) – *Forces And Motion*

The photograph shows a small glass ball used to investigate density and pressure.

(a) The mass of the ball is 19 g.

The density of the ball is 2.3 g/cm^3.

(i) State the formula linking density, mass and volume.

(1)

(ii) Calculate the volume of the ball.

(2)

volume = ... cm^3

(b) The ball is dropped into deep water and sinks to a depth of 560 cm.

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

(1)

(ii) Calculate the increase in pressure at this depth.

[density of water = 1000 kg/m^3]

(2)

increase in pressure = ... Pa

(Total for Question 6 = 6 marks)

5 - (4PH1/1PR_Summer_2019_Q7) - *Forces And Motion*

A student investigates how the surface material of a ramp affects the average speed of a block sliding down the ramp.

(a) Design a suitable method for the student's investigation.

Your answer should include

- the measuring equipment needed
- details of the independent, dependent and control variables
- how the average speed will be determined

You may include a diagram to help your answer.

(6)

(b) Justify why the student should display their results as a bar chart.

(1)

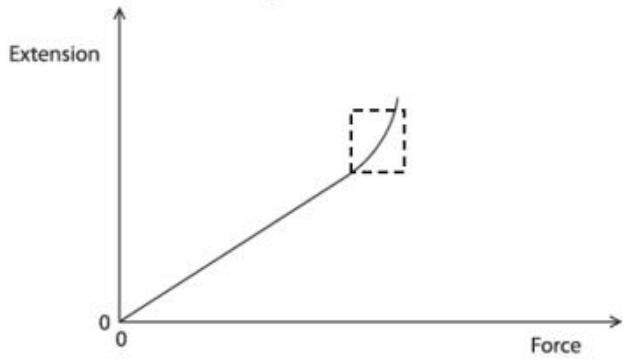
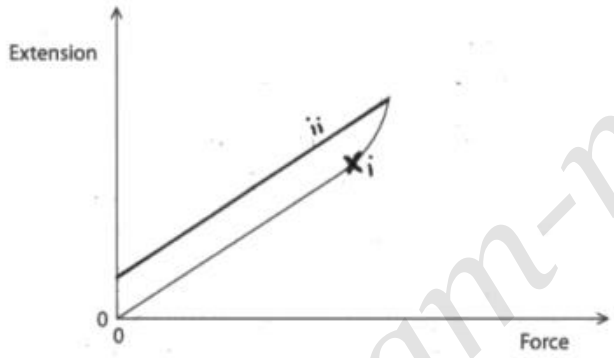
(Total for Question 7 = 7 marks)

ANSWERS

1 – (4PH1/1P_Summer_2019_Q4) – *Forces And Motion*

(a)	(i)	0.9 (s);		1
	(ii)	distance = area (under line);	allow ECF from incorrect time found in (a)(i) can be implied from calculation, explicit statement or working on graph itself	4
		thinking distance (rectangle) = 13.5 (m) OR braking distance (triangle) = 23.25 (m) correctly determined;		
		attempt at calculating area of a trapezium / adding values for areas of rectangle and triangle;		
		(stopping distance =) 37 (m);	allow 36.75, 36.7, 36.8	
	(iii)	acceleration formula seen in working;	can be implied from substitution of data	3
		correct substitution into acceleration formula; evaluation of acceleration;	allow ECF from incorrect time found in (a)(i) reject if given as a positive value	
		e.g. (acceleration =) change in velocity ÷ time	allow (a =) v-u ÷ t allow acceleration is gradient condone change in speed ÷ time	
		(acceleration =) (−)15 / 3.1 (acceleration =) −4.8 (m/s^2)	allow any answer that rounds to −4.8 allow deceleration = 4.8 (m/s^2)	
(b)		max. two factors linked to thinking distance: MP1. tiredness (of driver); MP2. age (of driver); MP3. alcohol or drug consumption; MP4. distraction (of driver);	allow 'reaction time' if no other thinking distance mark achieved ignore factors affecting visibility e.g. caffeine, medicine etc. e.g. using a mobile phone etc.	4
		max. two factors linked to braking distance: MP5. mass / weight of car; MP6. condition of brakes; MP7. condition of road; MP8. condition of tyres; MP9. slope of road;	ignore bald "the weather" allow however expressed e.g. more people, less luggage etc. e.g. icy road, wet road e.g. how much grip left / eq e.g. whether the car is going up or downhill	

2 – (4PH1/1P_Summer_2019_Q5) – *Forces And Motion*

(a)	(i)	cross drawn on line in region shown;  	cross cannot be drawn at the extreme upper end of the curved line	1
	(ii)	any line drawn above and starting at the end of the original that shows a reduction in extension as the force is decreased; line drawn is straight and returns to the extension axis above the origin;  	DOP judge straightness by eye	2
(b)	(i)	elastic (potential);		1
	(ii)	C (mechanically); A is incorrect because there is no electrical circuit B is incorrect because there is no temperature difference D is incorrect because transfers by radiation do not involve forces		1

3 – (4PH1/1P_Summer_2019_Q8) – *Forces And Motion*

(a)	(i)	downward force arrow labelled "weight"; upward force arrow labelled "drag" / "air resistance"; upward force larger than downward force by eye;	ignore starting position of arrows and any horizontal arrows allow "gravitational force", "gravitational pull", "force of gravity" reject "gravity" allow "friction" ignore "upthrust"	3
	(ii)	any four from: MP1. air resistance increases (greatly) when parachute is opened; MP2. idea that air resistance is greater than weight; MP3. (therefore) resultant force is upwards; MP4. idea that as speed decreases, air resistance decreases; MP5. resultant force (eventually) becomes zero; MP6. constant speed achieved;	allow "drag" for air resistance throughout condone "gravity" for weight throughout allow "upwards force" for air resistance allow upward force is bigger than downward force allow deceleration / upwards acceleration ignore "it slows down" allow forces are balanced/equal air resistance = weight allow idea that there is no acceleration	4

(b)	attempted use of $v^2 = u^2 + (2 \times a \times s)$;	accept answers in terms of GPE lost = KE gained, whatever candidate chooses for mass can be implied from calculation reject if contradicted by another irrelevant formula and no further working seen	4
	correct substitution; rearrangement of formula / evaluation of v^2; evaluation of v; e.g. $v^2 = u^2 + (2 \times a \times s)$; $v^2 = 0.45^2 + (2 \times 3.4 \times 2.0)$; $v = \sqrt{(0.45^2 + (2 \times 3.4 \times 2.0))}$ OR $v^2 = 13.8$ (v =) 3.7 (m/s)	allow if 13.8 seen allow 3.72, 3.715...	
(c)	any one from: MP1. Mars has a smaller mass; MP2. Mars has a lower density; MP3. Mars has a smaller (iron rich) core;	allow RA allow Mars is less massive	1

4 – (4PH1/1PR_Summer_2019_Q6) – *Forces And Motion*

(a)	(i)	density = mass / volume;	allow rearrangements and use of symbols e.g. $V = m / \rho$ or $D = M/V$	1
	(ii)	substitution OR rearrangement; evaluation; e.g. $V = m / \rho$ OR $2.3 = 19 / V$ (V =) 8.3 (cm^3)	 allow 8.26...	2
(b)	(i)	pressure difference = height x density x g;	allow use of standard symbols e.g. $p = h \times \rho \times g$ reject 'gravity'	1
	(ii)	substitution; evaluation; e.g. (p =) 5.6 x 1000 x 10 (p =) 56 000 (Pa)	accept use of g = 9.8(1) m/s^2 -1 if POT error in substitution Use of 9.8 gives 54 880 Use of 9.81 gives 54 936 Both round to 55 000	2

5 – (4PH1/1PR_Summer_2019_Q7) – *Forces And Motion*

(a)	**measuring equipment:** MP1. ruler / tape measure; MP2. stopclock / stopwatch; **variables:** MP3. surface material is the independent variable; MP4. (average) speed is the dependent variable; MP5. any one control variable from; • size / mass / material / area /weight of block • height/angle/gradient of ramp • initial force given to block • distance travelled down the ramp **determining average speed:** MP6. use of (average) speed = distance travelled / time	allow if clearly included in diagram condone 'timer' accept use of light gates if connected to timing device e.g. computer/datalogger accept 'camera' if subsequent method describes 'freeze-frame'/timestamp technique allow time as the dependent variable allow 'keep constant' for 'control variable' allow 'push' given to block allow initial speed or velocity allow same starting point and finishing point accept use of light gate if description includes length of card/block and time of transit	6
(b)	(bar chart because) surface material is a {categoric / discontinuous / non-continuous} variable;	condone surface material being a discrete variable	1