Roy White

CCEA GCSE

PHYSICS QUESTIONS

COLOURPOINT EDUCATIONAL

Print ISBN: 978 1 78073 190 2
eBook ISBN: 978 1 78073 314 2

First Edition
First Impression 2021

Layout and design: April Sky Design
Printed by: GPS Colour Graphics, Belfast

Colourpoint Educational
An imprint of Colourpoint Creative Ltd
Colourpoint House
Jubilee Business Park
21 Jubilee Road
Newtownards
County Down
Northern Ireland
BT23 4YH

Tel: 028 9182 0505
E-mail: sales@colourpoint.co.uk
Web site: www.colourpoint.co.uk

The Author

Roy White taught Physics to A level for over 30 years in Belfast. He works for an examining body as Chair of Examiners for Double Award Science, Chair of Examiners for A level Life and Health Sciences, Principal Examiner for GCSE Physics and Principal Moderator for Entry Level Science. In addition to this text, he has been the author or co-author of over a dozen successful books supporting the work of science teachers in Northern Ireland.

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Note: This book is designed to be used by both Double Award Physics candidates and GCSE Physics candidates. Questions that should ONLY be attempted by GCSE Physics candidates are indicated with grey shading, as shown here, or otherwise indicated in the text. These questions should NOT be attempted by Double Award Physics candidates.

Note: Candidates will be in one of two tiers – Foundation Tier or Higher Tier. Questions that should ONLY be attempted by Higher Tier candidates are indicated with the words "HT ONLY" in the margin, as shown here. Foundation Tier candidates should NOT attempt these questions.

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Unit 1

Motion, Force, Density and Kinetic Theory, Energy, and Atomic and Nuclear Physics

1.1 Motion

1. A pebble takes 3.0 seconds to fall 44.1 m from the top of a cliff on to the beach below. Calculate:

(a) the average speed of the pebble as it falls; [3]

(b) the speed of the pebble at the instant that it strikes the beach; [3]

(c) the rate at which the speed of the pebble was changing as it fell. [3]

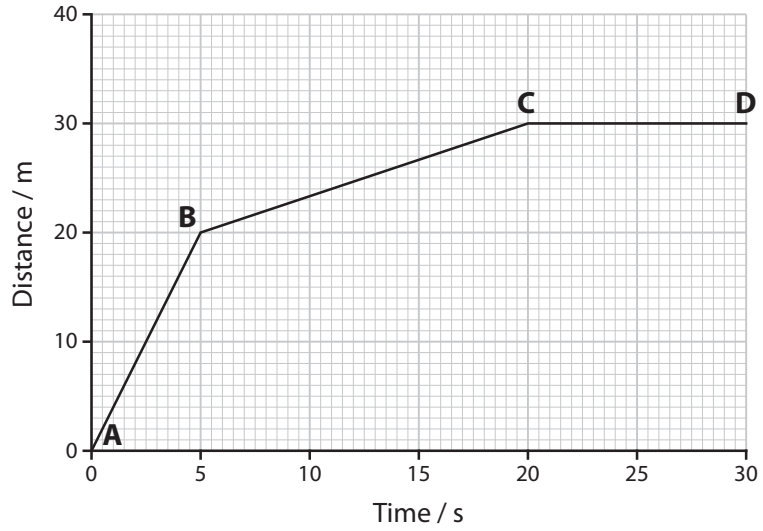
2. A marble accelerates uniformly from rest down a ramp of length 2.60 m with an average velocity of 13 cm/s. Calculate: HT ONLY

(a) the time taken by the marble to roll down the ramp; [3] HT ONLY

(b) the velocity of the marble at the end of the ramp; [3] HT ONLY

(c) the marble's acceleration, giving your answer in cm/s^2. [3] HT ONLY

3. The graph shows how the distance travelled by a pet rabbit changes over time.



Describe the motion of the rabbit for each region (AB, BC and CD) by using one of the following phrases:

at rest constant speed increasing speed

[3]

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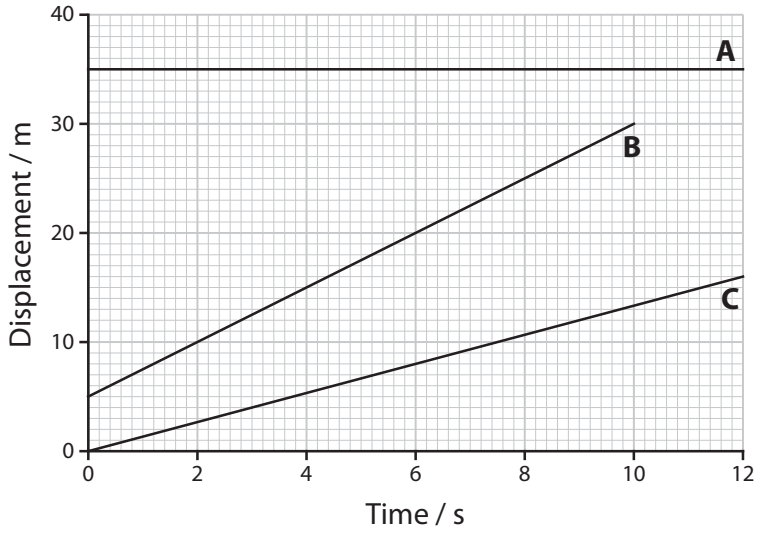
4. Below is the displacement-time graph of three dodgem cars at a fairground.

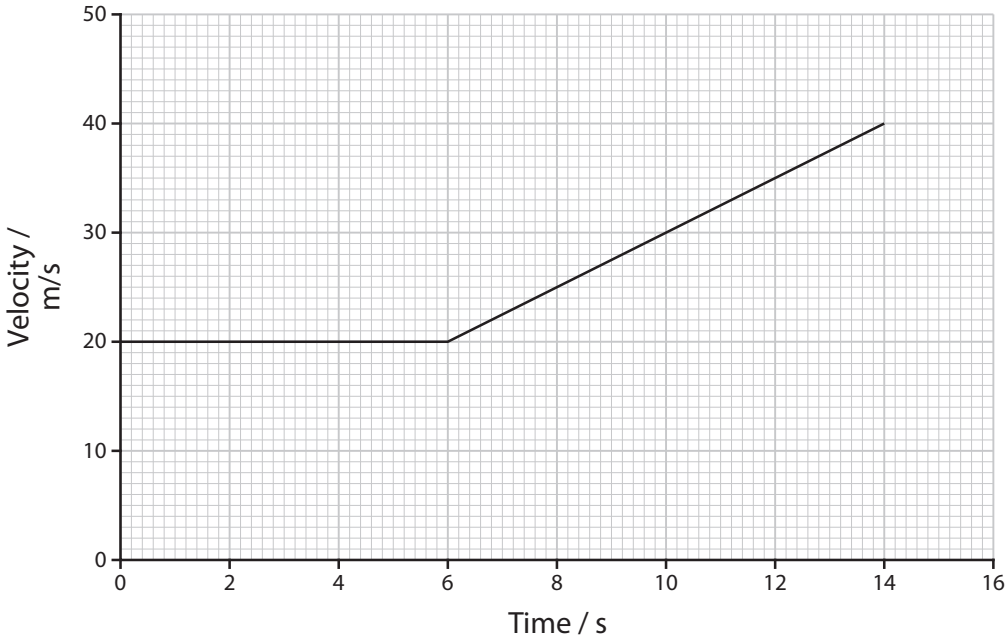


(a) Which car(s) was/were at rest at time $t = 0$? [1]

(b) Which car has a steady velocity of 2.5 m/s? [1]

(c) How far apart were cars **A** and **C** at time $t = 12$ s? [1]

5. Below is the velocity-time graph for a drone.



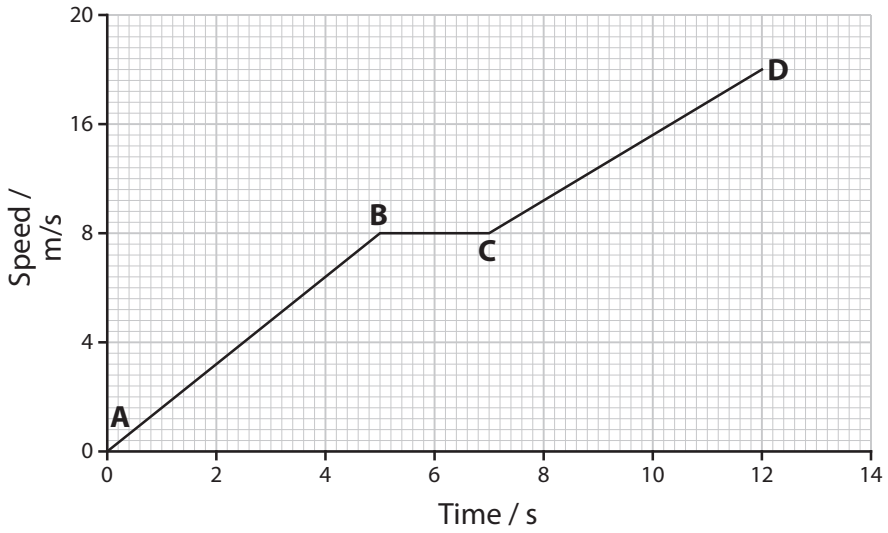
Calculate:

(a) the acceleration of the drone in the period between 6 and 14 seconds; [3]

(b) the total distance travelled by the drone in the 14 seconds of its motion; [4]

(c) the average speed of the drone in the 14 seconds of its motion, giving your answer to one decimal place. [3]

6. The graph below shows how the speed of a motor cyclist changes with time.



(a) In which period is the rate of change of speed least? [1]
(b) Calculate the rate of change of speed in the region **CD**. Give your answer to one decimal place. [3]
(c) How far did the motorcyclist travel in the first 5 seconds of the journey? [3]

7. A marble falls from rest at the top of a cliff and takes 2.8 seconds to reach the ground below.
(a) Write down the speed of the marble at the point when it hits the ground. [1]
(b) Calculate the average speed of the marble as it falls. [3]
(c) Calculate the height of the cliff. [3]

8. A father runs a 200 m race against his son. The boy runs down the racetrack at a steady speed. His father starts off 15 seconds after his son began to run, running down the same track at a higher constant speed. After a further 15 seconds, the father overtakes his son when they are both 120 m away from the starting line. The father finishes the race 10 seconds before his son.
(a) Calculate the speed of both the father and the son. [4]
(b) How far was the father in front of his son when he finished the race? [2]

9. A ball is thrown vertically upwards at 15 m/s. How long afterwards will it hit the ground? [4]

10. Two girls, 240 m apart, start running towards each other. One runs at 6 m/s and the other runs at 4 m/s.
(a) How long after the girls started running did they meet? [2]
(b) How much further had the faster girl run when the two of them met? [3]

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1.2 Force

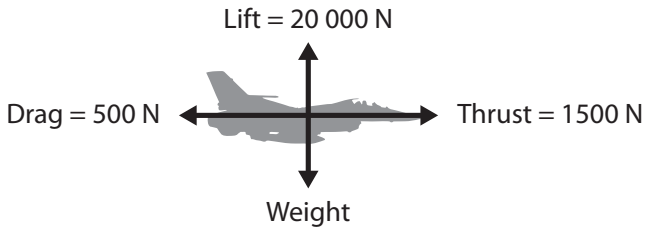
1. A lorry of mass 2800 kg accelerates at 2 m/s^2 along a motorway. If all the forces opposing motion add up to 700 N, calculate the forward force exerted by the lorry's engine. [4]

2. When a cyclist applies a forward force of 40 N on a straight, level road she moves at a steady speed. When she applies a forward force of 15 N, she decelerates at 0.5 m/s^2. Assuming that the force of friction has not changed, calculate the combined weight of the cyclist and her bicycle. [4]

3. One of the differences between mass and weight is that the former is measured in kg and the latter is measured in newtons. State two other differences. [2]

4. State Newton's First and Second Laws of Motion. [4]

5. A jet aircraft is flying at a constant height. Use the information shown in the diagram to calculate the aircraft's acceleration.



[5]

6. **(a)** State Hooke's Law in full. [2]

(b) A spring is clamped vertically. When a load of 6 N is attached to the spring, its total length is 18 cm. When the applied load is 10 N, the total length is 20 cm. Calculate:

(i) the natural (unextended) length of the spring, and [3]

(ii) the spring constant (Hooke's Law constant). [3]

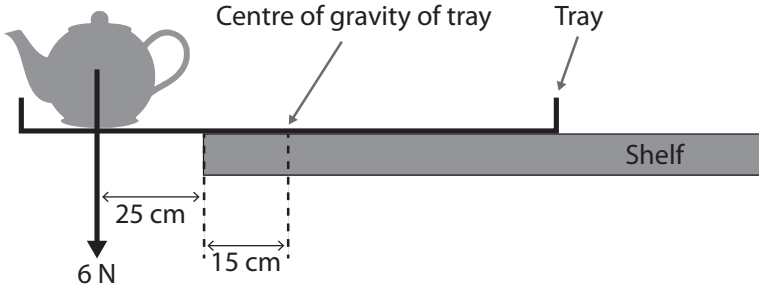
(c) A force of 12 N is now applied to the spring used in part (b).
What extension would you expect to observe? [1]

7. A concrete cube of side 0.8 m is used in building a bridge. When resting on the ground it exerts a pressure of 20 kPa. Calculate:

(a) the area in contact with the ground, and [1]

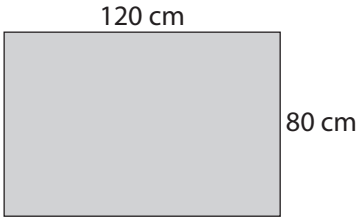
(b) the mass of the concrete cube. [4]

8. A tray overhangs a shelf, as shown in the diagram. The distance between the centre of gravity of the tray and the edge of the shelf is 15 cm. A teapot of weight 6 N rests with its centre of gravity 25 cm from the edge of the shelf.



(a) Explain what is meant by **centre of gravity**. [2]
(b) State, in full, the Principle of Moments. [3]
(c) Calculate the moment of the teapot about the pivot. [4]
(d) Use your answers to parts (b) and (c) to find the weight of the tray. [3]

9. A concrete slab weighing 50 N and measuring 120 cm × 80 cm rests on the ground. Calculate the smallest force needed to raise it on one of its edges.



[3]

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10. Describe how you would carry out an experiment using a suspended metre ruler and attached weights to verify the Principle of Moments. [6]

1.3 Density and Kinetic Theory

1. **(a)** Define what is meant by the word density. [1]
(b) Aluminium has a density of 2.7 g/cm^3. An aluminium block of mass 64.8 g is in the form of a cuboid of length 2 cm and breadth 3 cm. Find the height of the aluminium block. [5]

2. Describe how you would find the density of an unknown liquid. [6]

3. Use the results shown below to find the density of an irregularly shaped object.

Experimental Results
Mass of object = 60 g
Initial volume of water in measuring cylinder = 15 cm^3
Volume in cylinder when object completely immersed = 45 cm^3 [3]

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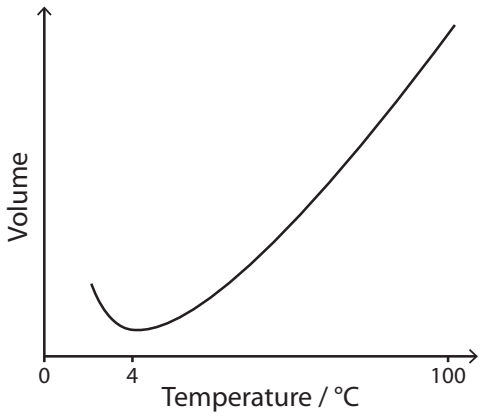
4. The sketch graph drawn below (not to scale) shows how the volume of a fixed mass of **liquid** water changes as the temperature rises from about 3°C to about 100°C.



(a) Sketch a graph to show how the density of the water changes over the same range of temperatures. [1]
(b) Outside water pipes often burst in winter if they are not suitably lagged. Use the graph above to explain why this is so. [1]
(c) Explain why lagging the pipes makes it less likely that the pipes will burst. [2]

5. **(a)** Describe **(i)** the motion of the molecules and **(ii)** the forces between the molecules in solids, liquids and gases. [7]
(b) Describe and explain why the density of solids, liquids and gases are different. [5]

6. A student places an empty measuring cylinder on a top-pan balance. He then pours different amounts of an unknown liquid into the cylinder, recording the total volume and the balance reading each time he does so.
The results are shown in the table below.

Volume of liquid / cm^3	20	30	40	50	60
Balance reading / g	39	46	53	60	67

(a) Using graph paper, plot a graph of Balance reading / g (vertical axis) against Volume of liquid / cm^3 (horizontal axis), and draw the line of best fit with a ruler. [5]
(b) Determine the gradient of the graph, give its unit and state its physical significance. [4]
(c) State the value of the intercept on the vertical axis, give its unit and state its physical significance. [2]

7. According to legend, almost 2500 years ago, King Hiero of Syracuse asked a goldsmith to make him a crown of pure gold. After the crown had been made and paid for, rumours circulated that the goldsmith had made the crown from a mixture of gold and silver. The king asked his cousin, Archimedes, to find out if the crown was made of pure gold or not, without causing any damage to it.

Imagine you are Archimedes. You have the crown and samples of pure gold and pure silver. What would you do?

Hint: You might find it useful to look again at your answer to Question 3. [8]

8. When bridges are being built engineers regularly take samples of the concrete being used and test them to see if the concrete is suitable for the purpose. A particular project requires the concrete to have a density between 2350 and 2400 kg/m^3. An engineer tests a sample of the concrete in the form of a cube of length 15 cm and finds its mass to be exactly 8000 grams. Is the concrete suitable for this project? Justify your answer. [7]

9. A technician has a large quantity of brine (salt water) of density 1.08 g/cm^3. The technician is asked to prepare a sample of brine of density 1.04 g/cm^3.
The technician knows that pure water has a density of 1.00 g/cm^3. Calculate:
(a) the mass of 1000 cm^3 of pure water; [1]
(b) the mass of 1000 cm^3 of brine of density 1.04 g/cm^3; [1]
(c) the mass of salt in 1000 cm^3 of brine of density 1.04 g/cm^3. [1]

The technician measures out 500 cm^3 of brine of density 1.08 g/cm^3. Calculate:
(d) the mass of salt in this 500 cm^3 sample of brine of density 1.08 g/cm^3. [3]
(e) the volume of water that the technician must add to this sample to dilute it to a density of 1.04 g/cm^3. *Hint: Look back at your answers to parts (c) and (d).* [2]

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10. The density of pure gold is 19.3 g/cm^3. A jeweller mixes together 150.0 g of pure gold with 5.60 cm^3 of pure copper in order to make 200.0 g of 18 carat gold from which jewellery products can be made.

(a) Show that the volume of 150 g of pure gold is 7.77 cm^3. [3]

(b) Show that the total volume of the mixture of pure gold and copper made by the jeweller is 13.37 cm^3. [2]

(c) Use your answer to part (b) and the information given above to calculate the density of the 18 carat gold, giving your answer to 1 decimal place. [3]