Surname	Centre Number	Candidate Number
First name(s)		2

GCE AS

B420U10-1

S25-B420U10-1

WEDNESDAY, 14 MAY 2025 – MORNING

PHYSICS – AS component 1
Motion, Energy and Matter

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**8**	
3.	**11**	
4.	**14**	
5.	**13**	
6.	**11**	
7.	**9**	
Total	**75**	

B420U101
01

ADDITIONAL MATERIALS

In addition to this paper, you will require a calculator and a **Data Booklet**.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The total number of marks available for this paper is 75.

The number of marks is given in brackets at the end of each question or part-question.

You are reminded to show all working. Credit is given for correct working even when the final answer is incorrect.

The assessment of the quality of extended response (QER) will take place in **4**(a).

© WJEC CBAC Ltd.

Examiner only

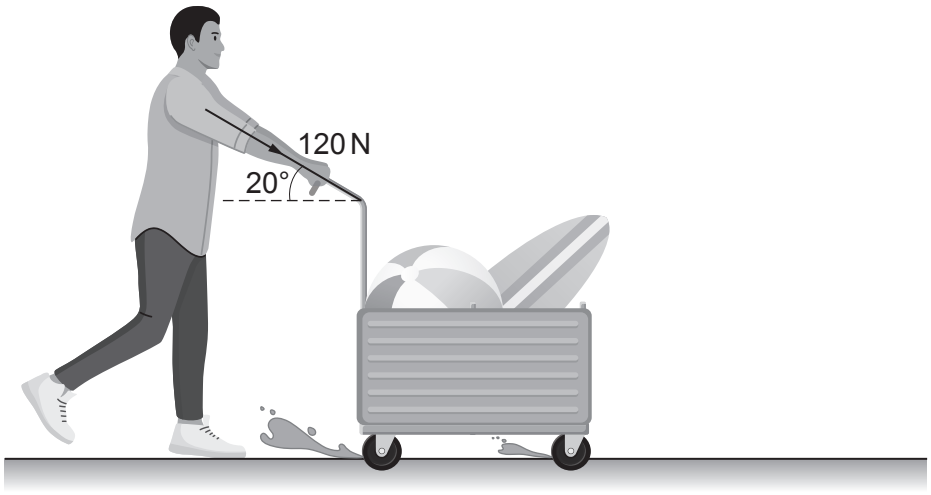
Answer **all** questions.

1. (a) State the difference between a vector and a scalar quantity. [1]

.....

.....

(b) Simon pushes a fully loaded beach trolley at a constant velocity across a beach. He applies a force of 120 N at an angle of 20º to the horizontal, as shown. The trolley and its load have a combined mass of 65 N.



(i) Simon states that, because the trolley is going at a constant speed, the resistive force on the trolley must be about 110 N. **Evaluate, using a calculation**, whether Simon is correct. [2]

.....

.....

.....

© WJEC CBAC Ltd.

Examiner only

(ii) Calculate the overall downward force that the trolley makes on the sand. [3]

.....

.....

.....

.....

.....

(iii) Explain whether it would require a larger or a smaller force to pull the trolley at the same angle to the horizontal, than to push it.
Hint: consider the extent to which the trolley's wheels sink into the sand. [3]

.....

.....

.....

.....

.....

9

© WJEC CBAC Ltd.

Turn over.

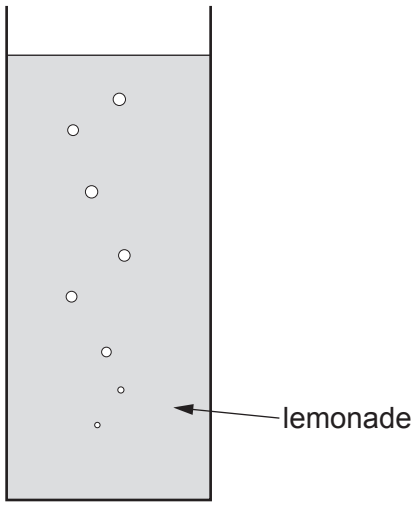
Examiner only

2. (a) State what is meant by the centre of gravity of an object. [1]

.....

.....

(b) Robyn orders a glass of lemonade in a cafe.



(i) **Clearly show and label the position** of the centre of gravity for the glass of lemonade. **Show with an arrow** the weight of the glass of lemonade. [2]

(ii) Robyn accidently knocks the glass of lemonade over. Her friend Mali claims that the glass would have been more stable if it had been half empty rather than full of lemonade. Evaluate this claim. [2]

.....

.....

.....

© WJEC CBAC Ltd.

Examiner only

(iii) The cafe owner notices the accident and decides to order some new, more stable glasses. State what features the glasses should have **and** explain how they increase the stability. [3]

.....

.....

.....

.....

.....

8

© WJEC CBAC Ltd.

Examiner only

3. Vihaan is riding an electric scooter up the high street in his local town at a speed of $4.5\,m\,s^{-1}$. At point **A** he starts to accelerate uniformly reaching a speed of $9.2\,m\,s^{-1}$ at **B**, which is 4.0 m higher than **A**.

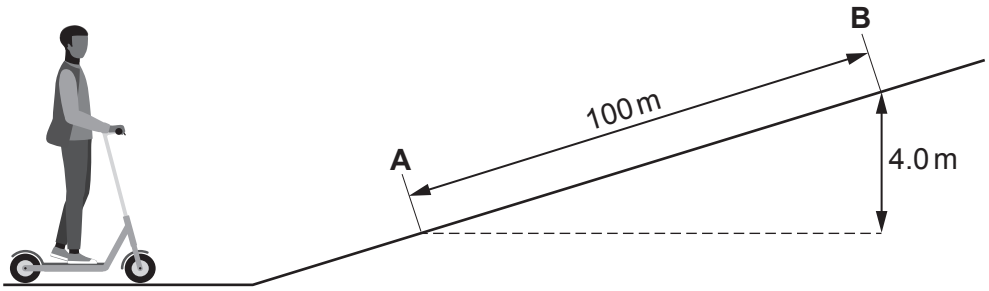


Diagram not drawn to scale

(a) Show that the time taken for Vihaan's journey between **A** and **B** is approximately 15 s. [2]

.....

.....

.....

(b) Vihaan and the scooter have a combined mass of 55 kg. Determine the **increase** in the sum of the kinetic and potential energy between **A** and **B**. [3]

.....

.....

.....

.....

.....

© WJEC CBAC Ltd.

Examiner only

(c) The scooter's electric motor operates at 24 V and 6.0 A. Vihaan also provides 3500 J of work between **A** and **B**.

(i) Calculate the electrical energy transferred by the motor between **A** and **B**. [2]

.....

.....

.....

(ii) Determine the efficiency of the **total** energy transfer. [2]

.....

.....

.....

(iii) Resistive forces will affect the motion of the scooter. Identify these forces **and** where they act. [2]

.....

.....

.....

B420U101
07

11

© WJEC CBAC Ltd.

Examiner only

4. (a) Glass is an example of an amorphous, brittle material. Explain what is meant by an amorphous, brittle material **and** how glass fractures under tension. Give your answer at both a molecular and macroscopic level. [6 QER]

(b) A glass fibre of breaking stress 8.11×10^6 Pa just breaks when a mass of 2.6 kg is suspended from it. Determine the diameter of the fibre. [4]

© WJEC CBAC Ltd.

Examiner only

(c) The Young modulus, E, of a material can be given by the equation:

$$E = \frac{Fl}{xA}$$

where F = force, l = length, x = extension and A = cross-sectional area.

Use this equation to express the units of E in terms of the base units kg, m and s. Clearly show your workings. [4]

.....

.....

.....

.....

.....

.....

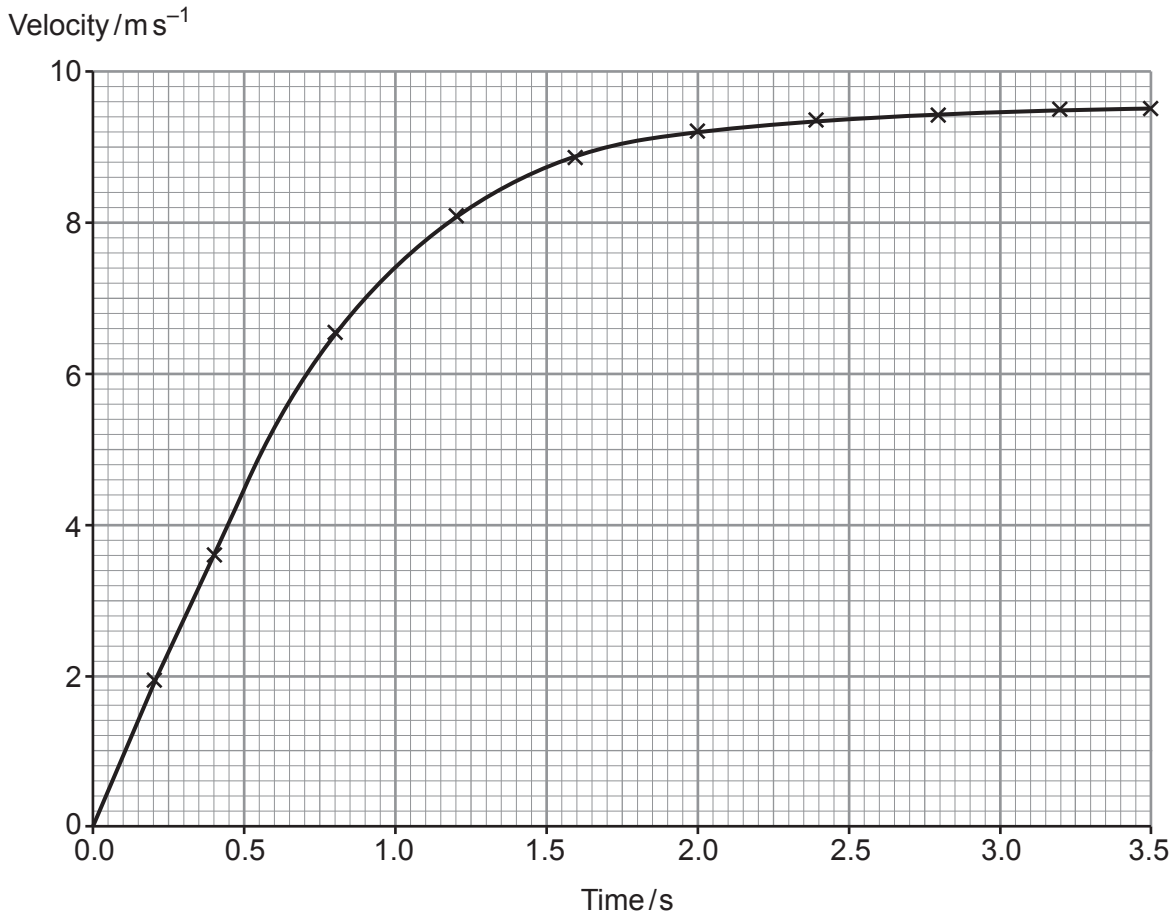
.....

14

© WJEC CBAC Ltd.

Examiner only

5. Gethin drops a table tennis ball from rest. The graph below shows how the ball's velocity changes with time.



(a) Assuming that the graph is straight for the first 0.5 s, calculate the displacement during this time. [2]

.....

.....

.....

© WJEC CBAC Ltd.

Examiner only

(b) (i) By drawing a tangent, determine the acceleration of the ball at 1.0 s. [3]

.....

.....

.....

.....

.....

(ii) The mass of the ball is 2.7 g. Calculate the resultant force acting on the ball at 1.0 s. [2]

.....

.....

.....

(iii) Determine the force of air resistance acting on the ball at 1.0 s. [3]

.....

.....

.....

.....

.....

(c) The ball eventually reaches terminal velocity.

(i) State the terminal velocity of the ball. [1]

.....

.....

(ii) Explain, in terms of forces, why the ball eventually reaches terminal velocity. [2]

.....

.....

.....

13

© WJEC CBAC Ltd.

Examiner only

6. (a) The table shows some information about first generation subatomic particles.

Particle	Symbol	Quark combination	Charge / e	Baryon number	Lepton number
delta	Δ^{++}	uuu			
neutron	n				
	e^{+}	none			
proton	p				
neutral pion		$d\bar{d}$ or $u\bar{u}$			
	ν_e				

Complete the table. [6]

(b) (i) The following reaction shows the decay of a neutron, n. Identify particle X, giving your reasoning in terms of conservation laws. [3]

$$n \longrightarrow p + e^{-} + X$$

.....

.....

.....

.....

.....

(ii) Determine which force is responsible for this decay. Explain your answer. [2]

.....

.....

.....

11

© WJEC CBAC Ltd.

Examiner only

7. The star Betelgeuse can be considered to be a black body.

(a) Explain what is meant by a black body. [1]

.....

.....

(b) (i) The maximum intensity of Betelgeuse occurs at a wavelength of 700 nm. Justify whether this is consistent with Betelgeuse being described as a red star. [1]

.....

.....

(ii) Determine the surface temperature of Betelgeuse. [2]

.....

.....

.....

(iii) The power emitted by Betelgeuse is 4.0×10^{30} W. Determine its diameter. [3]

.....

.....

.....

.....

.....

(c) The James Webb Space Telescope was launched in 2022 at a cost of 10 billion dollars, funded by the U.S.A., Canada and Europe. Explain whether you feel this is a good use of resources. [2]

.....

.....

.....

9

END OF PAPER

© WJEC CBAC Ltd.

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

Examiner only

© WJEC CBAC Ltd.

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

© WJEC CBAC Ltd.

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

© WJEC CBAC Ltd.