

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

AS MATHEMATICS

Unit Mechanics 1B

Tuesday 19 June 2018

Afternoon

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- the blue AQA booklet of formulae and statistical tables.
- You may use a graphics calculator.

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- Do not write outside the box around each page.
- Show all necessary working, otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- The **final** answer to questions requiring the use of calculators should be given to three significant figures, unless stated otherwise.
- Take $g = 9.8 \text{ m s}^{-2}$, unless stated otherwise.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	



Answer **all** questions.

Answer each question in the space provided for that question.

1 Three forces, $\mathbf{F}_1 = (3\mathbf{i} - 7\mathbf{j})\text{N}$, $\mathbf{F}_2 = (-6\mathbf{i} + 14\mathbf{j})\text{N}$ and $\mathbf{F}_3 = (\mathbf{i} - \mathbf{j})\text{N}$ act on a particle of mass 4 kg. No other forces act on the particle.

(a) Find the resultant of the three forces.

[2 marks]

(b) Find the magnitude of the acceleration of the particle.

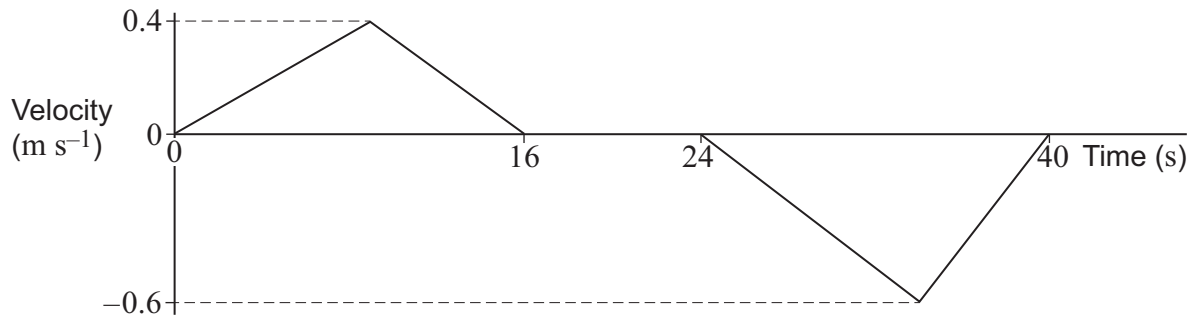
[3 marks]

QUESTION
PART
REFERENCE

Answer space for question 1



2 The graph below shows how the velocity of a lift varies during a 40 second period.



- (a) Find the distance travelled by the lift in the first 16 seconds of the motion. **[2 marks]**
- (b) Find the total distance travelled by the lift in the 40 second period. **[3 marks]**
- (c) Find the average velocity of the lift during the 40 second period. **[3 marks]**

QUESTION
PART
REFERENCE

Answer space for question 2



3 Two particles, A and B , are moving on a smooth horizontal surface when they collide. During the collision, the particles coalesce to form a single particle. Particle A has mass 2 kg and particle B has mass $m\text{ kg}$. Immediately before the collision, their velocities are $(4\mathbf{i} + 2\mathbf{j})\text{ m s}^{-1}$ and $(3\mathbf{i} + U\mathbf{j})\text{ m s}^{-1}$ respectively, where U is a constant. Immediately after the collision, the combined particle moves with velocity $(3.4\mathbf{i} + 2\mathbf{j})\text{ m s}^{-1}$.

(a) Find m .

[3 marks]

(b) Find U .

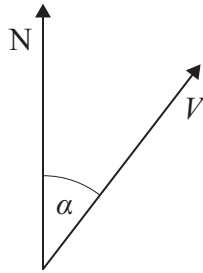
[3 marks]

QUESTION
PART
REFERENCE

Answer space for question 3



- 4 Relative to the air, an aeroplane flies with velocity V on a bearing α , as shown in the diagram.



The air is moving due east at 20 m s^{-1} . The aeroplane travels at 120 m s^{-1} on a bearing of 040° .

- (a) Find V . [3 marks]

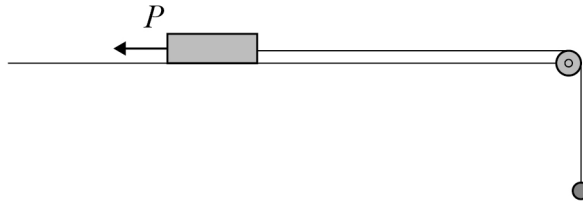
- (b) Find α , giving your answer to the nearest degree. [4 marks]

QUESTION
PART
REFERENCE

Answer space for question 4



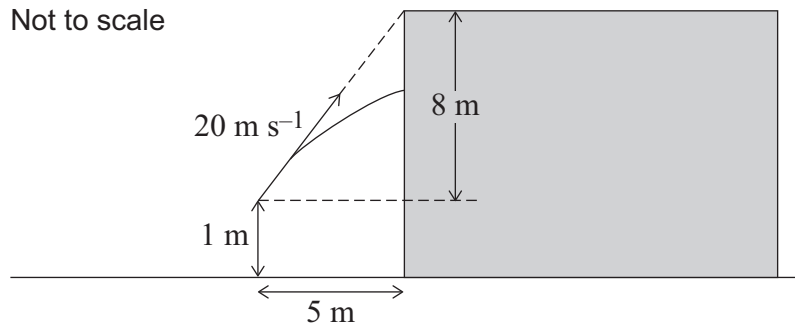
- 5** A block, of mass 4 kg, is on a smooth horizontal surface. It is attached to a light inextensible string that passes over a smooth peg. A particle of mass 6 kg is attached to the other end of the string. The section of the string between the peg and the particle is vertical. A horizontal force of magnitude P newtons acts on the block, as shown in the diagram.



- (a) P is such that the system remains at rest. By forming two equations, find P . **[3 marks]**
- (b) P is changed so that the block accelerates away from the peg at 0.6 m s^{-2} . By forming two equations of motion, find P . **[4 marks]**
- (c) When the block is moving away from the peg at 2 m s^{-1} , the force of magnitude P newtons is removed. Find the distance that the block travels as its speed reduces from 2 m s^{-1} to 0 m s^{-1} . **[6 marks]**
- (d) Explain fully how your answer to part (c) would change if the effects of air resistance were included. **[2 marks]**

QUESTION
PART
REFERENCE**Answer space for question 5**

- 6** A fire fighter points the nozzle of a hose at the top of a building. The water leaves the hose with a velocity of 20 m s^{-1} directed towards the top of the vertical wall of the building. The building has a height of 9 metres and the nozzle is a horizontal distance of 5 metres from the vertical wall of the building. Assume that the nozzle is 1 metre above ground level.



Consider one particle of water that leaves the nozzle of the hose and assume that the only force acting on this particle is its weight.

- (a) Find the time that it takes for the particle of water to travel from the nozzle to the building. **[4 marks]**
- (b) Find the height of the particle of water, above the ground, when it hits the wall of the building. **[3 marks]**
- (c) Find the speed of the particle of water just before it hits the wall of the building. **[5 marks]**

QUESTION
PART
REFERENCE

Answer space for question 6



QUESTION
PART
REFERENCE**Answer space for question 7****Turn over ▶**

8 Two particles, A and B , move on a horizontal surface with constant accelerations of $(8\mathbf{i} + 4\mathbf{j}) \text{ m s}^{-2}$ and $(6\mathbf{i} + 10\mathbf{j}) \text{ m s}^{-2}$ respectively. The unit vectors \mathbf{i} and \mathbf{j} are perpendicular.

At time $t = 0$, A has position $(7\mathbf{i} + 8\mathbf{j}) \text{ m}$ and velocity $(4\mathbf{i} + 3\mathbf{j}) \text{ m s}^{-1}$.

At time $t = 0$, B has position $(70\mathbf{i} + k\mathbf{j}) \text{ m}$ and velocity $(2\mathbf{i} - 1\mathbf{j}) \text{ m s}^{-1}$, where k is a constant.

The particles collide.

(a) Find the time when the particles collide.

[5 marks]

(b) Find k .

[3 marks]

QUESTION
PART
REFERENCE

Answer space for question 8



There are no questions printed on this page

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