Pearson Edexcel International Advanced Level

Monday 13 October 2025

Afternoon (Time: 1 hour 30 minutes)

Paper reference **WME01/01A**

Mathematics

International Advanced Subsidiary/Advanced Level
Mechanics M1
Question Paper

You must have: Answer book (sent separately)

Do not return this question paper with the answer book.

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1. Two particles P and Q are moving in opposite directions along the same horizontal straight line.
Particle P is moving due east and particle Q is moving due west.
Particle P has mass $2m$ and particle Q has mass $3m$.
The particles collide directly.
Immediately before the collision, the speed of P is $4u$ and the speed of Q is u.
The magnitude of the impulse in the collision is $\frac{33}{5}mu$.

(a) Find the speed and direction of motion of P immediately after the collision.

(3)

(b) Find the speed and direction of motion of Q immediately after the collision.

(3)

(Total for Question 1 is 6 marks)

2.

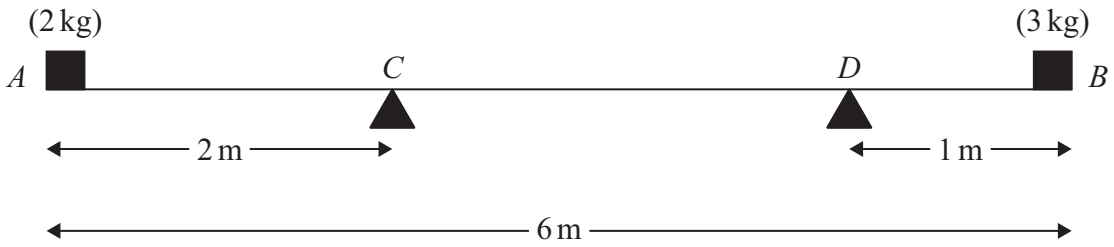


Figure 1

A plank AB, of length 6 m and mass 4 kg, rests in equilibrium horizontally on two supports at C and D, where $AC = 2$ m and $DB = 1$ m.

A brick of mass 2 kg rests on the plank at A and a brick of mass 3 kg rests on the plank at B, as shown in Figure 1.

The plank is modelled as a uniform rod and all bricks are modelled as particles.

(a) Find the magnitude of the reaction exerted on the plank

(i) by the support at C,

(ii) by the support at D.

(6)

The 3 kg brick is now removed and replaced with a brick of mass x kg at B.

The plank remains horizontal and in equilibrium but the reactions on the plank at C and at D now have equal magnitude.

(b) Find the value of x.

(4)

(Total for Question 2 is 10 marks)

3. Two forces, $\mathbf{F}_1$ and $\mathbf{F}_2$, act on a particle A.

$\mathbf{F}_1 = (2\mathbf{i} - 3\mathbf{j})$ N and $\mathbf{F}_2 = (p\mathbf{i} + q\mathbf{j})$ N, where p and q are constants.

Given that the resultant of $\mathbf{F}_1$ and $\mathbf{F}_2$ is parallel to $(\mathbf{i} + 2\mathbf{j})$,

(a) show that $2p - q + 7 = 0$

(5)

Given that $q = 11$ and that the mass of A is 2 kg, and that $\mathbf{F}_1$ and $\mathbf{F}_2$ are the only forces acting on A,

(b) find the magnitude of the acceleration of A.

(5)

(Total for Question 3 is 10 marks)

4. A block A of mass 9 kg is released from rest from a point P which is a height h metres above horizontal soft ground.

The block falls and strikes another block B of mass 1.5 kg which is on the ground vertically below P.

The speed of A immediately before it strikes B is $7\,\text{m}\,\text{s}^{-1}$.

The blocks are modelled as particles.

(a) Find the value of h.

(2)

Immediately after the impact the blocks move downwards together with the same speed and both come to rest after sinking a vertical distance of 12 cm into the ground.

Assuming that the resistance offered by the ground has constant magnitude R newtons,

(b) find the value of R.

(7)

(Total for Question 4 is 9 marks)

5.

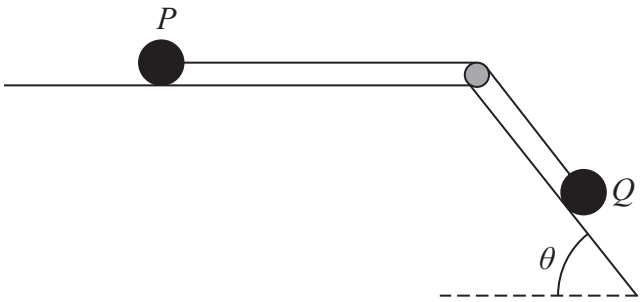


Figure 2

Two particles P and Q have masses 0.1 kg and 0.5 kg respectively.

The particles are attached to the ends of a light inextensible string.

Particle P is held at rest on a rough horizontal table.

The string lies along the table and passes over a small smooth pulley which is fixed to the edge of the table.

Particle Q is at rest on a smooth plane which is inclined to the horizontal at an angle θ, where $\tan\theta = \frac{4}{3}$

The string lies in the vertical plane which contains the pulley and a line of greatest slope of the inclined plane, as shown in Figure 2.

Particle P is released from rest with the string taut.

During the first 0.5 s of the motion P does not reach the pulley and Q moves 0.75 m down the plane.

(a) Find the tension in the string during the first 0.5 s of the motion.

(6)

(b) Find the coefficient of friction between P and the table.

(5)

(Total for Question 5 is 11 marks)

6.



Figure 3

A washing line $ABCD$ is fixed at the points A and D.

There are two heavy items of clothing hanging on the washing line, one fixed at B and the other fixed at C.

The washing line is modelled as a light inextensible string, the item at B is modelled as a particle of mass 3 kg and the item at C is modelled as a particle of mass M kg.

The section AB makes an angle α with the horizontal, where $\tan \alpha = \frac{3}{4}$, the section BC is horizontal and the section CD makes an angle β with the horizontal, where $\tan \beta = \frac{12}{5}$, as shown in Figure 3.

The system is in equilibrium.

(a) Find the tension in AB.

(4)

(b) Find the tension in BC.

(3)

(c) Find the value of M.

(5)

(Total for Question 6 is 12 marks)

7. Two trains, A and B, start together from rest, at time $t = 0$, at a station and move along parallel straight horizontal tracks.

Both trains come to rest at the next station after 180 s.

Train A moves with constant acceleration $\frac{2}{3}$ m s^{-2} for 30 s, then moves at constant speed for 120 s and then moves with constant deceleration for the final 30 s.

Train B moves with constant acceleration for 90 s and then moves with constant deceleration for the final 90 s.

(a) Sketch, on the same axes, the speed–time graphs for the motion of the two trains between the two stations.

(3)

(b) Find the acceleration of train B for the first half of its journey.

(5)

(c) Find the times when the two trains are moving at the same speed.

(4)

(d) Find the distance between the trains 96 s after they start.

(5)

(Total for Question 7 is 17 marks)

TOTAL FOR PAPER IS 75 MARKS

Please check the examination details below before entering your candidate information

Candidate surname StemUp Model Solution | Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Monday 13 October 2025

Afternoon (Time: 1 hour 30 minutes) | Paper reference **WME01/01A**

Mathematics

International Advanced Subsidiary/Advanced Level
Mechanics M1
Answer Book

You must have: Question paper (sent separately)
Mathematical Formulae and Statistical Tables (Yellow), calculator

Total Marks

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Whenever a numerical value of g is required, take $g = 9.8$ m s^{-2}, and give your answer to either 2 significant figures or 3 significant figures.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 7 questions in this question paper. The total mark for this paper is 75.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

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Question 1

Write the answer to Question 1 on these 2 pages

Take east as the positive direction.

Impulse on P acts west (towards the west), impulse on Q acts east.

(a) Impulse-momentum for P:

$$-\frac{33}{5}mu = 2m(v_P - 4u)$$

$$2v_P = 8u - \frac{33}{5}u = \frac{7}{5}u$$

$$v_P = 0.7u$$

Speed of P = 0.7u, direction due east (unchanged)

(b) Impulse-momentum for Q (velocity before = $-u$):

$$\frac{33}{5}mu = 3m(v_Q - (-u))$$

$$3v_Q + 3u = \frac{33}{5}u$$

$$3v_Q = \frac{18}{5}u$$

$$v_Q = 1.2u$$

Speed of Q = 1.2u, direction due east (reversed)

(Check, CLM: $2m(4u) + 3m(-u) = 5mu = 2m(0.7u) + 3m(1.2u)$ ✓)

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Question 1 continued

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(Total for Question 1 is 6 marks)

Question 2

Write the answer to Question 2 on these 4 pages

Plank weight 4g acts at the midpoint G, AG = 3 m, so CG = 1 m,

GD = 2 m, DB = 1 m. Let the reactions be R_C and R_D.

(a)(i) M(D): $3R_C + (1 \times 3g) = (2 \times 4g) + (5 \times 2g)$

$3R_C = 8g + 10g - 3g = 15g$

$R_C = 5g$

$R_C = 49$ N

(ii) Resolving vertically: $R_C + R_D = 4g + 2g + 3g = 9g$

$R_D = 9g - 5g = 4g$

$R_D = 39.2$ N

(b) Now $R_C = R_D = R$.

M(C): $3R + (2 \times 2g) = (1 \times 4g) + (4 \times xg)$

$3R = 4xg$

Resolving vertically: $2R = 2g + 4g + xg = (6 + x)g$

$$R = \frac{(6 + x)g}{2}$$

$$3 \times \frac{(6 + x)g}{2} = 4xg$$

$18 + 3x = 8x$

$5x = 18$

$x = 3.6$

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Question 2 continued

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(Total for Question 2 is 10 marks)

Question 3

Write the answer to Question 3 on these 2 pages

(a) $R = F_1 + F_2 = (2i - 3j) + (pi + qj) = (p + 2)i + (q - 3)j$

R is parallel to $(i + 2j)$, so

$$\frac{p + 2}{q - 3} = \frac{1}{2}$$

$2(p + 2) = q - 3$

$2p + 4 = q - 3$

$2p - q + 7 = 0$ as required

(b) $q = 11$: $2p - 11 + 7 = 0 \Rightarrow p = 2$

$R = (2 + 2)i + (11 - 3)j = (4i + 8j)$ N

N2L: $R = ma \Rightarrow 4i + 8j = 2a$

$a = (2i + 4j)$ m s^{-2}

$|a| = \sqrt{(2^2 + 4^2)} = \sqrt{20} = 4.4721...$

Magnitude of acceleration = 4.47 m s^{-2}

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Question 3 continued

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Question 4

Write the answer to Question 4 on these 4 pages

(a) A falls from rest: $v^2 = u^2 + 2as$

$7^2 = 0^2 + 2 \times 9.8 \times h$

$49 = 19.6h$

$h = 2.5$

(b) CLM for the impact (downwards positive, common speed v):

$9 \times 7 + 1.5 \times 0 = (9 + 1.5)v$

$63 = 10.5v \Rightarrow v = 6 \text{ m s}^{-1}$

Sinking 12 cm = 0.12 m and coming to rest: $v^2 = u^2 + 2as$

$0^2 = 6^2 + 2a(0.12)$

$0.24a = -36 \Rightarrow a = -150 \text{ m s}^{-2}$

N2L for the combined blocks (downwards positive):

$10.5g - R = 10.5 \times (-150)$

$R = 102.9 + 1575 = 1677.9$

$R = 1680$ (3 s.f.)

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Question 4 continued

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(Total for Question 4 is 9 marks)

Question 5

Write the answer to Question 5 on these 4 pages

$\tan\theta = \frac{4}{3} \Rightarrow \sin\theta = \frac{4}{5}, \quad \cos\theta = \frac{3}{5}$

(a) Q from rest: $s = ut + \frac{1}{2}at^2$

$0.75 = 0 + \frac{1}{2}a(0.5)^2$

$0.75 = 0.125a \Rightarrow a = 6 \text{ m s}^{-2}$

N2L for Q (down the plane): $0.5g\sin\theta - T = 0.5a$

$0.5 \times 9.8 \times \frac{4}{5} - T = 0.5 \times 6$

$3.92 - T = 3$

$T = 0.92 \text{ N}$

(b) P: resolving vertically, $R = 0.1g = 0.98 \text{ N}$

N2L for P (towards the pulley): $T - F = 0.1a$

$0.92 - F = 0.1 \times 6 = 0.6$

$F = 0.32 \text{ N}$

P is sliding, so friction is limiting: $F = \mu R$

$0.32 = \mu \times 0.98$

$\mu = \frac{0.32}{0.98} = 0.32653...$

$\mu = 0.327$ (3 s.f.)

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Question 5 continued

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(Total for Question 5 is 11 marks)

Question 6

Write the answer to Question 6 on these 4 pages

$\tan\alpha = \frac{3}{4} \Rightarrow \sin\alpha = \frac{3}{5}$, $\cos\alpha = \frac{4}{5}$; $\tan\beta = \frac{12}{5} \Rightarrow \sin\beta = \frac{12}{13}$, $\cos\beta = \frac{5}{13}$

(a) Resolving vertically at B:

$T_{AB}\sin\alpha = 3g$

$\frac{3}{5}T_{AB} = 3g$

$T_{AB} = 5g = 49\ N$

(b) Resolving horizontally at B:

$T_{BC} = T_{AB}\cos\alpha$

$T_{BC} = 49 \times \frac{4}{5} = 4g$

$T_{BC} = 39.2\ N$

(c) Resolving horizontally at C:

$T_{CD}\cos\beta = T_{BC}$

$\frac{5}{13}T_{CD} = 39.2 \Rightarrow T_{CD} = 101.92\ N$

Resolving vertically at C:

$T_{CD}\sin\beta = Mg$

$101.92 \times \frac{12}{13} = 9.8M$

$94.08 = 9.8M$

$M = 9.6$

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Question 6 continued

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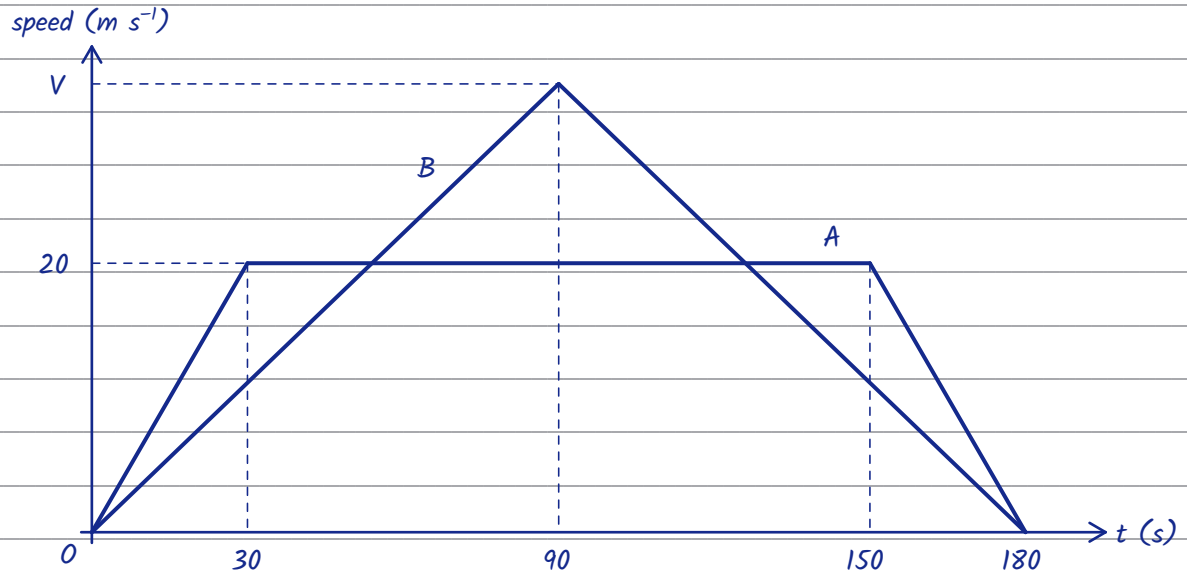
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(Total for Question 6 is 12 marks)

Question 7

Write the answer to Question 7 on these 3 pages

(a)



(b) Distance between stations = area under the graph for A

Top speed of A $= \frac{2}{3} \times 30 = 20$ m s^{-1}

Distance $= \frac{1}{2}(180 + 120) \times 20 = 3000$ m

Train B (top speed V at t = 90):

$\frac{1}{2} \times 180 \times V = 3000 \Rightarrow V = \frac{100}{3}$

Acceleration of B $= \frac{V}{90} = \frac{100}{270} = \frac{10}{27}$ m s^{-2} $(= 0.370...)$

$a = \frac{10}{27}$ m s^{-2}

(c) Same speed when B has speed 20 (A is at constant speed 20):

B accelerating: $\frac{10}{27} t_1 = 20 \Rightarrow t_1 = 54$

B decelerating: $\frac{100}{3} - \frac{10}{27}(t_2 - 90) = 20 \Rightarrow t_2 - 90 = 36$

$t_1 = 54$ s and $t_2 = 126$ s

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Question 7 continued

(d) Train A at $t = 96$:

distance $= 300 + 20 \times (96 - 30) = 300 + 1320 = 1620$ m

Train B at $t = 96$:

speed at $t = 96$: $v = \frac{100}{3} - \frac{10}{27} \times 6 = \frac{280}{9}$ m s^{-1}

distance from $t = 90$ to 96: $\frac{1}{2}\left(\frac{100}{3} + \frac{280}{9}\right) \times 6 = \frac{580}{3}$

distance $= 1500 + \frac{580}{3} = \frac{5080}{3} = 1693.33...$ m

Distance between trains $= \frac{5080}{3} - 1620 = \frac{220}{3}$

$= 73.3$ m (3 s.f.)

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Question 7 continued

(Total for Question 7 is 17 marks)

TOTAL FOR PAPER IS 75 MARKS

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