

A Level Maths Mechanics Practice Exam: Mark Scheme

Pearson Edexcel A Level Mathematics (9MA0) · 18 questions · 60 marks

- M marks are for a correct method; A marks for an accurate answer that follows a correct method; B marks are independent of method.
- Accept any correct method that reaches a correct answer, unless the question says which method to use.
- Practise these topics online with instant feedback: alevelmathrevision.com/alevel-frontend/alevel-unit.html?course=uk&unit=5

Question 1

2 marks

B1 Near the Earth's surface the change in height is tiny compared with the Earth's radius, so g hardly changes

B1 e.g. a rocket or satellite far above the Earth's surface, where g is noticeably smaller

Final answer: g hardly changes near the Earth's surface; not valid far above it (e.g. a satellite)

Question 2

2 marks

M1 Perpendicular component $40 \sin 70^\circ$, or perpendicular distance $0.25 \sin 70^\circ$

A1 9.40 N m

Final answer: 9.40 N m

Question 3

3 marks

M1 Converts both speeds: 10 m s^{-1} and 25 m s^{-1}

M1 $a = \frac{25 - 10}{6}$

A1 2.5 m s^{-2}

Final answer: 2.5 m s^{-2}

Question 4

3 marks

B1 Deceleration = $\frac{30 - 10}{40} = 0.5 \text{ m s}^{-2}$ (gradient)

M1 Area of the trapezium $\frac{30 + 10}{2} \times 40$

A1 800 m

Final answer: 0.5 m s^{-2} , 800 m

Question 5

3 marks

M1 $40 = 2t + \frac{1}{2}(3)t^2$

M1 Solves $1.5t^2 + 2t - 40 = 0$

A1 $t = 4.54 \text{ s}$ (the negative root is rejected)

Final answer: 4.54 s



Question 6**3 marks**

M1 $15 = 1.2u - \frac{1}{2}(9.8)(1.2)^2$

A1 $1.2u = 22.056$

A1 $u = 18.4 \text{ m s}^{-1}$

Final answer: 18.4 m s^{-1}

Question 7**3 marks**

B1 At rest when $t = 3$

M1 $s = 9t - \frac{1}{3}t^3$

A1 18 m

Final answer: 18 m

Question 8**3 marks**

M1 $\vec{v} = \frac{\vec{AB}}{3} = \frac{12\mathbf{i} - 9\mathbf{j}}{3}$

A1 $(4\mathbf{i} - 3\mathbf{j}) \text{ m s}^{-1}$

A1 Speed 5 m s^{-1}

Final answer: $(4\mathbf{i} - 3\mathbf{j}) \text{ m s}^{-1}$; 5 m s^{-1}

Question 9**3 marks**

M1 Resultant is zero: $\mathbf{F} = -[(2\mathbf{i} - 3\mathbf{j}) + (-5\mathbf{i} + \mathbf{j})]$

A1 $\mathbf{F} = (3\mathbf{i} + 2\mathbf{j})$

A1 $\sqrt{13} = 3.61 \text{ N}$

Final answer: $\mathbf{F} = (3\mathbf{i} + 2\mathbf{j}) \text{ N}$; $\sqrt{13} = 3.61 \text{ N}$

Question 10**3 marks**

M1 $15 = 5a$

A1 $a = 3 \text{ m s}^{-2}$

A1 $T = 2 \times 3 = 6 \text{ N}$

Final answer: 3 m s^{-2} , 6 N

Question 11**3 marks**

M1 Resolves: $R = mg \cos \alpha$ and $F = mg \sin \alpha$

M1 Limiting: $F = \mu R$

A1* $\mu = \tan \alpha = 0.75$

Final answer: $\mu = \tan \alpha = 0.75$



Question 12**3 marks**

B1 $|\mathbf{F}| = \sqrt{9^2 + 12^2} = 15 \text{ N}$

M1 $\mathbf{F}$ points north-east: angle $\tan^{-1} \frac{9}{12}$ east of north

A1 Bearing 036.9°

Final answer: 15 N on a bearing of 036.9°

Question 13**3 marks**

M1 Moments about A : $P \sin 40^\circ \times 1.6 = 50 \times 0.8$

A1 Correct equation

A1 $P = 38.9$

Final answer: $P = 38.9$

Question 14**3 marks**

M1 Moments about B : $2T_A = 8g \times 1.25$

A1 $T_A = 49 \text{ N}$

A1 $T_B = 78.4 - 49 = 29.4 \text{ N}$

Final answer: $T_A = 49 \text{ N}$, $T_B = 29.4 \text{ N}$

Question 15**4 marks**

M1 $\mathbf{a} = \frac{6\mathbf{i} - 8\mathbf{j}}{2} = 3\mathbf{i} - 4\mathbf{j}$

M1 $\mathbf{r} = \frac{1}{2}\mathbf{a}t^2$ with $t = 3$

A1 $(13.5\mathbf{i} - 18\mathbf{j}) \text{ m}$

A1 Distance $\sqrt{13.5^2 + 18^2} = 22.5 \text{ m}$

Final answer: $(13.5\mathbf{i} - 18\mathbf{j}) \text{ m}$; 22.5 m

Question 16**4 marks**

M1 $0 = 6^2 - 2a(4.5)$

A1 Deceleration 4 m s^{-2}

M1 $\mu mg = 4m$

A1 $\mu = 0.408$

Final answer: $\mu = 0.408$



Question 17**6 marks****M1** (a) Distances t^2 and $5t + \frac{1}{2}t^2$ **M1** Sum is 100**A1** $1.5t^2 + 5t - 100 = 0$ **A1** $t = \frac{20}{3} = 6.67 \text{ s}$ **M1** (b) $s = \left(\frac{20}{3}\right)^2$ **A1** 44.4 m**Final answer:** (a) $\frac{20}{3} = 6.67 \text{ s}$ (b) 44.4 m**Question 18****6 marks****M1** (a) $5400 = 1800a$ **A1** 3 m s^{-2} **M1** (b) Trailer: force in the bar = 600×3 **A1** 1800 N**A1** Thrust: the bar pushes back on the trailer to slow it**B1** (c) $\frac{20^2}{2 \times 3} = 66.7 \text{ m}$ **Final answer:** (a) 3 m s^{-2} (b) 1800 N, a thrust (c) 66.7 mEnd of mark scheme · More free exams: alevelmathrevision.com/alevel-frontend/free-practice-exams