

Edexcel IAL M2 Mechanics 2 Practice Exam: Mark Scheme

Pearson Edexcel International A Level Mathematics · 11 questions · 59 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=ial&unit=6

Question 1

4 marks

$$1. v = \frac{ds}{dt} = 6t^2 - 30t + 24 \text{ M1}$$

$$v = -12 \text{ m s}^{-1} \text{ A1}$$

$$2. a = \frac{dv}{dt} = 12t - 30 \text{ M1}$$

$$a = -6 \text{ m s}^{-2} \text{ A1}$$

Final answer: a) -12 m s^{-1} ; b) -6 m s^{-2}

Question 2

4 marks

$$\mathbf{a} = (6t - 4)\mathbf{i} + 2\mathbf{j} \text{ M1 A1}$$

$$\mathbf{F} = m\mathbf{a} = 0.5(8\mathbf{i} + 2\mathbf{j}) = 4\mathbf{i} + \mathbf{j} \text{ M1}$$

$$|\mathbf{F}| = \sqrt{17} = 4.12 \text{ N A1}$$

Final answer: $\sqrt{17} = 4.12 \text{ N}$

Question 3

4 marks

$$\frac{1}{2}m(25^2) = \frac{1}{2}mv^2 + m(9.8)(15) \text{ M1 A1}$$

$$v^2 = 331, v = 18.2 \text{ m s}^{-1} \text{ A1}$$

Only the height gained appears in the energy equation (no other force does work), so the angle does not affect the speed **B1**

Final answer: 18.2 m s^{-1}

Question 4

4 marks

Areas 16 and 6 **B1**

$$\text{Distances from } AB: 2 \text{ and } 4 + \frac{1}{3}(3) = 5 \text{ B1}$$

$$22\bar{y} = 16(2) + 6(5) \text{ M1}$$

$$\bar{y} = \frac{31}{11} = 2.82 \text{ cm A1}$$

Final answer: $31/11 = 2.82 \text{ cm}$



Question 5

5 marks

$$1. \frac{18000}{15} - 30(15) = 1000a \text{ M1 A1}$$

$$a = 0.75 \text{ m s}^{-2} \text{ A1}$$

$$2. \frac{18000}{v} = 30v \text{ M1}$$

$$v^2 = 600, v = 24.5 \text{ m s}^{-1} \text{ A1}$$

Final answer: a) 0.75 m s^{-2} ; b) 24.5 m s^{-1}

Question 6

5 marks

$$\text{CLM: } 4(5) + 6(1) = 4(1.4) + 6v_B \text{ M1 A1}$$

$$v_B = 3.4 \text{ m s}^{-1} \text{ A1}$$

$$e = \frac{3.4 - 1.4}{5 - 1} \text{ M1}$$

$$e = 0.5 \text{ A1}$$

Final answer: 3.4 m s^{-1} ; $e = 0.5$

Question 7

5 marks

$$R = W, F = S \text{ B1}$$

$$\text{M(foot): } S \times 2a \sin \theta = Wa \cos \theta \text{ M1 A1}$$

$$\text{Limiting: } S = 0.4W, \text{ so } \tan \theta = \frac{1}{0.8} \text{ M1}$$

$$\theta = 51.3^\circ \text{ A1}$$

Final answer: 51.3°

Question 8

7 marks

$$1. \text{Components } 21 \text{ (horizontal) and } 28 \text{ (vertical) B1}$$

$$20 = 28t - 4.9t^2 \text{ M1}$$

$$t = \frac{28 \pm \sqrt{392}}{9.8}: 0.837 \text{ and } 4.877 \text{ dM1 A1}$$

$$\text{Difference} = \frac{2\sqrt{392}}{9.8} = 4.04 \text{ s A1}$$

$$2. 21 \times 4.041 \text{ M1}$$

$$84.9 \text{ m A1}$$

Final answer: a) 4.04 s ; b) 84.9 m

Question 9

7 marks

$$\text{Areas: rectangle } 96, \text{ triangle } 16, \text{ remainder } 80 \text{ B1}$$

$$\text{Triangle centroid } \left(\frac{32}{3}, \frac{8}{3}\right) \text{ B1}$$

$$80\bar{x} = 96(6) - 16\left(\frac{32}{3}\right) \text{ M1 A1}$$

$$\bar{x} = \frac{76}{15} \text{ A1}$$

$$80\bar{y} = 96(4) - 16\left(\frac{8}{3}\right), \bar{y} = \frac{64}{15} \text{ M1 A1}$$

Final answer: $(76/15, 64/15)$



Question 10**7 marks**

1. Impact speed $\sqrt{2(9.8)(4.9)} = 9.8 \text{ m s}^{-1}$ **M1 A1**

Rebound 4.9 m s^{-1} , height $\frac{4.9^2}{19.6} = 1.225 \text{ m}$ **M1 A1**

2. Fall: $4.9 = 4.9t^2$, $t = 1 \text{ s}$ **B1**

Between bounces: $0 = 4.9t - 4.9t^2$, $t = 1 \text{ s}$ **M1**

Total 2 s **A1**

Final answer: a) 1.225 m; b) 2 s

Question 11**7 marks**

$R = 100(9.8) = 980 \text{ N}$ **B1**

Limiting: $F = 0.3 \times 980 = 294 \text{ N}$, so $S = 294 \text{ N}$ **M1 A1**

M(foot): $294 \times 8 \sin 65^\circ = 25(9.8)(4 \cos 65^\circ) + 75(9.8)x \cos 65^\circ$ **M1 A1 A1**

$x = 5.53 \text{ m}$ **A1**

Final answer: 5.53 m

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