

Statistics & Mechanics - Sample Paper - Mark Scheme

M = method mark, A = accuracy mark, B = independent mark. AO1 = procedural fluency, AO2 = mathematical reasoning/proof, AO3 = problem solving in context.

SECTION A: STATISTICS

Question 1

Part	Scheme	Marks	AO
(a)	$P(A \cup B) = P(A) + P(B) - P(A \cap B) = 0.4 + 0.5 - 0.15$	M1	AO1
	$= 0.75$	A1	AO1
(b)	$P(A B) = P(A \cap B) / P(B) = 0.15 / 0.5$	M1 A1	AO1
	$= 0.3$	A1	AO1
(c)	Compare $P(A) \times P(B) = 0.4 \times 0.5 = 0.2$ with $P(A \cap B) = 0.15$	M1	AO2
	Since $0.2 \neq 0.15$, A and B are NOT independent	A1 A1	AO2
(d)	Correct Venn diagram structure (two overlapping circles in a rectangle)	M1	AO1
	Region $A \cap B$ labelled 0.15	A1	AO1
	A-only region labelled 0.25, B-only region labelled 0.35	A1	AO1
	Outside both regions labelled 0.25	A1	AO1

Total for Question 1: 12 marks

Question 2

Part	Scheme	Marks	AO
(a)	$P(X=5) = {}^{15}C_5 (0.3)^5 (0.7)^{10}$	M1	AO1
	$= 0.2061$ (4 d.p.)	A1 A1	AO1
(b)	$P(X \leq 3) = P(0) + P(1) + P(2) + P(3)$	M1	AO1
	$= 0.2969$ (4 d.p.)	A1 A1	AO1
(c)	$P(X \geq 8) = 1 - P(X \leq 7)$	M1	AO1
	$= 0.0500$ (4 d.p.)	A1 A1	AO1
(d)	Mean $= np = 4.5$	B1	AO1
	Variance $= np(1-p) = 3.15$	B1	AO1
	Valid condition, e.g.: each flip is independent of the others, and the probability of heads is constant at 0.3 for every flip	B1 B1	AO2

Total for Question 2: 13 marks

Question 3

Part	Scheme	Marks	AO
(a)	$z = (70-65)/8 = 0.625$	M1	AO1
	$P(X>70) = 1-\Phi(0.625)$	M1	AO1
	$= 0.2660$ (4 d.p.)	A1 A1	AO1
(b)	z-values for 55 and 70: -1.25 and 0.625	M1	AO1
	$P(55<X<70) = \Phi(0.625)-\Phi(-1.25)$	M1	AO1
	$= 0.6284$ (4 d.p.)	A1 A1	AO1
(c)	$\Phi(z) = 0.90 \rightarrow z = 1.2816$	M1 A1	AO1
	$h = 65 + 1.2816 \times 8$	M1	AO1
	$h = 75.3$ (1 d.p.)	A1	AO1

Total for Question 3: 13 marks

Question 4

Part	Scheme	Marks	AO
(a)	$H_0: \rho = 0, H_1: \rho > 0$ (where ρ is the population correlation coefficient)	B1 B1	AO1
(b)	Critical region: $r > 0.4973$	M1	AO2
	$0.62 > 0.4973$, so the result lies in the critical region	A1	AO2
	Reject H_0	A1	AO2
	There is sufficient evidence, at the 5% level, of positive correlation in the population	A1 A1 A1	AO3
(c)	The population from which the sample is drawn should follow a bivariate normal distribution	B1 B1 B1 B1	AO2

Total for Question 4: 12 marks

SECTION B: MECHANICS

Question 5

Part	Scheme	Marks	AO
(a)	$s = ut + \frac{1}{2}at^2 = 5(6) + \frac{1}{2}(2)(6^2)$	M1 A1	AO1
	$= 66$ m	A1 A1	AO1
(b)	$v = u + at = 5 + 2(6)$	M1	AO1
	$= 17$ m s ⁻¹	A1 A1	AO1
(c)	Straight line graph, correct starting value (5) and gradient (2), correctly labelled axes	M1 A1 A1	AO1

Total for Question 5: 10 marks

Question 6

Part	Scheme	Marks	AO
(a)	P: weight 5g down, tension T up. Q: weight 3g down, tension T up (both correctly drawn/labelled)	M1 A1 A1	AO1

(b)	P (falling): $5g - T = 5a$	M1 A1	AO3
	Q (rising): $T - 3g = 3a$	M1 A1	AO3
	Add the equations: $2g = 8a$	M1	AO3
	$a = 2.45 \text{ m s}^{-2}$	A1	AO3
(c)	Substitute a into either equation, e.g. $T = 3(g+a)$	M1 A1	AO3
	$T = 36.75 \text{ N}$	A1 A1	AO3

Total for Question 6: 13 marks

Question 7

Part	Scheme	Marks	AO
(a)	Horizontal: $28\cos 40^\circ = 21.4 \text{ m s}^{-1}$	M1 A1	AO1
	Vertical: $28\sin 40^\circ = 18.0 \text{ m s}^{-1}$	A1	AO1
(b)	Using $s=ut+\frac{1}{2}at^2$ vertically with $s=0$: $0 = 18.0T - 4.9T^2$	M1 A1	AO3
	$T(18.0-4.9T)=0 \rightarrow T = 3.67 \text{ s}$ ($T \neq 0$ rejected)	M1 A1	AO3
(c)	Range = horizontal speed $\times$ time of flight	M1	AO3
	$= 21.4 \times 3.67$	M1	AO3
	$= 78.8 \text{ m}$ (3 s.f.)	A1 A1	AO3
(d)	Using $v^2=u^2+2as$ vertically with $v=0$ at max height	M1	AO3
	$H = 18.0^2/(2 \times 9.8) = 16.5 \text{ m}$ (3 s.f.)	A1 A1	AO3

Total for Question 7: 14 marks

Question 8

Part	Scheme	Marks	AO
(a)	Correct diagram: weight 240N at centre (4m from A), load 100N at 2m from A, reactions R_A and R_B at the ends	M1 A1 A1	AO1
(b)	Taking moments about A: $R_B \times 8 = 240 \times 4 + 100 \times 2$	M1 A1	AO3
	$R_B \times 8 = 960 + 200 = 1160$	A1	AO3
	$R_B = 145 \text{ N}$	A1 A1 A1	AO3
(c)	Resolve vertically: $R_A + R_B = 240 + 100$	M1	AO1
	$R_A = 340 - 145 = 195 \text{ N}$	A1 A1 A1	AO1

Total for Question 8: 13 marks

Indicative grade boundaries

Indicative guide only, based on recent Pearson Edexcel Statistics & Mechanics boundary trends (out of 100).

Grade	A*	A	B	C	D	E
Mark $\geq$	76	65	56	47	39	31