GCE A LEVEL MARKING SCHEME

SUMMER 2025

A LEVEL
MATHEMATICS
UNIT 4 APPLIED MATHEMATICS B
1300U40-1

About this marking scheme

The purpose of this marking scheme is to provide teachers, learners, and other interested parties, with an understanding of the assessment criteria used to assess this specific assessment.

This marking scheme reflects the criteria by which this assessment was marked in a live series and was finalised following detailed discussion at an examiners' conference. A team of qualified examiners were trained specifically in the application of this marking scheme. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners. It may not be possible, or appropriate, to capture every variation that a candidate may present in their responses within this marking scheme. However, during the training conference, examiners were guided in using their professional judgement to credit alternative valid responses as instructed by the document, and through reviewing exemplar responses.

Without the benefit of participation in the examiners' conference, teachers, learners and other users, may have different views on certain matters of detail or interpretation. Therefore, it is strongly recommended that this marking scheme is used alongside other guidance, such as published exemplar materials or Guidance for Teaching. This marking scheme is final and will not be changed, unless in the event that a clear error is identified, as it reflects the criteria used to assess candidate responses during the live series.

SECTION A – Statistics			
Qu	**Solution**	**Mark**	**Notes**
1	X ~ U[c, d] Mean: $(c + d) / 2 = 7·5$ ■ $c + d = 15$ Variance: $(d - c)^2 / 12 = 3$ ■ $(d - c)^2 = 36$ ■ $d - c = 6$ Solving simultaneously: $2d = 21$ ■ $\boldsymbol{d = 10·5}$ $2c = 9$ ■ $\boldsymbol{c = 4·5}$	M1 M1 A1 A1	M1 for correct formula for mean of U[c,d] used M1 for correct formula for variance of U[c,d] used cao $d = 10·5$ (accept 21/2) cao $c = 4·5$ (accept 9/2)
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Qu	Solution	Mark	Notes
2(a)(i)	**P(correct answer)** P(correct) = P(C | VC)·P(VC) + P(C | Conf)·P(Conf) + P(C | NC)·P(NC) = 0·9 × 0·2 + 0·7 × 0·5 + 0·25 × 0·3 = 0·18 + 0·35 + 0·075 = **0·605**	M1 A1 A1	M1 for correct total probability structure with all three branches A1 for correct evaluation of each product cao 0·605 (accept 0·61 if rounded appropriately)
2(a)(ii)	**P(not confident | correct)** Using Bayes' Theorem: P(NC | correct) = P(correct | NC) × P(NC) / P(correct) = (0·25 × 0·3) / 0·605 = 0·075 / 0·605 = **0·124** (3 s.f.)	M1 A1	M1 for correct Bayes' formula seen or implied cao 0·124 (accept 0·124–0·125; ft their (a)(i))

2(b)(i)	**Smallest p for P(correct) ≥ 0·7** P(correct) = p × 1 + (1 − p) × 0·25 = 0·75p + 0·25 Require: 0·75p + 0·25 ≥ 0·7 0·75p ≥ 0·45 Smallest value: $\boldsymbol{p = 0·6}$	M1 A1 M1 A1	M1 for correct expression for P(correct) in terms of p A1 simplified correctly to 0·75p + 0·25 M1 inequality set up and solved correctly cao $p = 0·6$
2(b)(ii)	**P(pass) with P(correct) = 0·7** Let X = number of correct answers. $X \sim B(10, 0·7)$ P(pass) = P(X ≥ 8) = P(X = 8) + P(X = 9) + P(X = 10) P(X = 8) = $^{10}C_8 \times 0·7^8 \times 0·3^2$ = 0·2335… P(X = 9) = $^{10}C_9 \times 0·7^9 \times 0·3$ = 0·1211… P(X = 10) = $0·7^{10}$ = 0·0282… P(X ≥ 8) = **0·383** (3 s.f.)	B1 M1 A1	B1 correct binomial model stated or implied M1 correct inequality identified and binomial terms summed cao 0·383 (accept 0·382–0·383; use of statistical tables acceptable)

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Qu	**Solution**	**Mark**	**Notes**
3(a)	The article specifically claims delivery companies are *recruiting* bus drivers, implying bus driver numbers *decrease* as delivery driver numbers increase. This is a specific directional claim (negative correlation), so a one-tailed test is appropriate.	E1	E1 for reference to the specific directional nature of the claim (negative correlation / one direction only) *E0 for "the data looks negatively correlated" or reference to the scatter diagram only*
3(b)	**(Let ρ denote the population correlation coefficient)** $H_0: \rho = 0 \quad H_1: \rho < 0$ Test statistic = −0·8206 Critical value (n = 8, one-tailed, 5%): **−0·6215** Since −0·8206 < −0·6215, (there is sufficient evidence to) reject H_0. There is sufficient evidence at the 5% significance level of a significant **negative** linear correlation between number of delivery drivers and number of bus drivers.	B1 B1 B1 B1 E1	B1 correct hypotheses in terms of ρ (population); H_1 one-tailed negative; B0 for omission of ρ B1 test statistic = −0·8206 labelled as TS or used in correct comparison B1 correct critical value −0·6215 (from WJEC tables, n = 8, 5% one-tailed) B1 correct decision to reject H_0 with valid comparison E1 conclusion in context; must include word "negative"; cso — do not allow categorical statements
3(b)(i)	The councilor might conclude a causal link because a strong negative correlation exists *and* a plausible mechanism is given (delivery companies actively recruiting bus drivers).	B1	B1 plausible contextual reason — correlation alone is insufficient; mechanism required
3(b)(ii)	The evidence supports the article's claim: as the number of delivery drivers increases, the number of bus drivers tends to decrease, which is consistent with delivery companies recruiting bus drivers. *Note: candidates must not overstate — cannot definitively establish causation from correlation alone.*	B1	B1 sensible conclusion relating back to the original claim about recruitment

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Qu	**Solution**	**Mark**	**Notes**
	$X \sim N(28·3, 0·3^2)$		
4(a)	**P(*X* < 28)** $z = (28 - 28·3) / 0·3 = -1$ P(*X* < 28) = P(*Z* < −1) = 1 − Φ(1) = **0·1587**	M1 A1	M1 for correct standardisation A1 0·1587 (accept 0·158–0·159; M1A1 for correct answer from calculator)
4(b)	**P(*X* > 29·1 | *X* > 28·8)** P(*X* > 29·1 | *X* > 28·8) = P(*X* > 29·1) / P(*X* > 28·8) P(*X* > 28·8): *z* = (28·8 − 28·3) / 0·3 = 5/3 = 1·6■ P(*X* > 28·8) = 1 − Φ(1·667) = 1 − 0·9525 = 0·0475 P(*X* > 29·1): *z* = (29·1 − 28·3) / 0·3 = 8/3 = 2·6■ P(*X* > 29·1) = 1 − Φ(2·667) = 1 − 0·9962 = 0·0038 P(*X* > 29·1 | *X* > 28·8) = 0·0038 / 0·0475 = **0·0800** (3 s.f.)	M1 M1 A1 M1 A1 A1	M1 recognising conditional probability, leading to correct fraction M1 correct standardisation for 28·8 A1 P(*X* > 28·8) = 0·0475 (accept 0·047–0·048) M1 correct standardisation for 29·1 A1 P(*X* > 29·1) = 0·0038 (accept 0·003–0·004) A1 cao 0·0800 (accept 0·079–0·081; ft provided method correct)
4(c)(i)	The histogram shows an approximately **symmetric / bell-shaped** distribution, supporting the use of a Normal-based significance test on the sample mean.	B1	B1 comment on approximate symmetry or normal shape *Do not accept "unimodal" without reference to symmetry*
4(c)(ii)	**Significance test at 3% level** (Let μ be the mean mass of Graham's packs in grams.) $H_0: \mu = 28·3$ $H_1: \mu > 28·3$ x■ = 285 / 10 = 28·5 σ = 0·32 *X*■ ~ N(28·3, 0·32²/10) under H_0 **Method 1 (Test statistic)** TS = (28·5 − 28·3) / (0·32/√10) = 0·2 / 0·10119… = **1·976** Critical value (one-tailed, 3%): z_{crit} = **1·881** Since 1·976 > 1·881, reject H_0. **Method 2 (Critical region)** CR: x■ > 28·3 + 1·881 × 0·32/√10 = 28·3 + 0·1903 = 28·490 Since 28·5 > 28·490, reject H_0. There is sufficient evidence at the 3% significance level to support Graham's claim that his packs are, on average, heavier than 28·3 g.	B1 B1 B1 M1 A1 B1 m1 A1	B1 correct hypotheses; H_1 one-tailed (greater); B0 for omission of μ or non-strict inequality B1 x■ = 28·5 used appropriately (not just calculated) B1 correct distribution of X■ under H_0 stated or implied M1 for correct TS formula using σ = 0·32/√10 x■ A1 TS = 1·976 (accept 1·97–1·98) B1 critical value 1·881 (accept 1·88) m1 correct comparison, dependent on previous M1 A1 conclusion in context referencing Graham's claim; cso — do not allow categorical statements
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SECTION B – Differential Equations and Mechanics

Qu	Solution	Mark	Notes
5(a)	**Show $T_{AC} \approx 179$ N; find T_{BC}** Weight $W = 25 \times 9{\cdot}8 = 245$ N Cable AC at 60° to vertical; cable BC at 45° to vertical. Resolve **vertically** (↑): $T_{AC} \cos 60° + T_{BC} \cos 45° = 245$ $0{\cdot}5\,T_{AC} + (1/\sqrt{2})\,T_{BC} = 245 \quad \ldots (1)$ Resolve **horizontally** (→): $T_{BC} \sin 45° = T_{AC} \sin 60°$ $(1/\sqrt{2})\,T_{BC} = (\sqrt{3}/2)\,T_{AC} \quad \ldots (2)$ From (2): $T_{BC} = (\sqrt{6}/2)\,T_{AC}$ Substitute into (1): $T_{AC}[0{\cdot}5 + (\sqrt{3}/2)] = 245$ $T_{AC} \times 1{\cdot}3660\ldots = 245$ **$T_{AC} = 179{\cdot}3\ldots \approx 179$ N** (shown) $T_{BC} = (\sqrt{6}/2) \times 179{\cdot}3 =$ **219 N** (3 s.f.)	M1 A1 M1 A1 A1 A1	M1 resolving either horizontally or vertically — no missing or extra forces A1 correct vertical equation, oe M1 correct horizontal equation A1 correct horizontal equation, oe A1 convincing derivation leading to $T_{AC} \approx 179$ N, cso A1 cao $T_{BC} = 219$ N (accept 219–220 N)
5(b)	The traffic lights are modelled as a **particle** (all mass concentrated at point C), so their size and shape are ignored. The cables are assumed to be **light** and **inextensible**.	B1	B1 any valid modelling assumption, e.g. particle, light cables, smooth connections

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Qu	**Solution**	**Mark**	**Notes**

Qu	**Solution**	**Mark**	**Notes**
	Mass m = 1·2 kg, F = 30/(t + 2)^2 N. When t = 0·5, v = 20 ms^{-1}.		

Qu	**Solution**	**Mark**	**Notes**
	Uniform rod AB, length 3·8 m, weight 180 N. *Supports at C and D: DB = 0·8 m, CD = 1·8 m ■ AC = 1·2 m.* *Centre of rod G is at 1·9 m from A.*		
6(a)	**R_C and R_D with W = 69 N at A** **R_D = 24 N** Resolve vertically: R_C = 249 − 116 = **225 N**	M1 M1 A1 A1 M1 A1	M1 taking moments about one support to eliminate one unknown; dimensionally correct M1 correct moment equation A1 correct distances used, oe A1 cao R_D = 24N M1 vertical resolution used A1 cao R_C = 225 N
6(b)	**Greatest value of W for equilibrium** Limiting case: R_C = 0 (rod tilts about D when W at A is too **W = 105 N**	M1 M1 A1	M1 correct identification of limiting case (R_D = 0 correctly identified) M1 correct moment equation about D in limiting case cao W = 105 N

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7(a)	**Expression for v; limiting value** Newton's 2nd Law: $1{\cdot}2\ dv/dt = 30/(t + 2)^2$ dv/dt $= 25/(t + 2)^2$ Integrating: $v = \int 25(t + 2)^{-2}\ dt = -25/(t + 2) + C$ Apply initial condition ($t = 0{\cdot}5$, $v = 20$): 20 $= -25/2{\cdot}5 + C = -10 + C$ ■ $C = 30$ **v =** **30 − 25/(t + 2)** As $t \to \infty$: $25/(t + 2) \to 0$, so limiting value of v = **30 ms^{-1}**	M1 A1 M1 A1 M1 A1 B1	M1 Newton's 2nd Law applied correctly A1 $dv/dt = 25/(t + 2)^2$ M1 correct integration performed A1 $v = -25/(t + 2) + C$ M1 applying initial condition to find C A1 $v = 30 - 25/(t + 2)$ B1 limiting value = 30 ms^{-1} (ft from their expression for v)
7(b)	**Time to reach v = 29 ms^{-1}** $29 = 30 - 25/(t + 2)$ $25/(t + 2) = 1$ ■ $t + 2 = 25$ ■ **t = 23 s**	M1 A1	M1 correct equation set up using their expression for v cao t = 23 s
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Qu	**Solution**	**Mark**	**Notes**
	Object mass 5 kg, projected up rough plane inclined at 30° to horizontal.		
8(a)	**Show μ = 2√3/21 given deceleration = 6·3 ms^{-2}** Normal reaction: $R = mg\cos 30° = 5 \times 9{\cdot}8 \times (\sqrt{3}/2) = 24{\cdot}5\sqrt{3}$ N Friction (opposing motion, down the plane): $F = \mu R = 24{\cdot}5\sqrt{3}\ \mu$ Apply N2L (up the plane, decelerating): $-mg$ $\sin 30° - F = m \times (-6{\cdot}3)$ $-5 \times 9{\cdot}8 \times 0{\cdot}5 - 24{\cdot}5\sqrt{3}\ \mu = 5 \times (-6{\cdot}3)$ $-24{\cdot}5 - 24{\cdot}5\sqrt{3}\ \mu = -31{\cdot}5$ $24{\cdot}5\sqrt{3}\ \mu = 7{\cdot}0$ $\mu = 7{\cdot}0 / (24{\cdot}5\sqrt{3}) = 2/(7\sqrt{3}) =$ **2√3/21** (shown)	M1 B1 M1 A1 A1	M1 correct normal reaction found B1 friction force correctly expressed as μR M1 dimensionally correct equation of motion for object moving up plane; all forces/terms present A1 correct equation in μ A1 convincing derivation to show $\mu = 2\sqrt{3}/21$, cso
8(b)	**Does object remain stationary after coming to rest?** For the object to remain stationary, we need $\mu \geq \tan 30°$. $\tan 30° = 1/\sqrt{3} = \sqrt{3}/3 \approx 0{\cdot}577$ $\mu = 2\sqrt{3}/21 \approx 0{\cdot}165$ Since $\mu < \tan 30°$, friction is insufficient to hold the object. **The object will slide back down the plane.**	M1 A1	M1 correct comparison criterion identified (tan θ vs μ, or comparing friction force required with maximum available) A1 correct conclusion — object slides back down — with valid numerical justification

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Qu	**Solution**	**Mark**	**Notes**
	Rocket R launched from O on horizontal ground. Position vector r(t) given for $0 \le t \le 4$. *At $t = 4$, fuel runs out; R moves as a projectile. Safe zone: horizontal from O to F, OF = 600 m.*		
9(a)	**Velocity vector v(t); evaluate at t = 4** Differentiate r(t) component-wise to obtain v(t) = dr/dt. [Differentiate the i-component and j-component of r(t) separately.] Substitute t = 4 to find the velocity vector at t = 4.	M1 A1 A1	M1 correct differentiation of r(t); both components differentiated A1 correct i-component of velocity at t = 4 A1 correct j-component of velocity at t = 4 *Award A1A1 ft from correct differentiation even if arithmetic error; both components must be evaluated at t = 4*
9(b)(i)	**Show R takes ≈ 18 s to reach ground after fuel runs out** At t = 4: use position $(x_4, y_4) = r(4)$ and velocity $(u_x, u_y) = v(4)$. Projectile phase (let t′ = time after fuel runs out): Vertical: $y = y_4 + u_y t' - \frac{1}{2}g(t')^2$ Set y = 0 (ground level) and solve the resulting quadratic in t′: Take the positive root ■ **t′ ≈ 18 s** (shown)	B1 M1 M1 A1	B1 correct position and velocity at t = 4 used as initial conditions for projectile M1 correct projectile equation for vertical displacement M1 quadratic set up and solved; positive root selected A1 correct derivation leading to t′ ≈ 18 s, cso *Exact numerical values for y■ and u_y depend on the printed r(t) formula; credit correct method throughout*
9(b)(ii)	**Does R land within the safe zone?** Horizontal distance during projectile phase: $\Delta x = u_x \times t' = u_x \times 18$ Total horizontal distance from O = $x_4 + \Delta x$ Compare with 600 m: state clearly whether total ≤ 600 m or > 600 m, and conclude accordingly.	M1 A1	M1 horizontal distance calculated using t′ ≈ 18 and horizontal velocity component A1 correct conclusion with numerical justification and explicit comparison with 600 m (ft from (a) and (b)(i)) *A1 only awarded if comparison with 600 m is explicit and a definitive conclusion is given*
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	TOTAL FOR PAPER	**80**	