**IB MATH STUDIES EXAM REVIEW: Topic 5 Markscheme**

**Linear Equations, Parallel & Perpendicular Slopes, Midpoint, Distance, Perimeter, Circumference, Area, Surface Area, Volume, Density, Right-Angle Trigonometry, Law of Sines, Law of Cosines, Triangle Areas**

**1.** ***Unit penalty applies in parts (a) and (b)***

(a) AC2 = 7.22 + 9.62 (M1)

**Note:** Award (M1)for correct substitution in Pythagoras Theorem.

**UP** AC = 12 m (A1) (C2)

(b) AG2 = 122 + 3.52 (M1)

**Note:** Award (M1)for correct substitution in Pythagoras Theorem.

**UP** AG = 12.5m (A1)(ft) (C2)

**Note:** Follow through from their answer to part (a).

(c) tan *θ* =  or sin *θ* =  or cos *θ* =  (M1)

**Note:** Award (M1)for correct substitutions in trig ratio.

 *θ* = 16.3° (A1)(ft) (C2)

**Notes:** Follow through from parts (a) and/or part (b) where appropriate. Award (M1)(A0)for use of radians (0.284).

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**2.** (a)  (M1)

**Note:** Award (M1)for correct substitution into the gradient formula.

  (A1) (C2)

(b) *y* = *x* + *c* (A1)(ft)

**Note:** Award (A1)(ft)for their gradient substituted in their equation.

 *y* =  (A1)(ft) (C2)

**Notes:** Award (A1)(ft)for their correct equation.
Accept any equivalent form.
Accept decimal equivalents for coefficients to 3 sf.

 **OR**

 *y* – *y*1 = (*x* – *x*1) (A1)(ft)

**Note:** Award (A1)(ft)for their gradient substituted in the equation.

 *y* – 4 = (*x* + 1) **OR** *y* – 8 = (*x* – 5) (A1)(ft) (C2)

**Note:** Award (A1)(ft)for correct equation.

(c) *y* =  **OR** *y* – 4 = (8 + 1) **OR** *y* – 8 = (8 – 5) (M1)

**Note:** Award (M1)for substitution of x = 8 into their equation.

 *y* = 10 (10.0) (A1)(ft) (C2)

**Note:** Follow through from their answer to part (b).

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**3.** ***Unit penalty applies in parts (a) and (b).***

(a)  cm3 (M1)(M1)

**Notes:** Award (M1)for correctly substituted formula of a sphere. Award (M1)for multiplying their volume by 75.
If r = 10 is used, award (M0)(M1)(A1)(ft)for the answer 314000 cm3.

**UP** 39300 cm3 (A1) (C3)

(b) π × 202 × *h* = 39300 (M1)(M1)

**Notes:** Award (M1)for correctly substituted formula of a cone.
Award (M1)for equating their volume to their answer to part (a).

**UP** *h* = 93.8 cm (A1)(ft) (C3)

**Notes:** Accept the exact value of 93.75
Follow through from their part (a).

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**4.** ***Unit penalty applies in part (b).***

(a) sin  (M1)
100 + their  (M1)
126° (A1) (C3)

**Notes:** Accept an equivalent trigonometrical equation involving angle ABD for the first (M1).
Radians used gives 100°. Award at most (M1)(M1)(A0)if working shown.
BD = 8 m leading to 127°. Award at most (M1)(M1)(A0) (premature rounding).

(b) AC2 = 102 + 92 – 2 × 10 × 9 × cos(126.38...) (M1)(A1)

**Notes:** Award (M1)for substituted cosine formula.
Award (A1)for correct substitution using their answer to part (a).

**UP** AC = 17.0 m (A1)(ft) (C3)

**Notes:** Accept 16.9 m for using 126.
Follow through from their answer to part (a).
Radians used gives 5.08. Award at most (M1)(A1)(A0)(ft) if working shown.

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**5.** (a) 1380 (m) (A1) (C1)

(b) 1380 tan 28.3 (M1)
**=** 743.05.... (A1)(ft)
**=** 743 (m) (A1)(ft) (C3)

**Notes:** Award (M1) for correct substitution in tan formula or equivalent, (A1)(ft) for their 743.05 seen, (A1)(ft) for their answer correct to the nearest m.

(c) percentage error =  × 100 (M1)

**Note:** Award (M1) for correct substitution in formula.

 **=** 3.49 % (% symbol not required) (A1)(ft) (C2)

**Notes:** Accept 3.48 % for use of 743.
Accept negative answer.

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**6.** (a) –2 (A1) (C1)

**Note:** Accept (0, –2)

(b)  (A1) (C1)

(c) 2 (A1)(ft) (C1)

**Note:** Follow through from their answer to part (b).

(d) *y* **=** 2*x* ***+*** *c* (can be implied)
7 = 2 × 3 + *c* (M1) *c* **=** 1 (A1)(ft)
*y* **=** 2*x* ***+*** 1

**Notes:** Award (M1) for substitution of (3, 7), (A1)(ft) for c.
Follow through from their answer to part (c).

 **OR**

 *y* – 7 **=** 2(*x* – 3) (M1)(M1)

**Note:** Award (M1) for substitution of their answer to part (c), (M1) for substitution of (3, 7).

 2*x* – *y* ***+*** 1 **=** 0 ***or*** –2*x* ***+*** *y* – 1 **=** 0 (A1)(ft) (C3)

**Note:** Award (A1)(ft) for their equation in the stated form.

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**7.** (a) (i) 8.5 (cm) (A1)

(ii) 120° (A1)

(iii) 30° (A1) (C3)

(b)  (M1)(A1)(ft)

**Note:** Award (M1) for correct substituted formula, (A1) for correct substitutions.

 BC = 14.7  (A1)(ft) (C3)

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**8.** ***Unit penalty applies in parts (b) (c) and (d).***

(a) Angle ABC = 50° (A1)

(b)  (M1)(A1)(ft)

**Notes:** Award (M1)for substitution into the correct formula, (A1)(ft)for correct substitution. Follow through from their angle ABC.

**UP** AC = 23.4 m (A1)(ft)(G2)

(c) Area of ∆ ABC =  × 23.379... × 25 × sin 75° (M1)(A1)(ft)

**Notes:** Award (M1)for substitution into the correct formula, (A1)(ft)for correct substitution. Follow through from their AC.

 **OR**

 Area of triangle ABC =  (A1)(ft)(M1)

**Note:** (A1)(ft)for correct values of AB (29.479…) and CN (19.151…). Follow through from their (a) and /or (b). Award (M1)for substitution of their values of AB and CN into the correct formula.

**UP** Area of ∆ ABC = 282 m2 (A1)(ft)(G2)

**Note:** Accept 283 m2 if 23.4 is used.

(d) NM =  (M1)(M1)

**Note:** Award (M1)for 25 × sin 50° or equivalent for the length of CN, (M1)for dividing their CN by 2.

**UP** NM = 9.58 m (A1)(ft)(G2)

**Note:** Follow through from their angle ABC.Premature rounding of CN leads to the answers 9.60 or 9.6. Award at most (M1)(M1)(A0)if working seen. Do not penalize with (AP).
CN may be found in (c). The working for this part of the question may be in part (b).

(e) Angle NCB = 40° seen (A1)(ft)

**Note:** Follow through from their (a).

 From triangle MCP:
MP2 = (9.5756...)2 + 12.52 – 2 × 9.5756... × 12.5 × cos (40°) (M1)(A1)(ft)

 MP = 8.034... m (A1)(ft)(G3)

**Notes:** Award (M1)for substitution into correct formula, (A1)(ft)for their correct substitution. Follow through from their (d).
Award (G3) for correct value of MP seen without working.

 **OR**

 From right triangle MCP
CP = 12.5 m seen (A1)
MP2 = (12.5)2 – (9.575…)2 (M1)(A1)(ft)
MP = 8.034…m (A1)(G3)(ft)

**Notes:** Award (M1)for substitution into correct formula, (A1)(ft)for their correct substitution. Follow through from their (d).
Award **(G3)** for correct value of MP seen without working.

 **OR**

 From right triangle MCP
Angle MCP = 40° seen (A1)(ft)
 = sin (40°) or equivalent (M1)(A1)(ft)
MP = 8.034... m (A1)(G3)(ft)

**Notes:** Award (M1)for substitution into the correct formula, (A1)(ft)for their correct substitution. Follow through from their (a).
Award (G3) for correct value of MP seen without working.

 The goat cannot reach point P as MP > 7 m. (A1)(ft)

**Note:** Award (A1)(ft)only if their value of MP is compared to 7 m, and conclusion is stated.

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**9.** ***Unit*** ***Penalty*** ***applies*** ***in*** ***this*** ***question*** ***in*** ***parts*** ***(e)*** ***and*** ***(f)***

(a) (i) 22.5 (m) (A1)

(ii)
 (A1)

(b) *h* = 22*.*5 sin 53.1° (M1)
= 17.99 (A1)
= 18.0 (AG)

**Note:** Unrounded answer must be seen for (A1) to be awarded. Accept 18 as (AG).

(c) AC =  (M1)(M1)

**Note:** Award (M1) for multiplying by 2, (M1) for correct substitution into formula.

 **OR**

 AC = 2(22.5) cos 53.1° (M1)(M1)

**Notes:** Award (M1) for correct use of cosine trig ratio, (M1) for multiplying by 2.

 **OR**

 AC2 = 22.52 + 22.52 – 2(22.5)(22.5) cos 73.8° (M1)(A1)

**Note:** Award (M1) for substituted cosine formula, (A1) for correct substitutions.

 **OR**

  (M1)(A1)

**Note:** Award (M1) for substituted sine formula, (A1) for correct substitutions.

 AC = 27.0 (A1)(G2)

(d) BC =  (M1)
= 19.09 (A1)
= 19.1 (AG)

 **OR**

 *x*2 *+* *x*2 = 272 (M1)
2*x*2 = 272 (A1)
BC = 19.09… (A1)
= 19.1 (AG)

**Notes:** Unrounded answer must be seen for (A1) to be awarded.

(e) Volume = Pyramid + Cuboid
= (18)(19.12) + (108)(19.12) (A1)(M1)(M1)

**Note:** Award (A1) for 108, the height of the cuboid seen. Award (M1) for correctly substituted volume of cuboid and (M1) for correctly substituted volume of pyramid.

 = 41588 *(41 553 if 2(13.52) is used)*

**UP** = 41600 m3 (A1)(ft)(G3)

(f) Weight of air = 41600 × 1.2 × 0.9 (M1)(M1)

**UP** = 44 900 kg (A1)(ft)(G2)

**Note:** Award (M1) for their part (e) × 1.2, (M1) for × 0.9
Award at most (M1)(M1)(A0) if the volume of the cuboid is used.

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**10.** (a) (i) A(0, 4) *Accept* *x* = 0*, y* = 4 (A1)

(ii) B(8, 0) *Accept* *x* = 8*,* *y* = 0 (A1)(ft)

**Note:** Award (A0) if coordinates are reversed in (i) and (A1)(ft) in (ii).

(b) AB =  (M1)

 AB = 8.944 (A1)

 = 8.94 (AG)

(c) (i) *y* = –0.5*x* + 4 (M1)
Gradient AB = –0.5 (A1)

**Note:** Award (A2) if –0.5 seen.

 **OR**

 Gradient AB =  (M1)
 =  (A1)

**Note:** Award (M1) for correct substitution in the gradient formula. Follow through from their answers to part (a).

 Gradient CN = 2 (A1)(ft)(G2)

**Note:** Special case: Follow through for gradient CN from their gradient AB.

(ii) CN: *y* = 2*x* *+* *c*
7 = 2(4) + *c* (M1)

**Note:** Award (M1) for correct substitution in equation of a line.

 *y* = 2*x* – 1 (A1)(ft)(G2)

**Note:** Accept alternative forms for the equation of a line including y – 7 = 2(x – 4). Follow through from their gradient in (i).

**Note:** If c = –1 seen but final answer is not given, award (A1)(d).

(d) *x* + 2(2*x* – l) = 8 *or* *equivalent* (M1)
N(2, 3) (*x* = 2*, y* = 3) (A1)(A1)(ft)(G3)

**Note:** Award (M1) for attempt to solve simultaneous equations or a sketch of the two lines with an indication of the point of intersection.

(e) Cosine rule:  (M1)(A1)

**Note:** Award (M1) for use of cosine rule with numbers from the problem substituted, (A1) for correct substitution.

  = 82.9° (A1)(G2)

**Note:** If alternative right-angled trigonometry method used award (M1) for use of trig ratio in both triangles, (A1) for correct substitution of their values in each ratio, (A1) for answer.

**Note:** Accept 82.8° with use of 8.94.

(f) Area ACB =  (M1)(A1)(ft)

**Note:** Award (M1) for substituted area formula, (A1) for correct substitution. Follow through from their angle in part (e).

 **OR**

 Area ACB =  (M1)(M1)(ft)

**Note:** Award (M1) substituted area formula with their values, (M1) for substituted distance formula. Follow through from coordinates of N.

 Area ACB = 20.0 (A1)(ft)(G2)

**Note:** Accept 20

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**11.** ***Unit*** ***penalty*** ***(UP)*** ***applies*** ***in*** ***parts*** ***(b)(ii)(iii)*** ***and*** ***(d)***

 (a) (i) 15.4 × 5.5 (M1)
84.7 m2 (A1)

**UP** **=** 847000 cm2 (A1)(G3)

**Note:** Award (G2) if 84.7 m2 seen with no working.

 **OR**

 1540 × 550 (A1)(M1)

**UP** **=** 847000 cm2 (A1)(ft)(G3)

**Note:** Award (A1) for both dimensions converted correctly to cm, (M1) for multiplication of both dimensions. (A1)(ft) for correct product of their sides in cm.

**UP** (ii) 242 cm2 (0.0242 m2) (A1)

(iii)  = 70 (M1)
 = 50
70 × 50 **=** 3500 (A1)(G2)

 **OR**

  = 3500 (M1)(A1)(ft)(G2)

**Note:** Follow through from parts (a) (i) and (ii).

(b) (i) BC2 = 42 + 62 – 2 × 4 × 6 × cos 40° (M1)(A1)

**UP** BC **=** 3.90 m (A1)(G2)

**Note:** Award (M1) for correct substituted formula, (A1) for correct substitutions, (A1) for correct answer.

**UP** (ii) perimeter = 13.9 m (A1)(ft)(G1)

**Notes:** Follow through from part (b)(i).

(iii) Area **=**  × 4 × 6 × sin 40° (M1)

**UP** **=** 7.71 m2 (A1)(ft)(G2)

**Notes:** Award (M1) for correct formula and correct substitution, (A1)(ft) for correct answer.

(iv)  × 100% **=** 9.11% (A1)(M1)(A1)(ft)(G2)

**Notes:** Accept 9.10 %
Award (A1) for both measurements correctly written in the same unit, (M1) for correct method, (A1)(ft) for correct answer.
Follow through from (b) (iii) and from consistent error in conversion of units throughout the question.

(c) (i)  (M1)
**=** 30° (A1)(G2)

(ii) MN **=** 2 ×  (A1)(ft)(M1)

 **OR**

 MN **=** 2 × 11 tan 75°

**UP** MN **=** 82.1cm (A1)(ft)(G2)

**Notes:** Award (A1) for 11 and 2 seen (implied by 22 seen), (M1) for dividing by tan15 (or multiplying by tan 75). Follow through from their angle in part (c) (i)

(d) volume = 5419 × 2.5 (M1)

**UP** **=** 13500 cm3 (A1)(G2)

(e)  = 26.4 (M1)(A1)(ft)(G2)

**Note:** Award (M1) for dividing their part (d) by 514.
Accept 26.3.

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