For **Pearson Edexcel**
Level 3 GCE

AS Mathematics

Paper 2: Statistics and Mechanics

Churchill Paper 2A – Marking Guide

Method marks (M) are awarded for knowing and attempting to apply a valid method

Accuracy marks (A) are awarded for a correct answer, having earned the relevant method marks

(B) marks are unconditional accuracy marks (independent of method marks)

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Churchill AS Paper 2A Marking Guide – Edexcel

1 **(a)** Total no. = 95 + 71 + 27 + 33 = 226

No. of 20 to 29 = $\frac{40}{226}$ × 95 = 16.81... B1

No. of 30 to 39 = $\frac{40}{226}$ × 71 = 12.56...

No. of 40 to 54 = $\frac{40}{226}$ × 27 = 4.77...

No. of 55 to 69 = $\frac{40}{226}$ × 33 = 5.84...

Giving 17, 13, 5 and 6 M1

Total = 17 + 13 + 5 + 6 = 41 so round down 30 to 39

Nos. in groups = 17 (as required), 12, 5 and 6 respectively A1

(b) e.g. The employees who leave most quickly might be those who are least committed or have to collect children etc. Their views on the working week might not be representative of the views of all the employees B1 Total 4

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2 **(a)** e.g. There is strong positive correlation showing that as the mean wind direction increases, so does the maximum gust direction B1

(b) e.g. Giles is likely to be wrong about point *P*. The two directions are roughly 010º and 358º. As "360º" = 000º the directions are quite similar as with most of the other days B1

Giles is quite likely to be right about point *Q* as the directions are roughly 320º and 160º which are almost opposite directions which would rarely be the case B1

(c) mean ≈ $\frac{61900}{31}$ = 1996.7... = 2000 Dm (3sf) B1

std. Dev. ≈ $\sqrt{\frac{147460000}{31} - (1996.8)^2}$ M1

= 877.3... = 877 Dm (3sf) A1 Total 6

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3 **(a)** $P(X = 0) = 1 \times \left(\frac{1}{6}\right)^0 \times \left(\frac{5}{6}\right)^n = \left(\frac{5}{6}\right)^n$

$P(X = 1) = n \times \left(\frac{1}{6}\right)^1 \times \left(\frac{5}{6}\right)^{n-1}$ M1

Equal so $\left(\frac{5}{6}\right)^n = n \times \left(\frac{1}{6}\right)^1 \times \left(\frac{5}{6}\right)^{n-1}$

$\frac{5}{6} = n \times \frac{1}{6}$

$n = 5$ A1

(b) Total probability = 1 so $k + k^2 + 2k + \frac{3}{4}k = 1$ M1

$k^2 + \frac{15}{4}k - 1 = 0$

$4k^2 + 15k - 4 = 0$

$(4k - 1)(k + 4) = 0$ M1

$k = -4$ or $\frac{1}{4}$

As k is a probability it can't be negative so $k = \frac{1}{4}$ A1

$P(Y \leq 3) = k + k^2$

$= \frac{1}{4} + \left(\frac{1}{4}\right)^2 = \frac{5}{16}$ A1 Total 6

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4 **(a)** e.g. If, say, the crate was dropped, it might have a much higher proportion of boxes with cracked eggs and not be representative. B1
The sample should consist of boxes from lots of crates

(b) $X \sim B(60, 0.98)$ M1

$H_0 : p = 0.98$

$H_1 : p < 0.98$ B1

Test value $X = 57$ (60 – 3 boxes with no cracked eggs) M1

$P(X \leq 57) = 0.1187$ (from calculator) A1

$0.1187 > 0.1$

Do not reject H_0, no evidence at the 10% significance level that the manager's belief is right M1 A1 Total 7

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5 **(a)** **(i)** Number = area ≈ $10 \times 0.4 + 5 \times 1.0$ M1

$= 4 + 5 = 9$ A1

(ii) 20 to 30 = $10 \times 0.4 = 4$

30 to 38 = $8 \times 1.0 = 8$ 20 to 38 = 12

38 to 44 = $6 \times 1.5 = 9$ 20 to 44 = 21

$\frac{1}{2}$ of 34 = 17

Median ≈ $38 + \frac{5}{9} \times 6$ M1

= 41.3 s (3sf) A1

(b) P(at least one > 38) = 1 – P(both < 38) [None exactly 38]

$P(F < 38) = \frac{12}{34} = \frac{6}{17}$

$P(M < 38) = \frac{1}{2}$ [as median = 38] M1

P(at least one > 38) = $1 - (\frac{6}{17} \times \frac{1}{2})$ M1

$= 1 - \frac{3}{17} = \frac{14}{17}$ A1 Total 7

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6 **(a)** Let max velocity (at $t = 14$) be V

Distance = area under graph

$= 20 \times 8 + \frac{1}{2} \times 6 \times (20 + V) + \frac{1}{2} \times 2 \times V$ M1

$= 160 + 60 + 3V + V$

$= 220 + 4V$ A1

Therefore $220 + 4V = 340$

$4V = 120$

$V = 30$ m s^{-1} M1 A1

(b) Acceleration from time 8 to 14 seconds

Acceleration = gradient = $\frac{30 - 20}{14 - 8} = \frac{5}{3}$ m s^{-2} M1

Deceleration from time 14 to 16 seconds

Deceleration = gradient = $\frac{0 - 30}{16 - 14} = -15$ m s^{-2}

Magnitude of decel = $15 = 9 \times \frac{5}{3} = 9 \times$ magnitude of accel M1 A1 Total 7

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7 **(a)** Resultant force = $(4\mathbf{i} - \mathbf{j}) + (-11\mathbf{i} + 14\mathbf{j}) + (3\mathbf{i} - 6\mathbf{j})$ M1

$= -4\mathbf{i} + 7\mathbf{j}$

Magnitude of force = $\sqrt{(-4)^2 + 7^2}$ M1

$= \sqrt{65}$

$F = ma$: $\sqrt{65} = 3a$ M1

$a = \sqrt{65} \div 3 = 2.687... = 2.69$ m s^{-2} (3sf) A1

(b) $s = ut + \frac{1}{2}at^2$

$t = 3$ $s = 0 + \frac{1}{2} \times 2.687 \times 3^2 = 12.093...$ M1

$t = 4$ $s = 0 + \frac{1}{2} \times 2.687 \times 4^2 = 21.499...$

In 4th second $s = 21.499 - 12.093 = 9.41$ m (3sf) M1 A1 Total 7

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8 **(a)** $s = \int 0.1(3t^2 - 32t + 64)\ dt$

$s = 0.1(t^3 - 16t^2 + 64t) + c$ M1

When $t = 0$, $s = 0$ so $c = 0$ M1

When $t = 1$, $s = 0.1(1^3 - 16 \times 1^2 + 64 \times 1)$ M1

$s = 0.1(1 - 16 + 64) = 0.1 \times 49 = 4.9$ A1

So after 1 second the drone is 4.9 m above the ground

(b) **(i)** $v = 0.1(3t^2 - 32t + 64) = 0$

$3t^2 - 32t + 64 = 0$ M1

$(3t - 8)(t - 8) = 0$ M1

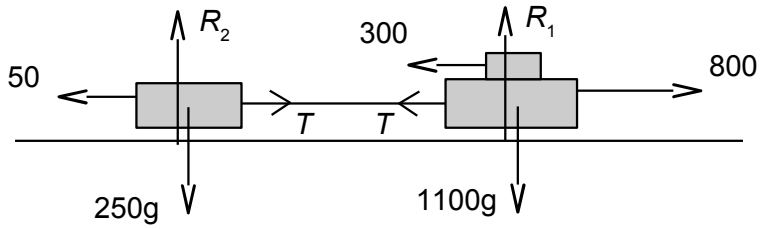
$t = \frac{8}{3}$ or 8

Next at rest after $2\frac{2}{3}$ s A1

(ii) e.g. The drone stops moving up and starts to move down B1

(c) e.g. After a short time the drone moves upwards with a velocity that keeps increasing forever. In reality this couldn't happen B1 Total 9

9



(a) $F = ma$ horizontally for trailer: $T - 50 = 250a$ **(A)** M1

$F = ma$ horizontally for car: $800 - 300 - T = 1100a$ A1

$500 - T = 1100a$ **(B)**

(A) + **(B)**: $500 - 50 = 250a + 1100a$ M1

$a = \dfrac{450}{1350} = \frac{1}{3}\ \text{ms}^{-2}$ A1

(b) $v^2 = u^2 + 2as$

$15^2 = 12^2 + 2 \times \frac{1}{3} \times s$ M1

$\frac{2}{3}s = 225 - 144 = 81$

$s = \frac{3}{2} \times 81 = 121.5$ m A1

(c) e.g. As the speed increases, the resistance to motion wil increase meaning a greater driving force will be needed to maintain the same acceleration A1 Total 7

TOTAL FOR PAPER: 60 MARKS