Version 1.0

General Certificate of Education (A-level)
January 2012

Mathematics MM2B

(Specification 6360)

Mechanics 2B

Report on the Examination

Set and published by the Assessment and Qualifications Alliance.

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Registered address: AQA, Devas Street, Manchester M15 6EX.

General

Candidates found the first few questions to be a good introduction to the paper, with the majority scoring most of the marks in questions 1, 2, 3, 4, 5 and 6. Questions 7 and 8 caused problems to many candidates. In question 7, many candidates had difficulty with the two tensions, T_A and T_B, being in the ratio of 2 : 5.

Question 1

Candidates answered this question well. Virtually all candidates used energy as required and scored all 8 marks, although, in part (c)(i), some subtracted the change in potential energy from the initial kinetic energy. A few ignored part (c)(i) and only answered part (c)(ii).

Question 2

This question was also answered well. In part (a), a few candidates did not divide $\mathbf{F}$ by 50 accurately. In part (b), a number of candidates did not find their '$+\mathbf{c}$' correctly, simply replacing their '$\mathbf{c}$' with $7\mathbf{i} - 4\mathbf{j}$. Others, on evaluating their '$\mathbf{c}$', took $-\mathrm{e}^{-2t}$ when $t = 0$ to be $+1$ rather than -1.

Question 3

Most candidates completed the force diagram correctly; a few showed their frictional force acting away from the wall. In part (b), most candidates appreciated that taking moments was needed, however a few forgot to include some distances or angles. Part (c) was well answered by most candidates, regardless of whether they were able to answer part (b), as it was quickly noticed that F was 256 N (given in part (b)) and R was $100g$ (resolving vertically).

Question 4

In part (a), the majority of candidates showed that the power was $25 \times 42 \times 42$, giving the answer of $44\,100$ watts. Part (b) proved more demanding, with many failing to find the accelerating force to be 2940 (the maximum force exerted by the engine) – 375 (the resistance force).

Question 5

This question was answered succinctly by the better candidates. Others were concerned that the mass was not given, and some tried to include terms in $mg\cos\theta$. Some found $\frac{mv^2}{r} = 0.85R$ but were unable to find R.

Question 6

This question was answered well by most candidates. However, in part (a), a few candidates did not show the required step $0.4\frac{\mathrm{d}v}{\mathrm{d}t} = 2 - 4v$; others lost and recreated the minus signs, eg $\frac{\mathrm{d}v}{\mathrm{d}t} = 5 - 10v = -10\,(0.5 + v) = -10\,(v - 0.5)$, which was penalised. In part (b), the majority of candidates used $\int \frac{1}{v - 0.5}\,\mathrm{d}v = -\int 10\,\mathrm{d}t$ and then solved this by integrating both sides.

The integration $\int \frac{1}{v-0.5}\mathrm{d}v$ caused some candidates difficulty, finding terms such as $\frac{1}{\frac{1}{2}v^2-0.5v}$ etc. The use of logarithms was often incorrect, with $\ln(v–0.5) = – 10t + \ln 0.5$ commonly becoming $v-0.5 = \mathrm{e}-10t+0.5$

Question 7

In part (a), most candidates assumed that conservation of energy was required. Unfortunately, some tried to use $v^2 = u^2 + 2as$. In part (b) candidates had difficulty in identifying their 'u' and their 'v', often not stating whether they were considering the tension at point A or at point B. Sometimes the force equation at A (or at B) was simply given as $T = mg$, with candidates ignoring any circular motion. The fact that T_A and T_B were stated to be in the ratio of $2 : 5$ caused major problems. Some stated that $T_A = 2$ and $T_B = 5$ — this was not accepted as it could not produce the correct solution — other candidates used $T_A = 2T$ and $T_B = 5T$, which was valid and often led to a successful solution. A number of candidates used $T = 2T$ and $T = 5T$; if they managed to keep track of which of these Ts were T_A , T_B or the T used in their ratio, this was condoned. A significant number of candidates incorrectly used $T_A = \frac{5}{2}$, which usually resulted in a negative value for u^2. In part (c), those candidates who were successful in part (b) found $v^2 = 5ag$. However many gave the ratio $u : v$ to be $9 : 5$ rather than $3 : \sqrt{5}$.

Question 8

Part (a) of this question was answered successfully by most candidates. Although many candidates were successful in part (b), a few attempted to use kinetic energy. Relatively few candidates were successful in part (c), with most candidates stating that when the particle was at B the string was stretched and hence the string had elastic potential energy and thus the particle must move. The fact that the particle would only move again if the tension in the string was greater than the friction, found in part (b), was only considered by the better candidates. Those candidates who had answered part (b) correctly usually answered parts (d) and (e) correctly.

Mark Ranges and Award of Grades

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