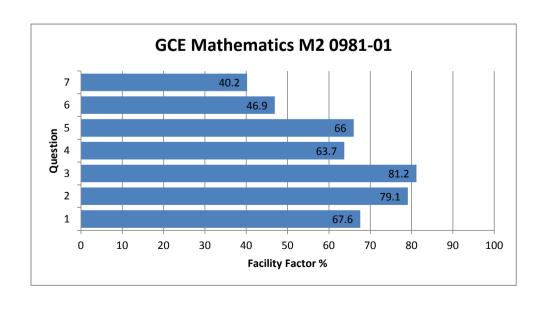


WJEC 2014 Online Exam Review

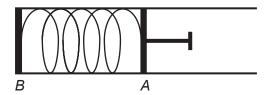
GCE Mathematics M2 0981-01

All Candidates' performance across questions

?	?	?	?	?	?	?	_
Question Title	N	Mean	S D	Max Mark	F F	Attempt %	
1	899	4.7	2.3	7	67.6	99.7	\leftarrow
2	897	7.9	2.7	10	79.1	99.5] .
3	899	8.1	2.9	10	81.2	99.7	\leftarrow
4	886	6.4	3	10	63.7	98.2	\leftarrow
5	896	8.6	4.3	13	66	99.3	1
6	878	6.1	4	13	46.9	97.3	\leftarrow
7	868	4.8	3.6	12	40.2	96.2	\leftarrow



1. The diagram shows a piston, of mass $0.8 \, \text{kg}$, enclosed in a horizontal tube and attached to a light spring of natural length $0.2 \, \text{m}$ and modulus of elasticity 625 N. The other end of the spring is fixed to the end of the tube at point B.



Initially, the piston is held at rest at a point A with the spring compressed a distance of $0.1 \,\mathrm{m}$, so that AB is the compressed length of the spring.

(a) Calculate the elastic energy stored in the spring.

[2]

The piston is then released. During the subsequent motion, it is subjected to a resistance to motion of constant magnitude 46 N.

(b) Determine the velocity of the piston when the spring reaches its natural length. [5]

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	energy 2l 2x0.2 = 15.625J.
Q1b)	
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	$=0.4V^{-1}$
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	= 0.784
-	- 0.700
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ji .	
	$15.625 + 0.784 - 0.44^2 + 1.568 - 6446$
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	60.466 = 0.4V2
	V2 - 151.165
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÷,	- 0.100	
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	16.034 = -44,432 +0.6V2	
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- 3. A vehicle of mass 4000 kg is travelling up a slope inclined at an angle α to the horizontal, where $\sin \alpha = \frac{2}{49}$. The engine of the vehicle is working at a constant rate of 90 kW.
 - (a) Calculate the resistance to the motion of the vehicle at the instant when its speed is $4.8\,\mathrm{ms^{-1}}$ and its acceleration is $1.2\,\mathrm{ms^{-2}}$.
 - (b) Determine the maximum velocity of the vehicle when the resistance to motion has magnitude 12800 N. [4]

3)0)			
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	F-FO = mc		
	F- = F-	Ma	
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	- 13	950 N	
4	***************************************		

b)	At max velocity		
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	P = FU		
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P = FU	
90000 = 12800 V	
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= 7.03 ms	



- 4. At time t = 0, an aeroplane A has position vector (3i + 5j + 20k) m and is flying with constant velocity (-i + 2j + k) ms⁻¹.
 At time t = 0, another aeroplane B has position vector (-2i + xj + 15k) m, and is flying with constant velocity (3i 4j + 2k) ms⁻¹.
 - (a) Find expressions for the position vector of A and the position vector of B at time t s. [3]
 - (b) Determine an expression for AB^2 , where AB is the distance between A and B at time t s. [4]
 - (c) Given that the shortest distance between A and B occurs at t = 5, calculate the value of x. [3]

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	a) PA = (3-6) i + (5+24)) + (20+4) 17
	rb=(-2+2t):+(x-4t);+(15+25)+
	b (10)3+(3-10)3
	6) AB = ro - ra
	AB=(-5+46)i+ (5c-5)-66)j+(-5+6)k
	AB= (-5+4+)2+ (6c-5)-6+)2+ (-5+4)2
	AB= 25-406 + (x-5) -126(x-5) +366 +25-106+62
	AB2 = 50 - 5 +37+2 + 22 - 10x +25 - 12tx + 60+
	AB2 = 3762 +75 + 23 - 1000 - 12600 +106
	c) Alle 6=5
	$= 2AB^2 = 37(5)^2 + 75 + x^2 - 10x - 75x + 86$
	AB = 925 + 75 + 23 -852 +50
	AB2 = 22 -85x +1050
	Shortest distance
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	AB= (-5+4+)2+ (x-5)-6+)2+ (-5+4)2 +
	AB= 25-406 + (x-5) -126(x-5) +366 +25-106+62
	AB2 = 50 - 5 +3762 + 22-10x +25 -12tx + 60+
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	AB2 = 3762 +75 +22-1000 -12600+106
	c) Alle t=5
	$= \frac{7AB^2 - 37(5)^2 + 75 + x^2 - 10x - 75x + 86}{AB^2 - 925 + 75 + x^2 - 85x + 50}$
	AB = 925 + 75 + 23 + 2 - 85x + 50
	AB2 = x2 -85x +1050
	Shortest distance
	when $\frac{\alpha}{\alpha z}(AB^s) = 0$
	$\left(\frac{d}{dx}\left(4B^{2}\right)=2c-85\right)$
	0 = 2x - 85
	85 = 2 x
	$\chi = 42.5$
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6. A particle of mass 3 kg moves on a horizontal plane. At time t = 0, the particle has position vector $-2\mathbf{i} + 3\mathbf{j}$ m, where \mathbf{i} and \mathbf{j} are unit vectors along the x-axis and y-axis respectively. At time t s, the particle moves with velocity \mathbf{v} ms⁻¹ given by

$$\mathbf{v} = 4\sin 2t \,\mathbf{i} + 15\cos 5t \,\mathbf{j}.$$

- (a) Find the magnitude of the force acting on the particle at time $t = \frac{3\pi}{2}$ s. [5]
- (b) Determine the position vector of the particle at time ts. [4]
- (c) Calculate the time and the distance of the particle from the origin when it crosses the y-axis for the first time. [4]

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	= 8(OSZE i - 75SinSt
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	= 67 ms-2.
	F= ma
	= 3 × 67
	= 201 N
b)	r = (-2i +3j) + t (4 sin2ti + 15cos Stj)
	= (-21 +3j) + 4tsin2ti + 1stcosstj
	= (-2 + 4 \(\frac{1}{2}\) \(\frac{1}{2}\) + (3 + 1\(\frac{1}{2}\) \(\frac{1}{2}\)
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	F= m q = 3 × 67 = 201 N	
5)	r = (-2i +3j) + t (4 Sin2ti + 15 (05 St)	
	= (-21 +3j) + 4tsinzti + 1st cosst j	
	= (-2 + 4 \(\) \(0
С	$r = 3\pm \underline{j}$ not mad. $r = 3 + 15\cos 5 \pm$	
	GOSSICIA 1/2	
	3 = j = (3 + 15 cos 5 +) j 18 cos 5 + 3 + 3	
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- 7. One end of a light rod of length l metres is freely jointed to a fixed point O and the other end is attached to a particle of mass m kg. The particle is projected so that it describes a vertical circle. The speed of the particle at the highest point, u ms⁻¹, is a quarter of its speed at the lowest point of the circle.
 - (a) Show that $u^2 = \frac{4}{15}gl$. [3]
 - (b) When the rod is inclined at an angle θ to the **downward** vertical,
 - (i) find an expression for the tension in the rod in terms of m, g and θ .
 - (ii) determine the value of θ when the tension in the rod becomes zero. [9]

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