OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

4761/01

MATHEMATICS (MEI)

Mechanics 1

THURSDAY 17 JANUARY 2008

Afternoon

Time: 1 hour 30 minutes

Additional materials: Answer Booklet (8 pages)
Graph paper
MEI Examination Formulae and Tables (MF2)

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- You are permitted to use a graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.
- The acceleration due to gravity is denoted by $g\,\mathrm{m\,s^{-2}}$. Unless otherwise instructed, when a numerical value is needed, use $g = 9.8$.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is 72.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.

This document consists of **6** printed pages and **2** blank pages.

Section A (36 marks)

1 A cyclist starts from rest and takes 10 seconds to accelerate at a constant rate up to a speed of $15\,\mathrm{m\,s^{-1}}$. After travelling at this speed for 20 seconds, the cyclist then decelerates to rest at a constant rate over the next 5 seconds.

(i) Sketch a velocity-time graph for the motion. [3]

(ii) Calculate the distance travelled by the cyclist. [3]

2 The force acting on a particle of mass 1.5 kg is given by the vector $\begin{pmatrix} 6 \\ 9 \end{pmatrix}$ N.

(i) Give the acceleration of the particle as a vector. [2]

(ii) Calculate the angle that the acceleration makes with the direction $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$. [2]

(iii) At a certain point of its motion, the particle has a velocity of $\begin{pmatrix} -2 \\ 3 \end{pmatrix}\,\mathrm{m\,s^{-1}}$. Calculate the displacement of the particle over the next two seconds. [3]

3

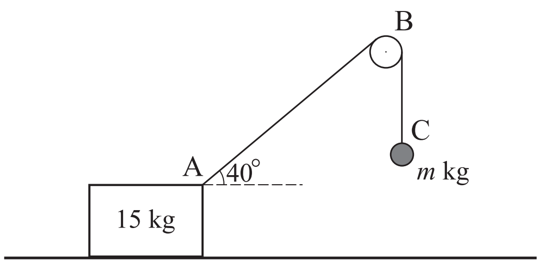

Fig. 3

Fig. 3 shows a block of mass 15 kg on a rough, horizontal plane. A light string is fixed to the block at A, passes over a smooth, fixed pulley B and is attached at C to a sphere. The section of the string between the block and the pulley is inclined at 40° to the horizontal and the section between the pulley and the sphere is vertical.

The system is in equilibrium and the tension in the string is 58.8 N.

(i) The sphere has a mass of m kg. Calculate the value of m. [2]

(ii) Calculate the frictional force acting on the block. [3]

(iii) Calculate the normal reaction of the plane on the block. [3]

4 Force **F** is $\begin{pmatrix} 4 \\ 1 \\ 2 \end{pmatrix}$ N and force **G** is $\begin{pmatrix} -6 \\ 2 \\ 4 \end{pmatrix}$ N.

(i) Find the resultant of **F** and **G** and calculate its magnitude. [4]

(ii) Forces **F**, 2**G** and **H** act on a particle which is in equilibrium. Find **H**. [3]

5

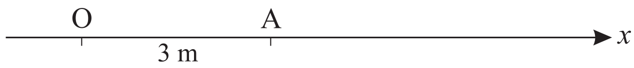

Fig. 5

A toy car is moving along the straight line Ox, where O is the origin. The time t is in seconds. At time $t = 0$ the car is at A, 3 m from O as shown in Fig. 5. The velocity of the car, v m s^{-1}, is given by

$$v = 2 + 12t - 3t^2.$$

Calculate the distance of the car from O when its acceleration is zero. [8]

Section B (36 marks)

6 A helicopter rescue activity at sea is modelled as follows. The helicopter is stationary and a man is suspended from it by means of a vertical, light, inextensible wire that may be raised or lowered, as shown in Fig. 6.1.

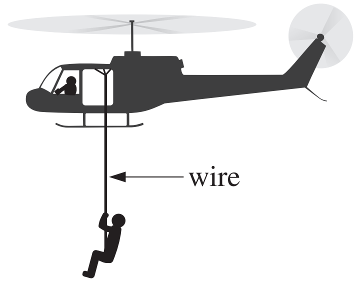

Fig. 6.1

(i) When the man is descending with an acceleration $1.5\,\mathrm{m\,s^{-2}}$ downwards, how much time does it take for his speed to increase from $0.5\,\mathrm{m\,s^{-1}}$ downwards to $3.5\,\mathrm{m\,s^{-1}}$ downwards?

How far does he descend in this time? [4]

The man has a mass of 80 kg. All resistances to motion may be neglected.

(ii) Calculate the tension in the wire when the man is being lowered

(A) with an acceleration of $1.5\,\mathrm{m\,s^{-2}}$ downwards,

(B) with an acceleration of $1.5\,\mathrm{m\,s^{-2}}$ upwards. [5]

Subsequently, the man is raised and this situation is modelled with a constant resistance of 116 N to his upward motion.

(iii) For safety reasons, the tension in the wire should not exceed 2500 N. What is the maximum acceleration allowed when the man is being raised? [4]

At another stage of the rescue, the man has equipment of mass 10 kg at the bottom of a vertical rope which is hanging from his waist, as shown in Fig. 6.2. The man and his equipment are being raised; the rope is light and inextensible and the tension in it is 80 N.

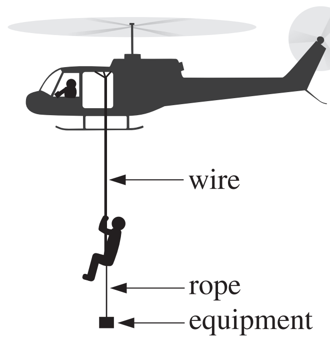

Fig. 6.2

(iv) Assuming that the resistance to the upward motion of the man is still 116 N and that there is negligible resistance to the motion of the equipment, calculate the tension in the wire. [4]

7 A small firework is fired from a point O at ground level over horizontal ground. The highest point reached by the firework is a horizontal distance of 60 m from O and a vertical distance of 40 m from O, as shown in Fig. 7. Air resistance is negligible.

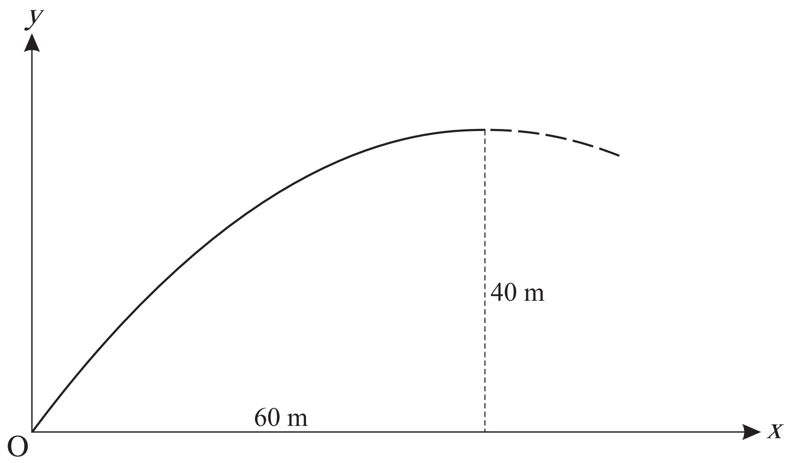

Fig. 7

The initial horizontal component of the velocity of the firework is $21\,\mathrm{m\,s^{-1}}$.

(i) Calculate the time for the firework to reach its highest point and show that the initial vertical component of its velocity is $28\,\mathrm{m\,s^{-1}}$. [4]

(ii) Show that the firework is $(28t - 4.9t^2)$ m above the ground t seconds after its projection. [1]

When the firework is at its highest point it explodes into several parts. Two of the parts initially continue to travel horizontally in the original direction, one with the original horizontal speed of $21\,\mathrm{m\,s^{-1}}$ and the other with a quarter of this speed.

(iii) State why the two parts are always at the same height as one another above the ground and hence find an expression in terms of t for the distance between the parts t seconds after the explosion. [3]

(iv) Find the distance between these parts of the firework

(A) when they reach the ground, [2]

(B) when they are 10 m above the ground. [5]

(v) Show that the cartesian equation of the trajectory of the firework before it explodes is $y = \frac{1}{90}(120x - x^2)$, referred to the coordinate axes shown in Fig. 7. [4]

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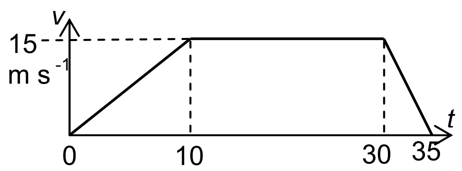
Q 1		Mark	Comment	Sub
(i)		B1 B1 B1	Acc and dec shown as straight lines Horizontal straight section All correct with *v* and times marked and at least one axis labelled. Accept (*t*, *v*) or (*v*, *t*) used.	3
(ii)	Distance is found from the area area is $\frac{1}{2}\times10\times15+20\times15+\frac{1}{2}\times5\times15$ (or $\frac{1}{2}\times(20+35)\times15$) = 412.5 so distance is 412.5 m	M1 A1 A1	At least one area attempted or equivalent *uvast* attempted over one appropriate interval. Award for at least two areas (or equivalent) correct Allow if a trapezium used and only 1 substitution error. FT **their** diagram. cao (Accept 410 or better accuracy)	3
		6		
2 (i)	$\begin{pmatrix}6\\9\end{pmatrix}=1.5\mathbf{a}$ giving $\mathbf{a}=\begin{pmatrix}4\\6\end{pmatrix}$ so $\begin{pmatrix}4\\6\end{pmatrix}$ m s^{-2}	M1 A1	Use of N2L with an attempt to find **a**. Condone spurious notation. Must be a vector in proper form. Penalise only once in paper.	2
(ii)	Angle is $\arctan\left(\frac{6}{4}\right)$ = 56.309… so 56.3° (3 s. f.)	M1 F1	Use of arctan with **their** $\frac{6}{4}$ or $\frac{4}{6}$ or equiv. May use **F**. FT **their a** provided both cpts are +ve and non-zero.	2
(iii)	Using $\mathbf{s} = t\mathbf{u}+0.5t^2\mathbf{a}$ we have $\mathbf{s}=2\begin{pmatrix}-2\\3\end{pmatrix}+0.5\times4\begin{pmatrix}4\\6\end{pmatrix}$ so $\begin{pmatrix}4\\18\end{pmatrix}$ m	M1 A1 A1 7	Appropriate single ***uvast*** (or equivalent sequence of ***uvast***). If integration used twice condone omission of **r**(0) but not **v**(0). FT **their a** only cao. isw for magnitude subsequently found. Vector must be in proper form (penalise only once in paper).	3

Q 3		Mark	Comment	Sub
(i)	$m \times 9.8 = 58.8$ so $m = 6$	M1 A1	$T = mg$. Condone sign error. cao. CWO.	2
(ii)	Resolve → $58.8\cos 40 - F = 0$ F = 45.043… so 45.0 N (3 s. f.)	M1 B1 A1	Resolving **their** tension. Accept $s \leftrightarrow c$. Condone sign errors but not extra forces. (**their** T) × $\cos 40$ (or equivalent) seen Accept ± 45 only.	3
(iii)	Resolve ↑ $R + 58.8\sin 40 - 15 \times 9.8 = 0$ R = 109.204… so 109 N (3 s. f.)	M1 A1 A1	Resolving **their** tension. All forces present. No extra forces. Accept $s \leftrightarrow c$. Condone errors in sign. All correct cao	3
		8		
Q 4		**Mark**	**Comment**	**Sub**
(i)	Resultant is $\begin{pmatrix}4\\1\\2\end{pmatrix} + \begin{pmatrix}-6\\2\\4\end{pmatrix} = \begin{pmatrix}-2\\3\\6\end{pmatrix}$ Magnitude is $\sqrt{(-2)^2+3^2+6^2} = \sqrt{49} = 7$ N	M1 A1 M1 F1	Adding the vectors. Condone spurious notation. Vector must be in proper form (penalise only once in the paper). Accept clear components. Pythagoras on **their** 3 component vector. Allow e.g. – 2² for (– 2)² even if evaluated as – 4. FT **their** resultant.	4
(ii)	**F** + 2**G** + **H** = **0** So **H** = - 2**G** - **F** = $-\begin{pmatrix}-12\\4\\8\end{pmatrix} - \begin{pmatrix}4\\1\\2\end{pmatrix}$ $= \begin{pmatrix}8\\-5\\-10\end{pmatrix}$	M1 A1 A1	Either **F** + 2**G** + **H** = **0** or **F** + 2**G** = **H** Must see attempt at **H** = – 2 **G** – **F** cao. Vector must be in proper form (penalise only once in the paper).	3
		7		

Q 5		Mark	Comment	Sub
	$a = 12 - 6t$	M1 A1	Differentiation, at least one term correct.	
	a = 0 gives *t* = 2	F1	Follow **their** *a*	
	$x = \int (2 + 12t - 3t^2)\mathrm{d}x$	M1	Integration indefinite or definite, at least one term correct.	
	$2t + 6t^2 - t^3 + C$	A1	Correct. Need not be simplified. Allow as definite integral. Ignore *C* or limits	
	x = 3 when *t* = 0	M1	Allow *x* = ± 3 or argue it is $\int_0^2$ from A then ± 3	
	so $3 = C$ and $x = 2t + 6t^2 - t^3 + 3$	A1	Award if seen WWW or $x = 2t + 6t^2 - t^3$ seen with +3 added later.	
	$x(2) = 4 + 24 - 8 + 3 = 23$ m	B1	FT **their** *t* and **their** *x* if obtained by integration but not if -3 obtained instead of +3. [If 20 m seen WWW for displacement award SC6] [Award SC1 for position if constant acceleration used for displacement and then +3 applied]	8
		8		

Q 6		Mark	Comment	Sub
(i)	$3.5 = 0.5 + 1.5T$ so T = 2 so 2 s $s = \frac{3.5+0.5}{2} \times 2$ so s = 4 so 4 m	M1 A1 M1 F1	Suitable *uvast*, condone sign errors. cao Suitable *uvast*, condone sign errors. FT **their** T. [If s found first then it is cao. In this case when finding T, FT **their** s, if used.]	4
(ii) (A) (B)	N2L ↓ : $80 \times 9.8 - T = 80 \times 1.5$ T = 664 so 664 N N2L ↓ : $80 \times 9.8 - T = 80 \times (-1.5)$ T = 904 so 904 N	M1 B1 A1 M1 A1	Use of N2L. Allow weight omitted and use of $F = mga$ Condone errors in sign but do not allow extra forces. weight correct (seen in (A) or (B)) cao N2L with all forces and using $F = ma$. Condone errors in sign but do not allow extra forces. cao [Accept 904 N seen for M1 A1]	5
(iii)	N2L ↑ : $2500 - 80 \times 9.8 - 116 = 80a$ a = 20 so 20 m s^{-2} upwards.	M1 A1 A1 A1	Use of N2L with $F = ma$. Allow 1 force missing. No extra forces. Condone errors in sign. ± 20, accept direction wrong or omitted upwards made clear (accept diagram)	4
(iv)	N2L ↑ on equipment: $80 - 10 \times 9.8 = 10a$ $a = -1.8$ N2L ↑ **either** all: $T - (80+10) \times 9.8 - 116 = 90 \times (-1.8)$ **or** on man: T – (80×9.8) – 116 – 80 = 80×(– 1.8) T = 836 so 836 N	M1 A1 M1 A1	Use of N2L on equipment. All forces. $F = ma$. No extra forces. Allow sign errors. Allow ± 1.8 N2L for system or for man alone. Forces correct (with no extras); accept sign errors; **their** ± 1.8 used cao [NB The answer 836 N is independent of the value taken for g and hence may be obtained if all weights are omitted.]	4
		17		

Q 7		Mark	Comment	Sub
(i)	Horiz $21t = 60$ so $\frac{20}{7}$ s (2.8571…) **either** $0 = u - 9.8 \times \frac{20}{7}$ **or** $-u = u - 9.8 \times \left(\frac{40}{7}\right)$ **or** $40 = u \times \frac{20}{7} - 4.9\left(\frac{20}{7}\right)^2$ so *u* = 28 so 28 m s $^{-1}$	M1 A1 M1 E1	Use of horizontal components and *a* = 0 or $s = vt - 0.5at^2$ with *v* = 0. Any form acceptable. Allow M1 A1 for answer seen WW. [If $s = ut + 0.5at^2$ and *u* = 0 used without justification award M1 A0] [If *u* = 28 *assumed* to find time then award SC1] Use of $v = u + at$ (or $v^2 = u^2 + 2as$) with *v* = 0. **or** Use of *v* = *u* + *at* with *v* = – *u* and appropriate *t*. **or** Use of $s = ut + 0.5at^2$ with *s* = 40 and appropriate *t* Condone sign errors and, where appropriate, $u \leftrightarrow v$. Accept signs not clear but not errors. Enough working must be given for 28 to be properly shown. [NB *u* = 28 may be found first and used to find time]	4
(ii)	$y = 28t - 0.5 \times 9.8t^2$	E1	*Clear & convincing* use of *g* = – 9.8 in $s = ut + 0.5at^2$ or $s = vt - 0.5at^2$ **NB: AG**	1
(iii)	Start from same height with same (zero) vertical speed at same time, same acceleration Distance apart is $0.75 \times 21t = 15.75t$	E1 M1 A1	For two of these reasons 0.75×21*t* seen **or** 21*t* and 5.25*t* both seen with intention to subtract. Need simplification - LHS alone insufficient. CWO.	3
(iv) (A)	**either** Time is $\frac{20}{7}$ s by symmetry so $15.75 \times \frac{20}{7} = 45$ so 45 m **or** Hit ground at same time. By symmetry one travels 60 m so the other travels 15 m in this time ($\frac{1}{4}$ speed) so 45 m.	B1 B1 B1 B1	Symmetry or *uvast* FT their (iii) with $t = \frac{20}{7}$ [SC1 if 90 m seen]	2
(B)	see next page			

Q7	continued			
(B)	**either** Time to fall is $40-10=0.5\times 9.8\times t^2$ t = 2.47435… need $15.75\times 2.47435..=38.971..$ so 39.0 (3sf) **or** Need time so $10=28t-4.9t^2$ $4.9t^2-28t+10=0$ so $t=\frac{28\pm\sqrt{28^2-4\times 4.9\times 10}}{9.8}$ so 0.382784… or 5.33150… Time required is 5.33150… $-\frac{20}{7}$ = 2.47435.. need $15.75\times 2.47435..=38.971..$ so 39.0 (3sf)	M1 A1 A1 A1 F1 M1 M1* A1 M1 F1	[SC1 if **either** and **or** methods mixed to give $\pm 30=28t-4.9t^2$ or $\pm 10=4.9t^2$] Considering time from explosion with u = 0. Condone sign errors. LHS. Allow ±30 All correct cao FT **their** (iii) only. Equating $28t-4.9t^2=\pm 10$ Dep. Attempt to solve quadratic by a method that could give two roots. Larger root correct to at least 2 s. f. Both method marks may be implied from two correct roots alone (to at least 1 s. f.). [SC1 for either root seen WW] FT **their** (iii) only.	5
(v)	Horiz $(x=)\ 21t$ Elim t between $x=21t$ and $y=28t-4.9t^2$ so $y=28\left(\frac{x}{21}\right)-4.9\left(\frac{x}{21}\right)^2$ so $y=\frac{4x}{3}-\frac{0.1x^2}{9}=\frac{1}{90}\left(120x-x^2\right)$	B1 M1 A1 E1	 Intention must be clear, with some attempt made. t completely and correctly eliminated from their expression for x and correct y. Only accept wrong notation if subsequently explicitly given correct value e.g. $\frac{x^2}{21}$ *seen* as $\frac{x^2}{441}$. Some simplification must be shown. [SC2 for 3 points shown to be on the curve. Award more only if it is made clear that (a) trajectory is a parabola (b) 3 points define a parabola]	4
		19		

4761: Mechanics 1

General Comments

Many of the candidates obtained high scores and many scored full marks to several of the questions. Most of the candidates could make a good start to every question and the only questions where very low scores were seen were Q2 (on the application of Newton's second law and constant acceleration formulae in a vector setting) and Q3 (on statics). Far fewer candidates scored full marks on Section B than on Section A; many strong candidates lost marks in Section B because of their lack of detail when establishing given answers.

Most of the candidates seemed to know what each question required of them and knew the appropriate techniques.

The presentation of the solutions was generally good but, as always, some candidates produced confused working where it was not even clear which part of the question was being attempted.

Candidates should always re-read a question when they think they have finished it to be sure they really have done so. In Qs 6 (i) and 7 (i), there were two requests and quite a few candidates attempted only one of them.

Comments on Individual Questions

Section A

1) **Drawing and using a velocity-time graph**

Most candidates scored full marks on this question with most of the errors being slips. The only common error was to think that the question said that the constant speed was maintained up to 20 s after the start instead of it being maintained for 20 s. Most candidates found the distance travelled by calculating the area under the graph and did this by considering three regions instead of treating it as a single trapezium.

2) **Newton's second law and kinematics in vector form**

A considerable number of candidates did not know how to deal with vectors but many others scored full marks.

(i) Most candidates applied $\mathbf{F} = m\mathbf{a}$ and did so accurately.

(ii) Being given a direction as that of the vector $\begin{pmatrix} 0 \\ 1 \end{pmatrix}$ threw some candidates who tried to combine this with their acceleration before finding the angle. Pleasingly few candidates found the complementary angle to the one required.

(iii) Many candidates knew what to do but others, who had used vectors successfully in part (i), now produced wrong scalar attempts or expressions containing both vector and scalar terms 'added'. The most common error made by those who used the vector form of the constant acceleration formulae was (surprisingly) to use $\mathbf{s} = t\mathbf{v} - \frac{1}{2}t^2\mathbf{a}$ with **v** taken to be the initial velocity. The most common error made by those who integrated was (less surprisingly) to integrate the given initial velocity once instead of integrating the constant acceleration twice.

3) **A statics problem**

While many candidates scored full marks with apparent ease, a few candidates showed they had some fundamental misconceptions. Most of the major errors stemmed from candidates not realising that they should separately consider the block and the sphere or that the tension of 58.8 N is common to the whole of the string; these candidates usually introduced some component of the weight of the block into the tension or included the weight of the sphere in calculations about the block. It was not uncommon for candidates to get part (i) wrong but the rest of the question completely correct. The comments below refer to candidates who did not make these mistakes.

(i) Most candidates managed this correctly.

(ii) Most candidates knew exactly what to do and did it accurately. It was pleasing to see fewer candidates than in the recent past confusing sine and cosine in this part and in part (iii).

(iii) A lot of accurate answers but many candidates wrongly believe that the normal reaction of a plane on a block is the component of the weight perpendicular to the plane and so these were not attempting the right calculation.

4) **Three component vectors and an equilibrium problem.**

Questions of this type set in the recent past have usually been answered poorly by all but the strongest candidates. It was very pleasing that most candidates were able to answer this question well with very few indicating that they had no idea what to do.

(i) Most candidates knew what 'resultant' means and found it but a few thought that it was the magnitude that was the resultant. Far more candidates than in the recent past knew how to find the magnitude of this 3 component vector but wrong methods were not uncommonly seen.

(ii) There were many accurate answers to this part, including some from candidates who had failed to deal with the vectors in part (i) and in Q2. It was pleasing that so many candidates correctly attempted to calculate $\mathbf{H} = -\mathbf{F} - 2\mathbf{G}$ instead of $\mathbf{H} = \mathbf{F} + 2\mathbf{G}$ and a little surprising how many slips were seen in the arithmetic.

5) **A kinematics problem requiring calculus**

This problem was unstructured and it was very pleasing to see so many confident, efficient and accurate solutions.

Most candidates differentiated *v* to find an expression for the acceleration and found that the acceleration is zero when *t* = 2. Some candidates then went on wrongly to try to find the displacement as $\frac{1}{2}\left(v(0)+v(2)\right)\times 2$ but most realized that they should integrate.

Quite a few candidates found the displacement between *t* = 0 and *t* = 2 to be 20 m and wrongly thought this was the position but the majority realized that something more was required; about half of these found the displacement and added 3 at the end and the rest instead obtained the appropriate arbitrary constant to give them an expression for the position at any time. Quite a few candidates, having found the position at time *t* = 2 from a general expression then went on to add another 3m.

Section B

6) **Kinematics and Newton's second law applied to vertical motion**

There were many very good answers to this question. There were few candidates who did not know how to use Newton's second law in simple applications but rather more that did not know how to deal with the connected particle situation in part (iv).

(i) Most candidates managed this part correctly but some forgot to find the distance.

(ii) There were many accurate answers to this part with most of the errors stemming from sign errors in the absence of a clear sign convention. A few candidates omitted the weight term and a small number thought that $F = mga$.

(iii) Most candidates included the resistance in a calculation using Newton's second law but (usually in the absence of a diagram) some omitted the weight. Many candidates gave their answer as 20 m s^{-2} but did not say whether upwards or downwards. A diagram indicating which direction they had taken to be positive was accepted in place of a statement.

(iv) The majority of candidates could not cope with this part. Quite a few did not realize that the tension in the rope allowed calculation of the acceleration and became stuck. Others made statements of the type, 'I do not know the acceleration, but assuming it is ….'. These (and others who made no statement) variously took the acceleration to be that in part (i) or part (ii) or part (iii) or zero.

Many candidates did not apply Newton's second law and simply juggled with the various forces.

Some of those with the right method made sign errors, again usually in the absence of a diagram showing their sign convention.

Despite these problems, there were many neat and efficient solutions.

7) **Projectile motion**

There were many complete solutions and many other candidates only lost a few marks because they did not fully establish the given answers in parts (i), (ii) and (v). Most candidates seemed to know how to approach the questions but many showed they had not completely understood the scenario as they did not use the correct times in part (iv).

A number of candidates seemed to confuse the horizontal and vertical components (but not consistently); one feels that a clear diagram would have helped them.

(i) There were few mistakes made here except by candidates who did not fully establish the given vertical component of speed. Many candidates did not use the most direct methods.

(ii) Most candidates obtained this mark. Again, the most common error was to write down the given answer without attempting to show how it was derived.

(iii) The explanations often lacked sufficient detail. It is not enough that the two parts have the same acceleration; it also depends on their starting from the same height at the same time with the same speed. Candidates were expected to indicate in some way at least two of these requirements. Very few thought to write down an expression for the height and show it applied to both parts.

Most candidates found an expression for the distance *between* the parts but a few stopped after writing down the positions of the parts at time *t*.

(iv) (A) The most common mistake in this part was to take *t* as being the time from projection from the ground and then use it as the time after the explosion. Otherwise there were few errors. Many candidates obtained the correct answer.

(B) This part presented more difficulties. Some candidates equated the expression for the vertical component of displacement to 10; others, more directly, equated the distance dropped to 40 – 10 = 30. The most common errors were with signs and more often, as in (A), from using the wrong time; very many of the candidates who solved $10 = 49t - 4.9t^2$ found the larger root correctly but then went on wrongly to assume this was the time elapsed after the explosion.

Many candidates produced good, efficient and correct answers.

(v) Unlike in some recent sessions, very many of the candidate knew exactly what to do. The only common error was to give insufficient evidence of working to get from the substituted equation to the given answer.