2821/01 Physics A: Forces and Motion

January 2004

Mark Scheme

ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1. Please ensure that you use the **final** version of the Mark Scheme.
   You are advised to destroy all draft versions.

2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks (½) should never be used.

3. The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.

   x = incorrect response (errors may also be underlined)
   ^ = omission mark
   bod = benefit of the doubt (where professional judgement has been used)
   ecf = error carried forward (in consequential marking)
   con = contradiction (in cases where candidates contradict themselves in the same response)
   sf = error in the number of significant figures

4. The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.

5. In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), mark the first answer(s) given up to the total number required. Strike through the remainder. In specific cases where this rule cannot be applied, the exact procedure to be used is given in the mark scheme.

6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)

7. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.

8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct and answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

The following annotations may be used when marking:

X	=	incorrect response (errors may also be underlined)
^	=	omission mark
bod	=	benefit of the doubt (where professional judgement has been used)
ecf	=	error carried forward (in consequential marking)
con	=	contradiction (in cases where candidates contradict themselves in the same response)
sf	=	error in the number of significant figures

Abbreviations, annotations and conventions used in the Mark Scheme:

/	=	alternative and acceptable answers for the same marking point
;	=	separates marking points
NOT	=	answers not worthy of credit
( )	=	words which are not essential to gain credit
___ (underlining)	=	key words which <u>must</u> be used
ecf	=	allow error carried forward in consequential marking
AW	=	alternative wording
ora	=	or reverse argument

Categorisation of marks

The mark scheme categorises marks on the *MACB* scheme.

B marks: These are awarded as independent marks, which do not depend on other marks. For a B-mark to be scored, the point to which it refers must be seen specifically in the candidate's answers.

M marks: These are method marks upon which A-marks (accuracy marks) later depend. For an M-mark to be scored, the point to which it refers must be seen in the candidate's answers. If a candidate fails to score a particular M-mark, then none of the dependent A-marks can be scored.

C marks: These are compensatory marks which can be scored if the point to which they refer are not written down by the candidates, providing subsequent working gives evidence that they must have known it. For example, if an equation carries a C-mark and the candidate does not write down the actual equation but does correct working which suggest he/she knew the equation, then the C-mark is awarded.

A marks: These are accuracy or answer marks which either depend on an M-mark, or allow a C-mark to be scored.

1	**(a)(i)**	distance/time or rate of change of distance	**B1**
	(ii)	(change in)displacement/time or rate of change of displacement	**B1**
	(iii)	scalar has a magnitude only e.g. speed	**B1**
		vector has magnitude and a direction e.g. velocity	**B1**
	(b)(i)	velocity	**B1**
		travels in two opposite directions or equivalent words / increasing and decreasing displacement	**B1**
	(ii)	**Z** any peak or trough / A / B / 0 / 3.0 / 6.0s	**B1**
		M any point where gradient is a maximum (1.0 – 1.6 or 4.4 – 5.0 s)	**B1**
		If M and Z are given on Fig.1.1 then max 1	
	(iii)	tangent to curve drawn	**B1**
		values given correct from graph	**C1**
		answers correct for maximum in range of 1.3 to 1.5	**A1**
			TOTAL [11]

2	**(a)**	weight = 28 x 9.8 / mg	**C1**
		= 270 (N) (274.4)	**A1**
		(using g = 10 then –1)	
	(b)	a completed triangle drawn with correct orientation	**B1**
		at least two labels for triangle with correct directions given	**B1**
		<u>calculation:</u> / <u>scale diagram:</u>	
		force P / weight = tan 35 / scale given	**C1**
		force P =192 (N) / 185 to 200 (N)	**A1**
	(c)	tension is greater	**B1**
		(reference to triangle) tension force would be greater (longer) as the holding force P would be larger (longer) for greater angle / larger value needed so vertical component still balances the weight	**B1**
			TOTAL [8]

3	**(a)(i)**	horizontal velocity = 25cos30	**B1**
		= 21.65 (m s^{-1})	**A0**
	(ii)	vertical velocity = 25sin30	**C1**
		= 12.5 (m s^{-1}) allow 13 (2 sig. fig.)	**A1**
	(b)(i)	straight line with positive gradient through 0,0	

3	**b(ii)**	curved line with positive increasing gradient zero gradient at 0,0	
		MAX 3	**B3**
	(c)(i)	straight line with positive gradient (through 0,0)	**B1**
		line to time axis when ball hits sand	**B1**
		non vertical line coming down to zero between impact and stone at rest	**B1**
	(ii)	horizontal line non zero (positive value)	**B1**
		negative (opposite) value from impact with sand	**M1**
		returning to zero between impact and stone at rest	**A1**
			MAX 5
			TOTAL [11]

4 (a)(i)		**(**when a system is in equilibrium) the sum of the anticlockwise moments equals the sum of the clockwise moments (about the same pivot)	**B1**
	(ii)	sum of the forces equals zero / resultant force is zero	**B1**
		sum of the moments equals zero	**B1**
	(b)(i)	W vertically down at G	**B1**
		Force at O vertical	**B1**
	(ii)	V x 0.9 x cos60 = W x 0.35 x cos60	**B1**
		V = (25 x 0.35) / 0.9	**B1**
		= 9.7(22) (N)	**A0**
	(iii)	total force is zero stated or implied / 25 – 9.7	**C1**
		force at hinge = 15.3 (N)	**A1**
		(or may take moments about G or V)	
			TOTAL [9]

5	**(a)**	cast iron:	brittle brittle explained as having no plastic region elastic elastic explained as returning to original length when the load is removed / linear graph / Hooke's law obeyed or equivalent words
			MAX 3

5 **(a)(cont)**

copper: ductile
ductile explained as can be formed into a wire
initially elastic
plastic where it stretches more and more with little increase in stress
plastic explained as does not return to its original length when the load is removed
reference to necking at the end

MAX 3

polythene: easy to deform / deformed with a small force
plastic
ductile
polymeric

MAX 2

MAX 8

QWC: **spelling, punctuation and grammar** **B1**
organisation and logic **B1**

6 **(a)(i)** motive force is the frictional force generated between the tyres and road that acts on the car in the direction of travel / force provided by the engine (to enable the vehicle to move forward). **B1**

(ii) air resistance / drag acts against the motive force **B1**
drag equals / balances the motive force **B1**

(iii) power = Fv **C1**
= 500 x 25
= 12500 (W) **A1**

(b)(i) distance = 25 x 0.62 **C1**
= 15.5 (m) **A1**

(ii) **1.** braking distance = 75 – 15.5 = 59.5 (m) **A1**

note ecf from (b)(i)

2. $0 = (25)^2 + 2a\ 59.5$ **C1**
$a = -(25)^2 / 2 \times 59.5$
= **(-)** 5.25 **A1**

unit = $m\ s^{-2}$ **B1**

note ecf from (b)(ii)

TOTAL [11]