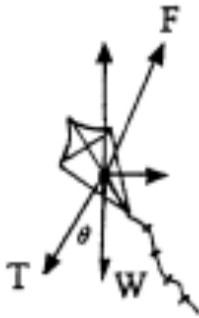


# Mark Scheme Resolving Past Paper Questions

## Jan 2002 to Jan 2009

3(a)



components at right angles **Q3 Jan 2002**  
 vertical component in line with weight ✓  
 (both components to start from the •)

(2)

(b)(i) (horizontal component) =  $25 \sin \theta = 12$  (or 13) N (12.5) ✓  
 ( $\pm 0.5$  N if scale drawing)

(ii) (vertical component) =  $25 \cos \theta = 22$  N (21.7) ✓  
 ( $\pm 0.5$  N if scale drawing) (2)

(c)(i) vertical component of  $F = 21.7 + 2.5 = 24$  N (24.2)  
 [or 25 (24.5)] ✓ (allow C.E. from (b))

(ii) horizontal component of  $F = 12$  (or 13) N ✓ (12.5) (allow C.E. from (b))

(iii)  $F = \sqrt{12.5^2 + 24.2^2}$  ✓ (allow C.E. from parts (i) and (ii))  
 $= 27$  N (27.2) [or 28 (28.2)] ✓ (26 N to 29 N if scale drawing)  
 [if  $\theta$  measured on diagram and  $F \cos \theta$  used, ✓ ✓ (same tolerance)] (4)  
(8)

4

**Q4 Jun 2003**

(a)(i) horizontal component of the tension in the cable ✓

(a)(ii) vertical component of the tension in the cable ✓ (2)

(b)(i)  $T_{\text{vert}} = 250 \times 9.81 = 2500$  N ✓ (2452 N)

(b)(ii)  $T_{\text{horiz}} = 1200$  N ✓

(b)(iii)  $T^2 = (1200)^2 + (2500)^2$  ✓  
 $T = (1.44 \times 10^6 + 6.25 \times 10^6)^{1/2} = 2800$  N ✓ (2773 N)  
 (if use of  $T_{\text{vert}} = 2450$  N then  $T = 2730$  N)  
 (allow C.E. for values from (b)(i) and (b)(ii))

(b)(iv)  $\tan \theta = \frac{1200}{2500}$  ✓

$\theta = 26^\circ$  ✓

(allow C.E. for values from (b)(i) and (b)(ii))

(6)  
(8)

**Question 2**

**Q2 Jan 2005**

- (a) vector quantities have direction (as well as magnitude) and scalar quantities do not ✓ (1)
- (b) vector: e.g. velocity, acceleration, momentum ✓  
 scalar: e.g. mass, temperature, energy ✓ (2)
- (c)(i) addition of forces (12 + 8) ✓  
 (use of  $F = ma$  gives)  $a = \frac{(12 + 8)}{6.5} = 3.1 \text{ m s}^{-2}$  ✓ (3.08  $\text{m s}^{-2}$ )
- (ii) subtraction of forces (12 - 8) ✓  
 $a = \frac{(12 - 8)}{6.5} = 0.62 \text{ m s}^{-2}$  ✓ (0.615  $\text{m s}^{-2}$ ) (4)  
 (7)

Question 2		
(a) (i)	horizontal component = $850 \times \cos 42$ ✓ = 630 N ✓ (632 N)	<b>Q2 Jun 2005</b>  <b>5</b>
(ii)	vertical component = $850 \times \sin 42 = 570 \text{ N}$ ✓ (569 N) (if mixed up sin and cos then CE in (ii))	
(iii)	weight of girder = $2 \times 570 = 1100 \text{ N}$ ✓ (1142 N) (use of 569 N gives weight = 1138 N) (allow C.E. for value of vertical component in (ii))	
(iv)	arrow drawn vertically downwards at centre of girder ✓	

Question 6		
(a)	component (parallel to ramp) = $7.2 \times 10^3 \times \sin 30$ ✓ (= $3.6 \times 10^3 \text{ N}$ )	<b>1</b>
(b)	mass = $\frac{7.2 \times 10^3}{9.81} = 734 \text{ (kg)}$ ✓ $a = \frac{3600}{734} = 4.9(1) \text{ m s}^{-2}$ ✓	<b>Q6 Jun 2005</b>  <b>2</b>
(c)	(use of $v^2 = u^2 + 2as$ gives) $0 = 18^2 - (2 \times 4.9 \times s)$ ✓ $s = 33(.1) \text{ m}$ ✓ (allow C.E. for value of $a$ from (b))	<b>2</b>
(d)	frictional forces are acting ✓ increasing resultant force [or opposing motion] ✓ hence higher deceleration [or car stops quicker] ✓ energy is lost as thermal energy/heat ✓	<b>Max 2</b>

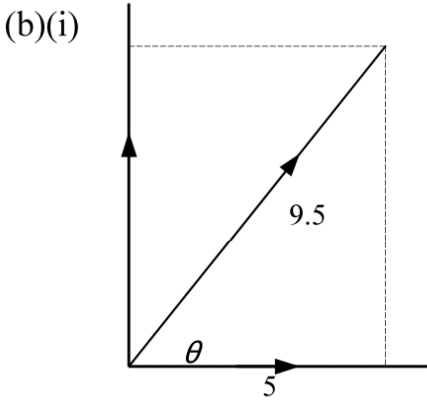
Question 6			
(a)	(i)	(horizontal) force = zero ✓	<b>Q6 Jan 2006</b>
	(ii)	(vertical) force = $2 \times 15 \sin 20$ ✓ = 10(.3)N ✓	
(b)	(i)	weight (of block) = 10(.3)N ✓ (allow C.E. for value from (a) (ii))	<b>3</b>
	(ii)	resultant force must be zero ✓ with reference to an appropriate law of motion ✓	
			<b>Total</b>
			<b>6</b>

Question 3			
		<b>Q3 Jan 2007</b>	
(a)	(i)	(use of $F_H = F \cos \theta$ gives) resultant force = $2 \times 6500 \cos 35$ resultant force = 11 000 N (10 649) (1 out of 2 if only one component given)	✓✓
	(ii)	(use of work = force $\times$ distance gives) work = 11 000 $\times$ 1.5 $\times$ 60 work = 990 000 J (958 408) (if use 10 649 then 960 000 J)	✓✓
(b)		there is an opposing force <b>or</b> mention of friction/drag work is done on this force <b>or</b> overall resultant force is zero	✓✓
(c)		initially accelerates as horizontal component increases (so) forward force now larger than drag <b>or</b> resultant force no longer zero <b>or</b> now a resultant forward force eventually reaches new higher constant speed	✓✓✓
			<b>Total</b>
			<b>9</b>

1  
 (a)(i) a quantity that has magnitude only  
 [or has no direction] ✓

(ii) any two: e.g. energy ✓  
 temperature ✓

(3)



scale ✓  
 5 N and 9.5 N ✓  
 correct answer (8.1 N ± 0.2 N) ✓

[or  $9.5^2 = 5.0^2 + F^2$  ✓  
 $F^2 = 90.3 - 25$  ✓  
 $F = 8.1$  N ✓ (8.07 N)]

(ii)  $\cos \theta = \frac{5.0}{9.5}$   
 gives  $\theta = 58^\circ$  ✓ ( $\pm 2^\circ$  if taken from scale diagram)

(4)  
 (7)

Question 2		
(a)	(i) to balance (or oppose) the weight ✓ or stop ladder moving downwards	2
	(ii) to balance P ✓ or stop slipping or stop ladder moving right	
(b)	<div style="text-align: right;"><b>Q2 Jun 2007</b></div> <p style="text-align: right;">correct arrow ✓</p>	1
(c)	(i) 43 N ✓	2
	(ii) 150 N ✓	
(d)	increases (in magnitude) ✓ as greater downward force (or vertical component increase) ✓ direction moves closer to vertical ✓	3
<b>Total</b>		<b>8</b>

Question 5			
(a)	(i)	(use of $F = ma$ ) $a = 1.9 \times 10^5 / 5.6 \times 10^4 = 3.4 \text{ ms}^{-2} \checkmark$	<b>Q5 Jan 2008</b> 3
	(ii)	(use of $v^2 = u^2 + 2as$ ) $82^2 = 2 \times 3.4 \times s \checkmark$ $s = 989 \text{ m} \checkmark$ c.e. from (i)	
(b)		air resistance increases with speed $\checkmark$ hence runway will be longer $\checkmark$	
(c)	(i)	(use of $F_h = F \cos \theta$ ) $F_h = 1.9 \times 10^5 \times \cos 22$ $F_h = 1.8 \times 10^5 \text{ N} \checkmark$	<b>2</b>
	(ii)	$F_v = 1.9 \times 10^5 \times \sin 22 = 7.1 \times 10^4 \text{ N} \checkmark$	
<b>Total</b>			<b>7</b>

Question 2			
(a)		<b>resultant</b> force must be zero $\checkmark$ because sledge is moving at constant velocity $\checkmark$ (or zero acceleration)	<b>2</b>
(b)		parallel component = $4.5 \times 9.81 \times \sin 22 = 16.5 \text{ N} \checkmark$ perpendicular component = $4.5 \times 9.81 \times \cos 22 = 41 \text{ N} \checkmark$ (if components swapped -1) (if no g then 1 max but must have unit as kg)	<b>Q2 Jun 2008</b>  <b>2</b>
(c)		same as (b) (i) e.g. $16.5 \text{ N} \checkmark$ same as (b) (ii) e.g. $41 \text{ N} \checkmark$ (ignore units)	<b>2</b>
			<b>6</b>

Question 2			<b>Q2 Jan 2009</b>
(a)	(i)	vector has direction <b>and</b> a scalar does not $\checkmark$	<b>4</b>
	(ii)	scalar examples; any two e.g. speed, mass, energy, time, power vector examples; any two e.g. displacement, velocity, acceleration, force or weight $\checkmark\checkmark\checkmark$ for 4 correct, $\checkmark\checkmark$ for 3 correct, $\checkmark$ for 2 correct	
(b)	(i)	horizontal component (= $2.8 \cos 35$ ) = $2.3 \text{ (kN)}$ ( $2293.6$ ) $\checkmark$ vertical component (= $2.8 \sin 35$ ) = $1.6 \text{ (kN)}$ ( $1606.0$ ) $\checkmark$	
	(ii)	power = force $\times$ velocity <b>or</b> $2.3 \text{ kN} \times 8.3 \text{ m s}^{-1} \checkmark$ (ecf from 2 (b)(i)) = $1.9 \times 10^4$ ( $19037$ or $19100$ ) $\checkmark$ ecf <b>W</b> (or $\text{J s}^{-1}$ ) $\checkmark$ (or $19\text{W}$ (or $\text{kJ s}^{-1}$ ))	<b>5</b>
(c)		(area of cross-section of cable =) $\pi \times (\frac{1}{2} 0.014)^2 \checkmark = 1.5(4) \times 10^{-4} (\text{m}^2) \checkmark$ stress (= $F/A$ ) = $\frac{2800 \text{ N}}{1.54 \times 10^{-4} \text{ m}^2}$ (allow ecf here if attempt to calculate area) $\checkmark$ = $1.8(2) \times 10^7 \checkmark$ ecf <b>Pa</b> (or $\text{N m}^{-2}$ ) $\checkmark$	<b>5</b>
<b>Total</b>			<b>14</b>