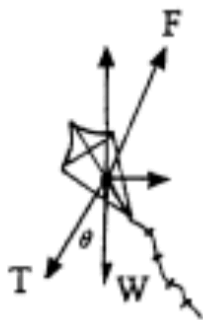


Mark Scheme Resolving Past Paper Questions

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) ✓
 (± 0.5 N if scale drawing)

(ii) (vertical component) = $25 \cos \theta = 22$ N (21.7) ✓
 (± 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 θ 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 m s⁻²)
- (ii) subtraction of forces (12 - 8) ✓
 $a = \frac{(12 - 8)}{6.5} = 0.62 \text{ m s}^{-2}$ ✓ (0.615 m s⁻²) (4)
 (7)

Question 2		
(a) (i)	horizontal component = $850 \times \cos 42$ ✓ = 630 N ✓ (632 N)	<p>Q2 Jun 2005</p> <p>5</p>
(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) = $7.2 \times 10^3 \times \sin 30$ ✓ (= $3.6 \times 10^3 \text{ N}$)	1
(b)	$\text{mass} = \frac{7.2 \times 10^3}{9.81} = 734 \text{ (kg)} \checkmark$ $a = \frac{3600}{734} = 4.9(1) \text{ m s}^{-2} \checkmark$	<p>Q6 Jun 2005</p> <p>2</p>
(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))	2
(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 ✓	Max 2

Question 6			
(a)	(i)	(horizontal) force = zero ✓	Q6 Jan 2006
	(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))	3
	(ii)	resultant force must be zero ✓ with reference to an appropriate law of motion ✓	
Total			6

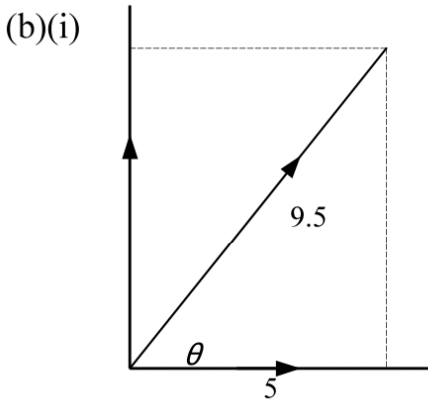
Question 3			
		Q3 Jan 2007	
(a)	(i)	(use of $F_H = F \cos \theta$ gives) resultant force = $2 \times 6500 \cos 35$ resultant force = 11 000 N (10 649) (1 out of 2 if only one component given)	✓✓
	(ii)	(use of work = force \times distance gives) work = 11 000 \times 1.5 \times 60 work = 990 000 J (958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

Q1 Jan 2004

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)	<p style="text-align: right;">Q2 Jun 2007</p> <p style="text-align: right;">correct arrow ✓</p>	1
(c)	(i) 43 N ✓ (ii) 150 N ✓	2
(d)	increases (in magnitude) ✓ as greater downward force (or vertical component increase) ✓ direction moves closer to vertical ✓	3
Total		8

Question 5		
(a)	(i) (use of $F = ma$) $a = 1.9 \times 10^5 / 5.6 \times 10^4 = 3.4 \text{ ms}^{-2} \checkmark$	Q5 Jan 2008 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 $F_h = F \cos \theta$) $F_h = 1.9 \times 10^5 \times \cos 22$ $F_h = 1.8 \times 10^5 \text{ N} \checkmark$	2
	(ii) $F_v = 1.9 \times 10^5 \times \sin 22 = 7.1 \times 10^4 \text{ N} \checkmark$	
Total		7

Question 2		
(a)	resultant force must be zero \checkmark because sledge is moving at constant velocity \checkmark (or zero acceleration)	2
(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)	2
(c)	same as (b) (i) e.g. 16.5 N \checkmark same as (b) (ii) e.g. 41 N \checkmark (ignore units)	2
Total		6

Question 2		Q2 Jan 2009
(a)	(i) vector has direction and a scalar does not \checkmark (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	4
(b)	(i) horizontal component (= $2.8 \cos 35$) = 2.3 (kN) (2293.6) \checkmark vertical component (= $2.8 \sin 35$) = 1.6 (kN) (1606.0) \checkmark (ii) power = force \times velocity or $2.3 \text{ kN} \times 8.3 \text{ m s}^{-1} \checkmark$ (ecf from 2 (b)(i)) = 1.9×10^4 (19037 or 19100) \checkmark ecf W (or J s^{-1}) \checkmark (or 19W (or kJ s^{-1}))	5
(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 Pa (or N m^{-2}) \checkmark	5
Total		14