

## Questions on Motion – Mark Scheme

1. Correct lines from:

- joule (J) to N m
- watt (W) to  $\text{J s}^{-1}$
- newton (N) to  $\text{kg m s}^{-2}$

B2

*Note: 2 marks for all correct  
1 mark for two correct  
0 marks for none or one correct*

[2]

2. (a) (i)  $v^2 = u^2 + 2as$  C1  
 $0 = (80)^2 + 2 \times a \times 120$  C1  
 $a = (-) 26.7 \text{ (m s}^{-2}\text{) ignore sign}$  A1
- (ii)  $t = (0 - 80) / -26.7$  C1  
 $t = 3.0 \text{ (s)}$  A1

- (b) (time lost by) car A =  $(3 + 9 + 4) = 16$  B1  
 car B was 17 behind C1  
 Car B takes 2 s to travel the 160 m / Car B 19 behind B1  
 Hence car A 3 s ahead  $(19 - 16)$  A1

[9]

3. (i) scalar named B1  
 has (only) magnitude / size / value (**not** quantity) B1
- (ii) vector named B1  
 has magnitude and direction B1  
 allow one out of two for a vector has direction and a scalar does not

[4]

4. (a) (i)  $v^2 = 0 + 2 \times 9.8(1) \times 30$  C1  
 $v = 24. (3) (m s^{-1})$  A1  
 (-1 if  $g = 10$  is used, once only on the paper)  
 (zero scored if  $s = 36$  m is used)
- (ii)  $s = ut + \frac{1}{2} at^2$  or  $v = u + at$  or  $s = (u + v)t / 2$   
 $30 = 0 + \frac{1}{2} \times 9.8(1) \times t^2$   $t = 24.3 / 9.8$   $t = 2 \times 30/24.3$  C1  
 $t = 2.5$  (s) A1

- (b) In the air: weight / force due to gravity B1  
 (allow air resistance if included as well)
- (Hence) constant acceleration / acceleration at  $9.8 m s^{-2}$  B1  
 (allow reduced acceleration / terminal velocity if air resistance included)
- In water: weight and (large) fluid resistance / upthrust / buoyancy B1  
 Hence deceleration / slows down B1

[8]

5. (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 the diagram 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

[7]

6. (i)  $N$  is normal to the ramp (judged by eye)  
*Allow marks even if the labels  $N$  and  $F$  are omitted* B1  
 $F$  is parallel and up the ramp B1
- (ii)  $F = W \sin\theta$  B1

[3]

7.

scalar	vector
density	acceleration
energy	displacement
power	weight
speed	
time	

All correct scores 4

4

6, 7 correct scores 3

4, 5 correct scores 2

2, 3 correct scores 1

[4]

- 8.(a) (i) 1. mass =  $360 / 9.8$  36.7 (kg) B1  
(allow 2sf)
- (ii) 2. density = mass / volume C1  
 $= 36.7 / 4.7 \times 10^{-3}$   
 $= 7.8 \times 10^{-3}$  A1  
 unit  $\text{kg m}^{-3}$  B1
- (ii) right angled triangle with an additional correct angle marked M1  
 set of correct force labels and correct arrows A1  
 algebra shown or scale given C1  
 tension = 270 (N) or value in the range 255 to 285 (N) A1
- (b) (i) tension is a vector / has magnitude and direction B1  
 direction involved in addition / the tensions or ropes act in  
 different directions B1
- (ii) sum =  $270 \sin 37 + 360 \sin 53$  B1  
 $= 162.5 + 287.5$  B1  
 (or one mark each for values of 162.5 and 287.5 seen) = 450 (N) A0

[12]

9. (a) (i) 1 Horizontal component =  $24\cos 30$  C1  
 $= 21$  (20.8) (N) A1
2. vertical component =  $24\sin 30$   
 $= 12$  (12.0) (N) A1
- (ii) vertical force =  $65 + 12$  M1  
 $= 77$  A0
- (iii) horizontal force = 20.8 (note ecf for 20.8 component)  
resultant =  $[(77)^2 + (20.8)^2]^{1/2}$  C1  
 $= 80$  (79.8) (N) A1  
(or by vector triangle need correct labels and arrows for C1 mark)
- (iv) 80 (79.8)(N) / equal to (iii) allow ecf B1  
the resultant force needs to be zero or forces need  
to balance above value to give no acceleration or constant velocity B1
- (b) (i)  $P = F / A$  C1  
 $= 77 / 4.2 \times 10^{-3}$   
 $= 18000$  (18333) (Pa) A1
- (ii) more / increases  
downward / vertical component (of P) will be greater B1  
(for larger angles)

[11]