

Questions on Motion – Mark Scheme

1. Correct lines from:

- joule (J) to N m
- watt (W) to J s^{-1}
- newton (N) to 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 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
(for larger angles) B1

[11]