1   (a   mass = (1.5 × 10 × 12)/(30 × 10) OR = (1.5 × 12)/30
         OR any correct moment equation with force or mass but not mixture   C1
         = 0.6(0) kg   A1   [2]

     (b) 21 N ecf from **(a)**   B1   [1]

     (c) (i)   stays in position   B1

          (ii) any two from:
                • clockwise moment = anticlockwise moment   B1
                • centre of mass at pivot   B1
                • no (resultant) moment/turning force acting on sculpture
                • balanced/in equilibrium
                • relative distances from pivot unchanged   [3]

                                                                                          [Total: 6]

2   (a   (i)   s = area under graph, stated or clearly used   C1
                = (½ × 18 × 10) + (120 × 18) + (½ × 18 × 20) Award if at least one term correct C1
                = 90 + 2160 +180   C1
                = 2430 m / 2.43 km at least 2 significant figures. *Unit penalty applies   A1

          (ii) v = u + at in any form OR (a=) gradient OR 18/10   C1
                = 1.8 m/s^2 *Unit penalty applies   A1

     (b) (F=) ma OR 1.1 × 10^5 × 1.8 ecf from **(a)(ii)**   C1
                = 1.98 × 10^5 N at least 2 significant figures. *Unit penalty applies   A1

     (c) driving force = friction/air resistance/drag   B1   [9]

          *Apply unit penalty once only

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3   **(a**   54 N *Unit penalty applies   B1

    (b) **(i)**   (the point where) proportionality between force/weight and
                    extension/Hooke's Law stops   B1

        (ii)   35 – 20 **or** 15 (cm) **or** 25 – 20 **or** 5 (cm)   C1
                (F =) kx **or** 54/15 × 5 **or** 54/15 **or** 5/15   from **2(a)**   C1
                18 N *Unit penalty applies   ecf from **2(a)**   A1
                54 – 18 **or** 36 **or** 5.4 – 1.8   ecf from **2(b)(ii)1.**   C1
                3.6 kg *Unit penalty applies   ecf from **2(b)(ii)1.**   A1

       (iii)   (ρ =)m/V **or** 3.6/0.0045   ecf from **2(b)(ii)2.**   C1
                800 kg/m^3 *Unit penalty applies   ecf from **2(b)(ii)2.**   A1

    (c)   air molecules further apart **or** oil molecules closer together   B1 **[10]**

    *Apply unit penalty once onl

4   **(a)**   idea of accelerating force/force down slope = friction force
            OR no resultant force/forces balanced   B1
            (accept energy argument if Physics correct)

    (b) **(i)**   idea of accelerating force/force down slope > friction force
                     OR forces unbalanced   B1
                     (accept energy argument if Physics correct)

        (ii)   F = ma NOT f α a   B1

       (iii)   12 × 2   C1
               24N   A1

    (c)   resultant force = 38N OR his **(b)(iii)** + 14   C1
               38/12 OR (his **(b)(iii)** + 14)/12   C1
               3.166 m/s^2 or 3.17 m/s^2 or 3.2 m/s^2 **NOT** 3.16   A1

        (ii)   v = at or 3.2 × 2.5   C1
                7.8 – 8.0 m/s   e.   A1

    (d)   idea of acceleration   B1   [11]

5 **(a)**	one slightly nearer the centre than the other	**C1**	
	20 kg is the nearer one to the pivot	**A1**	
(b)	Clockwise moments = anticlockwise moments (about point/pivot)	**A1**	
	(accept opposite directions and equal)		
(c)	18x2.5=20xB	**C1**	
	distance = 2.25(m)	**A1**	**2**
			[5]