

Forces ($F = ma$ / Resultant forces)

Mark Scheme 2

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	General Physics
Sub-Topic	Forces $F = m/a$ / Resultant forces
Paper Type	(Extended) Theory Paper
Booklet	Mark Scheme 2

Time Allowed: 82 minutes

Score: /68

Percentage: /100

Question	Answer	Mark
1(a)(i)	(P =) hdg OR $1.5 \times 850 \times 10$ OR mg / area of base OR $850 \times 2.4 \times 1.5 \times 1.5 \times 10 / (2.4 \times 1.5)$ 13 000 Pa or N/m ²	C1 (C1) A1
(a)(ii)	P = F/A OR (F =) PA OR $12\,750 \times 1.5 \times 2.4$ OR $12\,750 \times 3.6$ 46 000 N OR (Force =) weight of oil = mg = $2.4 \times 1.5 \times 1.5 \times 850 \times 10$ 46 000 N	C1 A1 (C1) (A1)
(b)	$(46000 / 10 =) 4600$ kg OR $m = Vd = (2.4 \times 1.5 \times 1.5) \times 850 = 4600$ kg	B1
(c)(i)	(density of brass) greater than that of oil / 850 kg/m^3 OR brass denser <u>than oil</u>	B1
(c)(ii)	(It won't sink as average) density of wood + key less than density of oil	B1
		Total: 7

- 2 (a) (i) acceleration OR increasing speed C1
 constant acceleration OR constant rate of increase in speed A1
 (ii) decreasing acceleration OR decreasing rate of increase in speed B1
 NOT deceleration
- (b) mention of air resistance AND weight (of object) / force due to gravity B1
 acceleration at start (of fall) is acceleration of gravity / 10 m/s^2 / a maximum / g
 OR acceleration decreases (as it falls) B1
 air resistance increases as speed increases/as it accelerates B1
 acceleration zero/terminal velocity/constant speed/maximum speed when
 air resistance = weight B1

[Total: 7]

- 3 (a) point marked P (on line or time axis) at $t \geq 2.0 \text{ s}$ B1
- (b) attempt at gradient OR $(a =) \Delta v/t$ OR $(v - u)/t$ OR $240 (-0)/2.0$
 OR division of correct points on graph C1
 120 m/s^2 A1
 (ii) suggestion of area (under graph) in words or formula or numbers
 OR $0.5 (120 + 240) \times 1.0$ OR $[(120 \times 1.0) + (0.5 \times 120 \times 1.0)]$ C1
 180 m A1
- (c) mass of sled changes / decreases OR fuel used up B1

[Total: 6]

4	(a) (i)	any scalar quantity other than mass	B1
	(ii)	any vector quantity other than force	B1
	(b)	$F = ma$ in any form OR $(a =) F/m$ 50 000/290 000 OR 50/290 $a = 0.17 \text{ m/s}^2$	C A1
	(c)	1 cm: 20 000 N/20 kN	
5	(a) (i)	straight line between A and B	B1
	(ii)	limit of proportionality	B1
	(b)	(WD =) $\frac{1}{2} F \times d$ OR $F_{\text{ave}} \times d$ OR 6.0×0.030 OR 18 (J) 0.18 J	C1 A1
	(c) (i)	$(x =) 2.0$ (cm) OR $6.0 - 4.0$ OR $F = kx$ OR 4.0 (N/cm) $12.0 \times 2.0/3.0$ OR 4.0×2.0 OR 8.0 (N) 0.80 kg OR 800 g	C1 C1 A
	(ii)	$(e =) 1.0$ (cm) OR $(\Delta e = -)1.0$ (cm) 4.0 N OR 4.0 N	C1 A1
			[Total: 9]
			[Total: 9]

- 6 (a) 3rd box only indicated, reverses direction B1
- (b) straight line up/down page B1
 arrow pointing down page B1
- (ii) to the right or left e.c.f. (b)(i) B1
 to the right e.c.f. (b)(i) B1
- (c) $F=ma$ in any form or F/m symbols, words or numbers OR final answer $6 \times 10^{-4} \text{ m/s}^2$ C1
 $(a = 0.21/0.35 =) 0.6 \text{ m/s}^2$ A1
- [Total: 7]**

- 7 (a) (i) A marked between $t = 0$ and $t = 6.0 \text{ s}$ B
 (ii) B marked between $t = 6.0 \text{ s}$ and $t = 7.0 \text{ s}$ B
 (iii) C marked on clearly curved section before $t = 14 \text{ s}$ B
- (b) (i) $(a =) \Delta v/t$ OR $30/1$ OR $15/0.5$ etc. OR triangle on graph/tangent
 (ignore – sign) $25 \text{ m/s}^2 < a < 35 \text{ m/s}^2$ A1
- (ii) $(F =) ma$ OR 750×30 e.c.f. from (b)(i) C1
 $2.2/2.25/2.3 \times 10^4 \text{ N}$ e.c.f. from (b)(i) A1
- (c) acceleration/rate of change of speed is zero OR speed is constant OR air resistance/backwards force equal and opposite to driving/forwards force B1

[Total: 8]

- 8 (a) (i) (increase in g.p.e. = mgh OR $65 \times 10 \times 8 =$) 5200 J B
- (ii) EITHER
 k.e. gained = g.p.e. lost C1
 $\frac{1}{2}mv^2 = 5200$ in any form C1
 $v^2 = 5200 / (0.5 \times 65)$ OR 160 C1
 $v = 12.6 \text{ m/s}$ e.c.f. (a)(i) A1
 OR
 $v^2 = u^2 + 2as / v^2 = 2gh$ (C1)
 $v^2 = 2 \times 10 \times 8$ (C1)
 $v^2 = 160$ (C1)
 $v = 12.6 \text{ m/s}$ e.c.f. (a)(i) (A1)
- (b) speed is the same B1
 EITHER
 loss in g.p.e. is the same B1
 k.e. gained is the same B1
 OR
 acceleration is the same (B1)
 distance fallen is the same (B1)
- [Total: 8]**
- 9 (a) (i) $v = u + at$ OR $(a =) (v - u) / t$ OR $24 = a \times 60$ OR $24 / 60$
 $0.4(0) \text{ m/s}^2$ A1
- (ii) $(F =) ma$ OR $7.5 \times 10^5 \times 0.40$ C1
 $300\,000 \text{ N}$ OR 300 kN
- (b) (i) in words or symbols $(P =) W / t$ OR $F \times d / t$ OR Fv
 OR $7.2 \times 10^4 \times 24 / 1$ OR $7.2 \times 10^4 \times 24$ C1
 $1.7 \times 10^6 \text{ W}$ A1
- (ii) gravitational/potential energy of train has to be increased
 OR force acts down the slope/backward force acts (on train) B1
- (for the same distance moved) more work done has to be done OR energy
 has to be provided (by the engine) B1
 in the same time (so needs more power) B1

[Total: 9]