Forces

Mark Scheme 1

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Forces, Density & Pressure
Sub Topic	Forces
Paper Type	Theory
Booklet	Mark Scheme 1

Time Allowed: **74 minutes**

Score: **/61**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a** stress = Young modulus × strain

= $1.8 \times 10^{11} \times 8.2 \times 10^{-4}$ *or* 1.476×10^{8} C1

= 0.15 (0.148) GPa A1 [2]

(b) (i) wavelength = $3 \times 10^{8} / 12 \times 10^{12}$ C1
= 25 μm A1 [2]

(ii) infra-red / IR B1 [1]

(c) (i) arrow drawn up to the left of 7.5 N force
approximately 5° to 40° to west of north A1 [1]

(ii) **1.** correct vector triangle or working to show
magnitude of resultant force = 6.6 N
allow 6.5 to 6.7 N if scale diagram M1 [1]

2. magnitude of acceleration = 6.6 / 0.75
[scale diagram: (6.5 to 6.7) / 0.75] C1

= 8.8 $m s^{-2}$ [scale diagram: 8.7 – 8.9 $m s^{-2}$] A1 [2]

(iii) 19° [use of scale diagram allow 17° to 21° (a diagram must be seen)] B1 [1]

2 **(a (i)** resultant force is zero B1

weight of plank + weight of man = $F_A + F_B$
or 200 (N) + 880 (N) *or* 1080 = $F_A + F_B$ B1 [2]

(ii) principle of moments used C1
(anticlockwise moments) $F_B \times 5.0$ C1
(clockwise moments) $880 \times 0.5 + 200 \times 2.5$ C1
F_B = (440 + 500) / 5.0 = 188 N A [4]

(b) straight line with positive gradient (allow freehand) M1
start point (0, 100) A1
finish point (5, 980) A1 [3]

3 **(a** mass is the property of a body resisting changes in motion / quantity of matter in a body / measure of inertia to changes in motion B1

weight is the force due to the gravitational field/force due to gravity or gravitational force B1 [2]

Allow 1/2 for *'mass is scalar weight is vector'*

(b) (i) arrow vertically down through O B1
tension forces in correct direction on rope B1 [2]

(ii) **1.** weight = mg = 4.9 × 9.81 (= 48.07) C1
69 sin θ = mg C1
θ = 44.(1)° *scale drawing allow ± 2°* A1 [3]
use of cos or tan 1/3 only

2. T = 69 cos θ C1
= 49.6 / 50 N *scale drawing 50 ±2 (2/2) 50 ±4 (1/2)* A1 [2]

correct answers obtained using scale diagram or triangle of forces will score full marks
*cos in **1.** then sin in **2.** (2/2)*

4 **(a** the point where (all) the weight (of the body) M1
is considered / seems to act A1 [2]

(b) (i) vertical component of T (= 30 cos 40°) = 23 N A [1]

(ii) the sum of the clockwise moments about a point equals the sum of the anticlockwise moments (about the same point) B1 [1]

(iii) (moments about A): 23 × 1.2 (27.58) M1
= 8.5 × 0.60 + 1.2 × W M1
working to show W = 19 or answer of 18.73 (N) A1 [3]

(iv) (M = W / g = 18.73 / 9.81 =) 1.9(09) kg A1 [1]

(c) (for equilibrium) resultant force (and moment) = 0 B1
upward force does not equal downward force / horizontal component of T not balanced by forces shown B1 [2]

5 **(a)** power is the rate of doing work or power = work done / time (taken) or
power = energy transferred / time (taken) B1 [1]

(b) **(i)** as the speed increases drag / air resistance increases B1
resultant force reduces hence acceleration is less B1
constant speed when resultant force is zero B1 [3]
(allow one mark for speed increases and acceleration decreases)

(ii) force from cyclist = drag force / resistive force B1
$P = 12 \times 48$ M1
$P = 576\,\text{W}$ A0 [2]

(iii) tangent drawn at speed = $8.0\,\text{m s}^{-1}$ M1
gradient values that show acceleration between 0.44 to $0.48\,\text{m s}^{-2}$ A1 [2]

(iv) $F - R = ma$ C1
$600 / 8 - R = 80 \times 0.5$ [using $P = 576$] $576 / 8 - R = 80 \times 0.5$ C1
$R = 75 - 40 = 35\,\text{N}$ $R = 72 - 40 = 32\,\text{N}$ A1 [3]

(v) at $12\,\text{m s}^{-1}$ drag is 48 N, at $8\,\text{m s}^{-1}$ drag is 35 or 32 N
R / v calculated as 4 and 4 or 4.4
and consistent response for whether R is proportional to v or not B1 [1]

6 **(a)** weight = 452×9.81
component down the slope = $452 \times 9.81 \times \sin 14°$ M1
$= 1072.7 = 1070\,\text{N}$ A0 [1]

(b) **(i)** $F = ma$ C1
$T - (1070 + 525) = 452 \times 0.13$ C1
$T = 1650\ (1653.76)\,\text{N}$ *any forces missing 1/3* A1 [3]

(ii) **1.** $s = ut + \frac{1}{2}at^2$ hence $10 = 0 + \frac{1}{2} \times 0.13t^2$ C1
$t = [(2 \times 10) / 0.13]^{1/2} = 12.4$ or 12 s A1 [2]

2. $v = (0 + 2 \times 0.13 \times 10)^{1/2} = 1.61$ or $1.6\,\text{m s}^{-1}$ A1 [1]

(c) straight line from the origin B1
line down to zero velocity in short time compared to stage 1 B1
line less steep negative gradient B1
final velocity larger than final velocity in the first part – at least 2× B1 [4]