Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Mark Schemes

Q1.

(a) attempted use of principle of moments:

seen by one correct side of an attempted principle of moments equation.

examples of acceptable responses for MP1 1150 × 3.6 ***or*** *1400 × 3.6* ***or*** *1800 × 1.8 + 750(3.6 – d)* ***or*** *1800 × 1.8 + 750 × or 750 × d + 1800 × 1.8* ✔

full use of principle of moments ✔

Condone ***one*** *error in distance or signs or force in an attempted use of principle of moments (must have 3 forces multiplied by 3 distances)*

(d =) 2.4 (m) ✔

For moments about ***B*** *(or* ***Q****):*

1150 × 3.6 = 1800 × 1.8 + 750(3.6 − d) /

1150 × 3.6 = 1800 × 1.8 + 750 x

Alternative

Finds component of tension in **P** due to worker's weight = 250 N /
Finds tension in **P** (due to weight of worker) by dividing weight of platform by 2 and subtracts from 1150 N

OR

Finds component of tension in **Q** due to worker's weight = 500 N /
Finds tension in **Q** (due to weight of worker) by dividing weight of platform by 2 and subtracts from 1400 N ✔

Recognises the ratio of weight distribution to worker position relative to cables **P** and **Q**

250 N : 500 N = 3.6 − d : d ✔ (principle of moments)

x seen (with appropriate working) as 1.2 m or 2.4 m (even when not answer line) gains MP1 and MP2

Moments about ***A*** *(or* ***P****):*

750 × d + 1800 × 1.8 = 1400 × 3.6

Alternative for MP1 and MP2:

Moments about worker's centre of gravity:

1150 × d + 1800(1.8 − d) = 1400 (3.6 − d)

MP1 for one correct side of equation seen.

MP2 all correct terms seen (condone one error).

(d =) 2.4 (m) ✔

d = *1.2 m* ***with supporting working gains*** *MP1 and MP2 (need principle of moments)*

3

(b) Extension = 0.18 m **or** use of $\varepsilon = \frac{\Delta L}{L}$ **or** reads off d correctly for their extension (+/- half a square) (where working for extension seen) ✔

Use of $\varepsilon = \frac{\Delta L}{L}$ *is by rearrangement to make* ΔL

the subject ***and*** *6 × 10^{-5} × 3 seen (condone use of* L *= 3.6 m here).*

Condone POT error on extension

(d =) 1.8 m ✔

Some supporting use of graph for read-off seen

Allow range of 1.75 m to 1.85 m

2

(c) (σ =) 1.1(4) × 10^{7} (N m^{-2}) ✔ c.a.o

1

(d) Straight line with negative gradient that intercepts extension axis and has a d range of 3.5 m to 3.7 m ✔

Penalise double and thick lines (limit on thickness of line: must be less than half square thick)

Straight line passes through (0, 0.46) ✔

Within 1/2 square

Straight line passes through (3.6, 0.26) ✔

Within 1/2 square

Condone accuracy within a square ***max 1*** *for MP2 and MP3*

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Q2.

(a) (component of total weight parallel to slope =) 640 sin θ ✔

Allow mg sin θ *or 65g sin* θ *or 638 sin* θ

or 637.7 sin θ *or 637.65 sin* θ

Condone labelling this component as W *in statements such as*

W = *640 sin* θ

Do not accept

W *sin* θ *unless* W *is defined as mg*

1

(b) use of $P = Fv$ ✔

Ecf from part (a) for MP1 and MP2

Use of $P = Fv$ by substitution and rearrangement to make F the subject.

Expect to see (F =) 190(.184) (N)

Accept a correctly rounded answer to 2 or more significant figure.

(θ =) 17(.4) (°) ✔

(Calculator displays: 17.35298907 for mg sin θ and 65g sin θ and 637.65 sin θ)

As an alternative to 17.35298907 may see Calculator display or answer of:

- *17.34316751 for 638 sin θ = 17(.3)*
- *17.3515853 for 637.7 sin θ = 17(.4)*
- *17.28726034 for 640 sin θ = 17(.3)*

Common ecf:

(65gcosθ = 190) = 72.6 (°) or 73(°) scores MP1 and MP2

(65 tanθ = 190) = 71.1 (°) or 71(°) scores MP1 and MP2

Use of $W = Fs\cos\theta$ is only acceptable as an ecf where F = 65g and component of weight is given as 65gcosθ (or equivalent) in part (a)

Alternative MP1:

height gain per second = 0.486 m ***and*** *distance along the slope per second = 1.63 m*

OR

Use of sin θ = $\dfrac{\text{height gained per second}}{\text{distance travelled per second}}$

2

(c) Less (useful) power output ✔

Same gain in (gravitational) potential energy (in climbing hill) / same amount of work done (in climbing hill) / gains same height (in climbing hill) ✔

Gains less (gravitational) potential energy every second ✔

OR (component of weight doing work against)
Less (useful) power output ✔

Effective θ has decreased / *mg* sin θ has decreased / component of the weight parallel to the slope has decreased ✔

General marking principle:

MP1 less (useful) power output

MP2 basic point

MP3 explains consequences of basic point in terms of power (MP3 is an extension of MP2, quoting

$P = \dfrac{\Delta W}{\Delta t}$ *without linking to an appropriate explanation is insufficient).*

Smaller force does less work per second ✔

OR (component of vertical velocity)
Less (useful) power output ✔

The vertical component of the velocity has decreased / height gained per second decreases ✔

Loses MP1: where conflicting statements made about (useful) power output / states more power output / total power output is same.

Loses MP3 for conflicting statements made in support of explanation.

Accept θ as the effective angle to the slope.

(P =) $mg\,v \sin\theta$ has decreased / $\mathrm{P} = \frac{\Delta W}{\Delta t}$ has decreased / less work done (against the weight) per second / Less gain in (gravitational) potential energy per second ✔

OR (distance travelled)

Less (useful) power output ✔
Less force is exerted over greater distance (for same change in height) ✔
Smaller force does less work per second ✔

Treat 'inputs more energy' or 'does more work' as neutral.

Condone P = E/t has decreased as MP3

3

(d) Draws tangent which touches curve between 9 and 11 s ✔

Must see an attempt to draw a tangent to curve to score any marks.

Determine gradient of a tangent drawn at 5s / Determines gradient of tangent drawn at 10s ✔

Read-offs must be within square of accuracy $\frac{1}{2}$

Condone one read-off error.

For tangent at t = 5s, expect to see an answer of 0.61 to 0.71 (m s^{-2}). MAX 2 marks for this.

(acceleration =) 0.21 ($\mathrm{m\,s^{-2}}$) ✔

Accept answers in range 0.15 to 0.27 (m s^{-2})

Accept 2 or 3 significant figures only.

MAX 1 mark

*Condone a correctly determined gradient for a tangent to the curve at **any other** point **between** 5 and 11 seconds.*

3

(e) Air resistance increases (with speed) / resistive forces increase (with speed) / Energy is transferred from the cyclist (due to work done) by resistive forces ✔

Condone 'frictional forces increase with speed' Treat kinetic energy is transferred from the cyclist as neutral.

MAX 3 from:

Initially, any of the gravitational potential energy that is transferred is transferred to kinetic energy of cyclist ✔

As speed increases, less of the gravitational potential energy transferred per second is transferred to kinetic energy of cyclist ✔

As speed increases, energy transferred per second to the air increases / as the speed increases, the energy transferred per second from the cyclist increases ✔

At top speed, the gravitational potential energy that is transferred (per second) is transferred to the air / the gravitational potential energy (transferred per second) is being transferred (from the cyclist) due to work done by resistive forces ✔

The answer must be written in terms of energy transfers

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