Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic: Mechanics And Materials

Name of the Student:____

Max. Marks : 20 Marks **Time : 20 Minutes**

Mark Schemes

Q1.

(a) Conversion of 1230 km h^{-1} to m s^{-1}

Expect to see 342 m s^{-1} (341.7)

OR

Calculates time for 343 m s^{-1} run

Expect to see 4.69 s

OR

Calculates total time (using total distance, 3.22 km, and speed record)

Expect to see 9.42 s

OR

Calculates unknown speed ✔

Expect to see 340.3 m s^{-1}

Answer that rounds to 4.73 (s) ✔

Do not accept 2sf for final answer.

2

(b) speed from graph: 450 m s^{-1} ✔

Accept 445 - 455 m s^{-1}

Use of their speed and KE equation to give consistent answer ✔

Expect to see 6.6×10^8 (J)

2

(c) **MAX three** from: ✔✔✔

- Use of graph to determine gradient
- Uses (their) speed and (their) gradient to give acceleration
- Use of $F = m \times$ (their a) to give resultant force
- Use of $P =$ (their F)× (their speed)

Final answer between 16% and 17%✔

Expect to see 450 m s^{-1} for their speed

Evidence for gradient may be on figure

Allow ECF from (b)

- $\frac{450}{5600}$ *= 0.080(4)*
- *Expect to see 450 × 0.08 = 36(.2) m s^{-2}*
- *Expect to see 2.35×10^5 N*

• *Expect to see 450 × 2.35 × 10^5 = 106 MW*

Reject power that is calculated assuming a constant speed.

4

(d) Identifies distance decelerating

AND

max velocity = (470 ±5) m s^{-1} ✔

Uses *suvat* equation(s)

to get *a* = (-) 15 m s^{-2} which is less than 3*g* (so yes). ✔

allow 7000 m to 7600 m

allow answer consistent with their distance that rounds to 15 or 16

give full credit to calculations that show that an acceleration of 3g would stop the car in a (much) shorter distance, with a statement that this means that the actual acceleration must be (much) less than 3g.

For MP2 allow calculation of

gradient × average speed to give

a = (-) 15 m s^{-2} which is less than 3g (so yes)

2

[10]

Q2.

(a) Evidence of appropriate use of Figure 1 e.g.

105 × 10^6 ÷7.5 × 10^{-4}

Some evidence that Figure 1 is used:

calculation based on a point on line between 75 MPa and 125 MPa

OR calculation from point on straight line extended

OR

Use of triangle from more than half of the linear section.

leading to an answer in the range 1.38 to 1.42 × 10^{11} Pa ✔

Allow 2 sf answer 1.4 × 10^{11} (Pa).

1

(b) Idea that wire undergoes only (very) small (increase in) strain beyond the linear section before fracture ✔

Reject idea that there is ***no*** *increase in strain.*

Condone 'extension' or '(plastic) deformation' for 'strain'.

Condone 'shortly after' for 'beyond'

Accept: does not show 'necking' before fracture

Accept: fracture occurs very near the limit of proportionality (condone 'elastic limit').

Accept references to a particular value of strain e.g. 9 x 10^{-4} to 12.7 x 10^{-4}

1

(c) Evidence of determination of total load or load on one wire ✔

(halves load)

Use of $E = \frac{(\text{their } F) \times L}{}$ ✔

$\Delta L = 1.1(4) \times 10^{-3}$ (m) ✔

Total load = (4.4 + 16.0) × 9.8(1) = 200(.1) N
Allow 'g' for 9.8(1)

Expect to see F = 100 N and
A = 5.03 × 10^{-7} m^2. Condone use of d in calculation of cross-sectional area A in MP2.
Or separate calculations using σ = F÷A, E = σ÷strain, strain = ΔL÷L
Condone POT error in MP2.

3

(d) Evidence of extension/strain in each wire is the same $_1$✔

Substitutes data leading to $F_a = 1.33\ F_s$ $_2$✔

Calculates F_s or F_a $_3$✔

Evidence of an attempt at a moment equation $_4$✔

Distance = 1.18 m ✔$_5$

ΔL = {FL÷AE} steel = {FL÷AE} aluminium {F÷d^2E} steel = {F÷d^2E} aluminium $_1$✔

$$\frac{F_s}{0.8^2 \times 210} = \frac{F_a}{1.6^2 \times 70}$$

$F_a = 1.33\ F_s$ OR $F_s = 0.752\ F_a$ $_2$✔

$1.33\ F_s + F_s = 200$ N

$F_s = 86$ N, $F_a = 114$ N $_3$✔

Attempt to take moments about A or B or other suitable point, expect to see 16.0gx = 228 - 4.4g ✔$_4$

Note that an answer of 1.14 m comes from not taking into account the weight of the beam

*Award **max 4** for this approach.*

ECF for MP2 and MP3 in MP4

5

[10]