Q1 **(a)**

scalar	vector
density	acceleration
energy	displacement
power	weight
speed	
time	

All correct scores 4
6, 7 correct scores 3
4, 5 correct scores 2
2, 3 correct scores 1 **[4]**

(b)(i) 1. speed = distance / time **C1**
= 22 / 2.4
= 9.2 (9.17) (m s^{-1}) **A1**

2. velocity = displacement / time **C1**
= 14 / 2.4
= 5.8 (5.83) (m s^{-1}) **A1**

(ii) displacement is not equal to the distance **B1**
displacement is in a straight line (which is always less than or equal to the total distance) **B1**

TOTAL [10]

Q2 **(a)** **1.** sum of the moments (about any point) is zero / no resultant torque **B1**

2. sum of all the forces acting is zero / no resultant force **B1**

(b)(i) $F_B \times 1.7 = (80 \times 0.85) + (650 \times 1.3)$ **B2**
One moment correct allow 1
Analysis leading to 537 N i.e. $F_B = 913 / 1.7$ **B1**

F = 540 (537) (N) **A0**

(ii) F_A = 650 + 80 –540 or F x 1.7 = 650 x 0.4 + 80 x 0.85 **C1**

= 190 (N) (193 N) **A1**

(iii) F_A goes up **B1**
F_B goes down **B1**
To obtain the same moment a smaller force is required if the distance from the pivot increases / ($F_A + F_B$) is a constant / weight (of painter) transfers from support B to support A **B1**

TOTAL [10]

Q3 **(a)** change in velocity / time taken or rate of change of velocity **B1**

(b) area under line or using equation $s = (u + v)\,t / 2$ or $s = ut + \frac{1}{2}at^2$ **B1**
$= (5.6 \times 0.57) / 2$ **B1**
$= 1.6$ (m) **A0**

(c)(i) using $\Delta v = 5.6$ or 5.1 (m s^{-1}) **C1**

$= [-5.1 - (5.6)] / 20 \times 10^{-3}$ **C1**

$= (-)535$ (m s^{-2}) **A1**

(c)(ii) line starts from 0.59 / 0.58 and –5.1 **B1**
straight line drawn of positive gradient (to the time axis) **B1**
same gradient as OA and to the time axis **B1**

(d)(i) potential energy $= mgh$ **C1**
or potential energy change $= 0.025 \times 9.81\ (1.3 - 1.6)$
$= (-)\ 0.074$ **A1**
unit J **B1**

(ii) (energy transformed) / lost to thermal / internal energy of the ball at the rebound (allow the energy losses are due to air resistance) **B1**

TOTAL [13]

Q4 **(a)(i)** work done = force x distance (moved in the direction of the force) **B1**

(ii) watt is a joule per second **B1**

(b)(i) gradient $= 360000 / 60$ **C1**
$= 6000$ (J m^{-1}) **A1**

(ii) work done = loss in k.e. (E_k) **B1**
$F \times x = E_k$ so $F = E_k / x$ is the gradient of the graph **B1**

(iii) $F = ma$ **C1**
$a = 6000 / 800 = 7.5$ (m s^{-2}) **A1**

(iv) greater **B1**

E_k is larger hence distance is larger (from graph) or using $F = ma$
acceleration is less hence distance is larger **B1**

TOTAL [10]

Q5 (a)(i) strain = extension /<u>original</u> length **B1**

(ii) stress = force / (cross-sectional) area **B1**

(b) **diagram:**

- suitably fixed wire at one end, allow wooden clamps labelled on bench top arrangement or girder in a ceiling support / two wires used
- masses used as load at other end wire, allow labelling of a 'rectangular block' to be masses, load, force, weight(s)
- appropriate length of wire used marked to a pointer,
- extension measured with suitable apparatus that is labelled apparatus that will work is needed for these points to score (a maximum of can be awarded for a load labelled for apparatus that is not applicable I e a wire in a clamp and stand)

(max 3) **B3**

readings:

diameter, mass / load / force, extension, original length **B2**

all 4 scores 2, 2 or 3 score 1

method of obtaining the readings:

diameter with a micrometer,
in several places,
mass weighed on a balance,
several loads used,
extension using micrometer or vernier or metre rule,
correct original length using metre rule.
repeat readings <u>on unloading</u>

(max 4) **B4**

determination of the Young modulus:

Young modulus = stress / strain,
force/load given by mg,
diameter gives area using $\pi d^2/4$,
plot a graph of force against extension,
gradient of graph determined, E = (gradient x length) /A,
or equivalent using stress / strain graph
gradient = Young modulus,
within the elastic limit i.e. where the line is straight or other good physics point

(max 4) **B4**

QWC: technical language (correct terms used for the readings to be measured and instruments to be used e.g. mass – balance, diameter – micrometer, length – ruler, extension – ruler and / or correct terms for determination of YM correct link with force and mass, diameter and area, YM and stress and strain related) majority of these correct **B1**

SPAG (written work has less than four errors in spelling and punctuation grammar and sentence formation) **B1**

Total [17]

[Total 60]