Multiple Choice Answers

Q17: B

Q18: C

Q19: A

1(a)	rate of change of velocity
1(b)(i)	acceleration = 320 / 20 = 16 m s^{-2}
1(b)(ii)	$s = \frac{1}{2}((u) + v)t$ **or** distance = area under graph
	(height) = $\frac{1}{2} \times 20 \times 320$ = 3200 m **or** 3.2 km
1(c)(i)	$(\Delta E_P) = mg\Delta h$
	$= 2.9 \times 10^6 \times 9.81 \times 3200$ $= 9.1 \times 10^{10}$ J
1(c)(ii)	$(\Delta E_K) = \frac{1}{2} m\Delta(v^2)$
	$= \frac{1}{2} \times 2.9 \times 10^6 \times 320^2$ $= 1.5 \times 10^{11}$ J
1(c)(iii)	(power =) work done / time
	power = $((1.5 + 0.91) \times 10^{11}) / 20$ = 1.2×10^{10} W

6(a)	(a particle that) cannot be divided / subdivided (into smaller particles)
6(b)(i)	any combination of one quark and one antiquark
	up / charm / top **and** antiup / anticharm / antitop **or** down / strange / bottom **and** antidown / antistrange / antibottom
6(b)(ii)	$E_{(K)} = \frac{1}{2} mv^2$
	$2.1 \times 10^{-16} = \frac{1}{2} \times 0.67 \times 1.66 \times 10^{-27} \times v^2$
	$v = 6.1 \times 10^5\ \text{m s}^{-1}$
6(c)(i)	number of electrons = 88
6(c)(ii)	(number of nucleons = 228 – 5 × 4 = 208) number of protons = 88 – (5 × 2) + 4 = 82
	number of neutrons= 208 – 82 = 126 = 126

1	**Defining the problem**
	vary *r* and measure *v* **or** *r* is the independent variable and *v* is the dependent variable
	keep *x* constant
	Methods of data collection
	labelled diagram of workable experiment including: • one end of spring resting against block clamped to bench using G-clamp • light gate positioned at P • light gate connected to timer • apparatus shown on bench • labels for light gate **and** P **and** at least one other label from bench, block, stand, spring, ball, timer
	method to determine *r*, e.g. use calipers or micrometer to measure diameter *d* **and** $r = d / 2$
	description of method to determine *v*, use diameter of ball (to interrupt beam) ÷ measured time at light gate positioned at P
	instrument to determine *x*, e.g. rule(r) or calipers
	Method of Analysis
	plot a graph of (2 lg *v*) or (lg v^2) against lg *r* **or** plot a graph of (lg *v*) against (lg *r*) or equivalent, e.g. (ln *v*) against (ln *r*)
	$n = -$gradient for (2 lg *v*) or (lg v^2) against lg *r* **or** $n = -2 \times$ gradient for (lg *v*) against lg *r*

1	$Y = \frac{\rho \times 10^{y\text{-intercept}}}{kx^2}$ for (2 lg v) or (lg v^2) against lg r **or** $Y = \frac{\rho \times 10^{2 \times y\text{-intercept}}}{kx^2}$ for (lg v) against lg r	
	Additional detail including safety considerations	
	D1	precaution to <u>prevent ball leaving bench</u>, e.g. screens around apparatus / cushions on bench (to stop the ball)
	D2	keep k **and** ρ constant
	D3	description of method to determine k, e.g. add mass to spring and $k = mg$ / extension **or** use newton meter to measure force applied to spring and k = force / extension **or** take several readings of force and extension, plot a force–extension graph and k = gradient
	D4	description of experimental method to determine ρ, e.g. measure mass of ball using a balance **and** $\rho = \frac{m}{\frac{4}{3}\pi r^3}$
	D5	repeat measurements of <u>diameter</u> or <u>d</u> in different directions <u>and</u> determine the average value of d
	D6	method to keep x constant, e.g. use a pin / ruler / card to indicate the starting point each time <u>to keep x constant</u>
	D7	x = original length of spring – <u>compressed</u> length of spring
	D8	adjust (vertical) position of light gate so that the diameter of (each) ball cuts the beam
	D9	repeat experiment for the same value of r **and** determine the average v

1	D10	relationship valid <u>if</u> a straight line is produced (with y-intercept = $\lg\left(\frac{Ykx^2}{\rho}\right)$ or $\frac{1}{2}\lg\left(\frac{Ykx^2}{\rho}\right)$). Do not accept line through the origin.

Multiple Choice Answers

Q12: D

Multiple Choice Answers

Q16: A