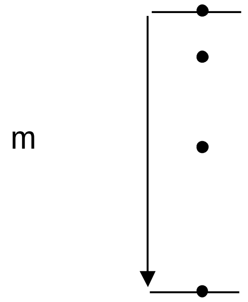
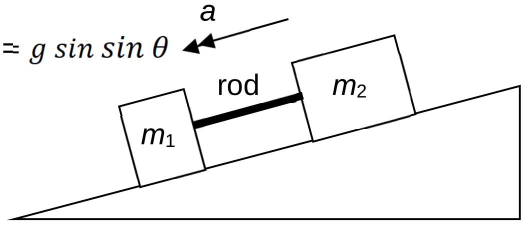
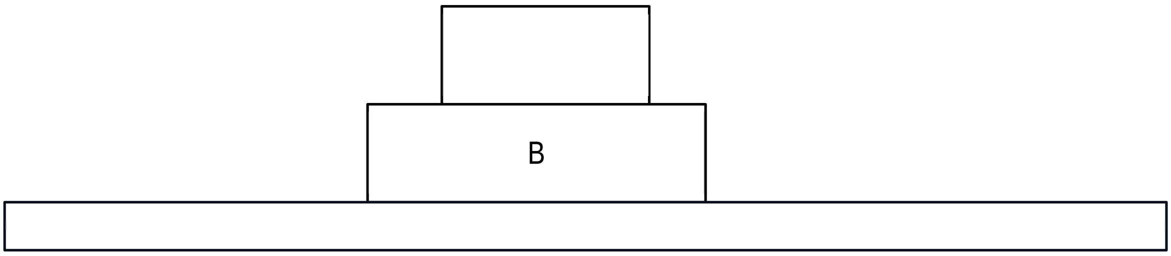
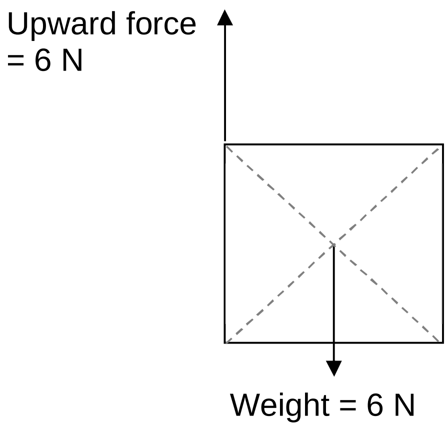
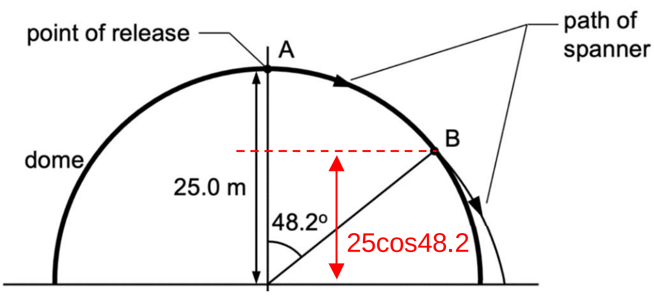
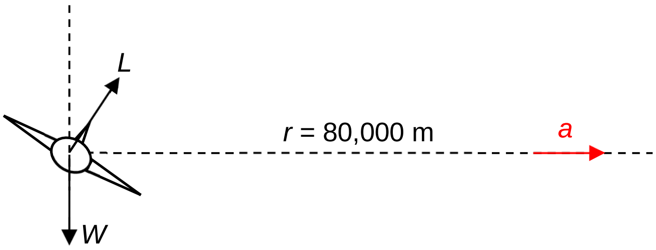
1	**A**	pico	nano	micro	
		10^{-12}	10^{-9}	10^{-6}	
2	**D**	The product *PS* has the same units as *Q* and *R*.			
3	**A**				

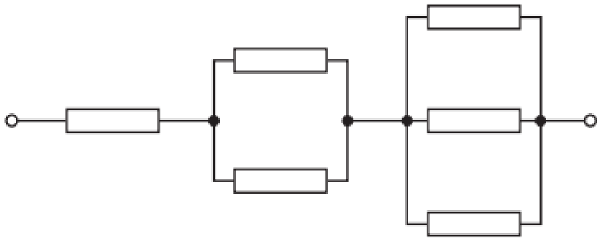
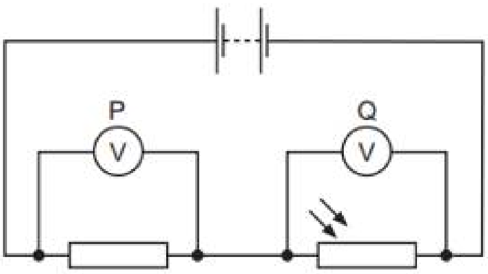
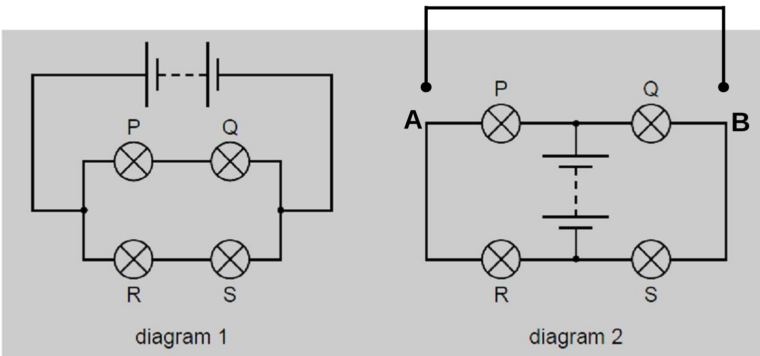
4	**B**	Accurate when the average is close to the true value. Precise when the spread of readings is small.
5	**A**	Constant acceleration: $v^2 = u^2 - 2as$ ® $\frac{1}{2}mv^2 = \frac{1}{2}mu^2 - (ma)s$ Since (ma) is constant, graph is a straight line with a negative gradient.
6	**B**	Constant acceleration = g. Initial speed $u = 0$ Let the time interval between successive drops be t. $9.0 = \frac{1}{2}g(3t)^2$ ® $t = \sqrt{\frac{2}{g}}$ Second drop from the roof: $s_2 = \frac{1}{2}gt^2 = 1.0$ m Third drop from the roof: $s_3 = \frac{1}{2}g(2t)^2 = 4.0$ m Distance $= s_3 - s_2 = 3.0$ m 
7	**D**	$x = 500 = (u\ cos\ cos\ \theta) \times 2t$ ® $u\ cos\ cos\ \theta = \frac{250}{t}$ ----------------- (1) $y = 210 = \frac{1}{2}(u\ sin\ sin\ \theta + 0)t$ ® $u\ sin\ sin\ \theta = \frac{420}{t}$ ----------------- (2) (2) | (1) gives: $tan\ tan\ \theta = \frac{420}{250}$ ® $\theta = 59°$
8	**A**	Consider both masses and the rod as one system: $(m_1 + m_2)g\ sin\ sin\ \theta = (m_1 + m_2)a$ ® $a = g\ sin\ sin\ \theta$ Consider forces acting on m_1 (or m_2) $m_1 g\ sin\ sin\ \theta - T = m_1 a = m_1 g\ sin\ sin\ \theta$ $T = 0$ 

9	**A** The reason why a person is unable to move a heavy box when he pushes it is because he cannot overcome the frictional force exerted by the floor on the box.
10	**A**  A B 70 N Consider both A and B as one system: $70 = (20 + 6.0)a$ ® $a = 2.69$ m s^{-2} Consider forces acting on B: $f' = 6.0a = 16$ N ® frictional force on A = f Alternatively, consider forces acting on A: $70 - f = 20a$ ® $f = 16$ N
11	**A** Moment = Force x perpendicular distance = 4 x 2 = 8 Nm. Moment for B = C = D = $(4\ sin\ sin\ 45\ ) \times 2 = 5.7$ Nm
12	**C** Resultant force = zero. Resultant torque = 6x clockwise x = half the length of the one side. Hence for equilibrium, we need an anticlockwise Torque of 6x Nm. 
13	**C** Impulse = area under force – time graph = $\frac{1}{2}(3 + 6)(20) = 90$ N s Impulse = change in momentum: $(20)v - 0 = 90$ ® $v = 4.5$ m s^{-1}

14	**B** Horizontally, momentum is conserved: (2.0)(0.50) = (2.5)v ® v = 0.40 m s^{-1} Change in momentum of trolley = (2.0)(0.40) □ (2.0)(0.50) = □ 0.20 Ns
15	**C**  From the relative speed relation: $u - 0 = 0.5u - v$ ® $v = 0.5u - u = -0.5u$ From momentum conservation: $mu = m(-0.5u) + m_2(0.5u)$ ® $m_2 = 3m$
16	**D** At maximum speed, $F_{engine} = D = kv^2$: $P = F_{engine}v = kv^3$ With two engines: $72{,}000 = k(12)^3$ With one engine: $36{,}000 = kv^3$ Dividing gives: $\frac{v^3}{(12)^3} = \frac{1}{2}$ $v = 9.52$ m s^{-1}
17	**C** Tension becomes zero and the only force acting on the mass is its weight. Hence, it undergoes projectile motion (i.e, constant vertical acceleration = g and non-zero constant velocity in the horizontal direction). For projectile motion, path is parabolic.
18	**B** Centripetal acceleration, $a = \frac{v^2}{r}$ From energy conservation, gain in k.e. = loss in g.p.e. $\frac{1}{2}mv^2 - 0 = mg(25 - 25\,cos\,cos\,(48.2)\,)$  $v^2 = 163.6$ ® $a = \frac{v^2}{r} = \frac{163.6}{25} = 6.54$ m s^{-2}

19	**B**  Horizontally: $L \sin \sin \theta = \frac{mv^2}{r}$ i.e. centripetal force = $L \sin \sin \theta$ or = $\frac{mv^2}{r}$ Ratio of centripetal force to the weight = $\frac{mv^2}{r} \div mg = \frac{v^2}{rg} = \frac{650^2}{80{,}000 \times 9.81}$ = 0.538
20	**A** Weight = Gravitational force exerted by Earth on satellite: $W = \frac{GMm}{r^2} = \frac{GM_{Earth}m_{satellite}}{R^2}$ At a distance of r = 5R + R = 6R from the centre of the Earth, gravitational force exerted by Earth on satellite = $\frac{GMm}{r^2} = \frac{GM_{Earth}m_{satellite}}{(6R)^2} = \frac{1}{36}\left(\frac{GM_{Earth}m_{satellite}}{R^2}\right) = \frac{W}{36}$
21	**C** Since satellite is in circular orbit, from Newton's 2nd Law: $F_{net} = m_{satellite}a$ ® $\frac{GMm}{R^2} = \frac{mv^2}{R}$ ® $mv^2 = \frac{GMm}{R}$ Kinetic energy of satellite = $\frac{1}{2}mv^2 = \frac{1}{2}\left(\frac{GMm}{R}\right)$
22	**B** Since satellite is in circular orbit, from Newton's 2nd Law: $F_{net} = m_{satellite}a$ ® $\frac{GMm_{satellite}}{R^2} = m_{satellite}R\omega^2$ mass of satellite cancels off. ® $\frac{GM}{R^3} = \omega^2 = \left(\frac{2\pi}{T}\right)^2$ For period T to be 24 hrs, there can only be 1 value of R.
23	**A** Length of wire in one turn of the coil = $2\pi r = 2\pi\left(\frac{D}{2}\right) = \pi D$ Total length of wire used in N turns $L = \pi DN$

	$R = \frac{\rho L}{A} = \frac{\rho(\pi DN)}{\pi\left(\frac{d}{2}\right)^2} = \frac{4\rho(DN)}{d^2}$

24	**D** $66{,}000 = R + \frac{R}{2} + \frac{R}{3}$  R = 36 k⋀
25	**D** Energy dissipated = QV ® potential difference $V = \frac{Energy\ Dissipated}{Q}$ p.d. across *r* = $\frac{10.0}{20.0}$ = 0.500 V p.d. across *R* = $\frac{50.0}{20.0}$ = 2.50 V emf = 2.50 + 0.50 = 3.00 V
26	**B** When light intensity decreases, resistance of the LDR increases. From potential divider rule, p.d. across LDR = Q increases while p.d. across fixed resistor = P decreases. 
27	**C** Let the e.m.f. of the battery be E. In diagram 1, p.d. across each of the 4 bulbs is $V = \frac{E}{2}$. In diagram 2, p.d. across each of the 4 bulbs is still $V = \frac{E}{2}$.  Points A and B are at the same potential, hence connecting A to B will not result in any current flowing between A and B.

28	**A** Only forces on WZ and XY produces turning effect. Maximum torque = NBILsin90 x WX = (20)(0.80)I(0.17) x (0.11) = 1.35 $I = \frac{1.35}{(20)(0.80)(0.17)(0.11)}$ = 4.51 A
29	**A** From Newton's 2nd law: Resultant force = mass x centripetal acceleration $Bqv = mv\omega$ ® $\omega = \frac{Bq}{m}$ Since $\omega = \frac{2\pi}{T}$ ® $\frac{2\pi}{T} = \frac{Bq}{m}$ ® $T = \frac{2\pi m}{Bq}$
30	**D** 90232Th → 224α + 2 – 10β + ZAX A = 232 – 8 = 224 and Z = 90 – 4 + 2 = 88