(1) ✓C - kelvin is a base unit

---

(2) ✓B - force is a vector, KE is a scalar

vectors	scalars
displacement	KE
acceleration	power
velocity	speed
momentum	
force	

---

(3) $d = k_1 v^2$ $d \to$ metres, $v \to ms^{-1}$

✓A $d = k_2 v'^2$ $d' \to m$, $v' \to kmhr^{-1}$

$v' = \frac{60 \times 60}{1000} = 3.6v$

$d = k_2 (3.6v)^2$
$= 12.96 k_2 v$

$12.96 k_2 = k_1$

$k_2 = \frac{k_1}{12.96}$ ~~= 0.07716 k~~ $0.0772 k_1$

---

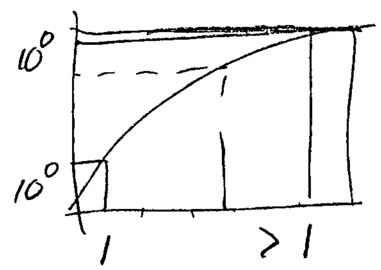
(4) $f = 5 Hz$ $T = \frac{1}{f} = 0.2 s = 200 ms$.

✓D 1 div → 100 ms

---

(5)

A



x. 10° → ~~to~~ 1

y 10° → >1

continuous

---

(6) $W = \frac{1}{2} k x^2$ $k = 100 \pm 2 Nm^{-1}$. $\Delta k = \frac{2}{100} = 0.02 = 2\%$

B $x = 0.050 \pm 0.002$ $\Delta x = \frac{2}{50} = 0.04 = 4\%$

~~$\Delta W = \frac{1}{2} 0.02 (0.04)^2 = \frac{1}{2} \times 3.2 \times 10^{-5}$~~ ~~$(0.04)^2 = 0.0016$~~ $= 1.6\%$

~~$\frac{\Delta W}{W}\% = 2 \times (1.6)^2 =$~~

NOT KNOWN AT THIS TIME

→ ERROR

(7) Terminal velocity $v = \frac{\Delta s}{\Delta t}$ is constant $\Rightarrow D$

D ✓ ∴ speed increases until constant

---

(8) $a = 1.0\ ms^{-1}$ $s = 3.5 \times 10^{-2}$ $v = 0$

$v^2 = u^2 + 2as$

$v = 0 \Rightarrow u^2 = |2as|$ $a = \frac{u^2}{2s} = \frac{1.0^2}{2 \times 3.5 \times 10^{-2}}$

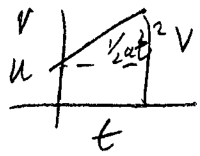
C ✓ $= 14.2857\ldots$

$= 14\ ms^{-2}$ (2 sf)

Not $9.8\ ms^{-1}$

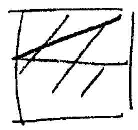
---

(9) $s = ut + \frac{1}{2}at^2$ ✓



$v - u = at$ $a = \frac{v-u}{t}$

D ✓ $s = vt - \frac{1}{2}at^2$ ✓



$vt - \frac{1}{2}at^2$

$\frac{(v+u)(v-u)}{2a} = \frac{v^2 - u^2}{2a}$

$2as = v^2 - u^2$

$v^2 = u^2 + 2as$ ✓

$D \rightarrow \frac{(v-u)}{2}t = \frac{at}{2} \neq ut + \frac{1}{2}at^2$ ✗

---

(10) fully grown woman → 65 kg → $65 \times 10 = 650\ N$

✓ D

---

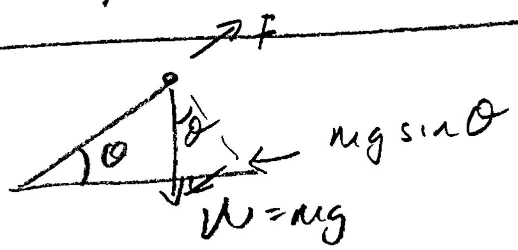
(11) $\Delta p = mv - (-mv) = 2mv$

$\Delta E = 0$

C

---

(12)



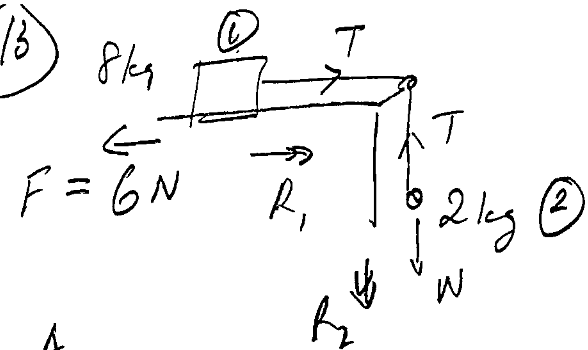
$F = ma$

$ma = mg\sin\theta - F$

C $F = mg\sin\theta - ma$

$m(g\sin\theta - a)$

(13)



A ✓

① $R_1 = T - F$

$8a = T - 6 \Rightarrow T = 8a + 6$

② $R_2 = W - T$

$2a = 2g - T$

$2a = 2g - (8a + 6)$

$2a = 2g - 8a - 6$

$10a = 2g - 6 = 2 \times 9.81 - 6$

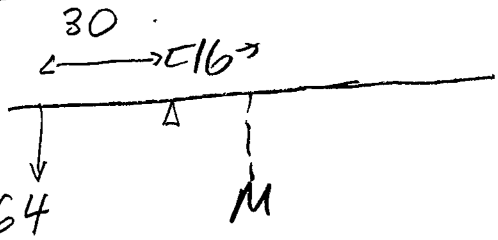
$a = 1.362 \approx 1.4\ ms^{-2}$ (2sf)

---

(14) C ✓ $F = ma = \frac{m \Delta v}{\Delta t} = \frac{\Delta mv}{\Delta t} = \frac{\Delta p}{\Delta t}$

---

(15)



C ✓

$F_1 d_1 = F_2 d_2$ ratios

$64 \times 30 = M \times 16$

$M = \frac{64}{16} \times 30 = 120g$

---

(16) $W = Fd = \frac{800 \times 1.5 \times 360 \times 60}{9}$ $v = \frac{s}{t}$ $s = vt$

C ✓

$= 2,880,000 = 2.88 \times 10^6 J$

$\approx 2.9 \times 10^6 J$ (2sf)

---

(17) ✓

A → false

B → false → some energy is lost as heat

C → true

D → false

$F = ma$ $P = \frac{\Delta W}{\Delta t}$

---

(18) $KE = \frac{1}{2}mv^2 = \frac{1}{2} \cdot 500 \times (2.0)^2 = 1000 J$

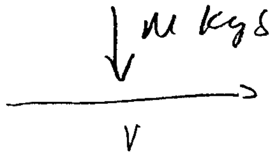
B

$10\% E \Rightarrow 100 J$

$U = mgh \Rightarrow$ $100 = m \times 9.8 \times 15$

$M = \frac{100}{9.8 \times 15} = 0.6802.. \approx 0.68 kg$ (2sf)

(19)



$\frac{\Delta p}{\Delta t} = mv$

$P = \frac{W}{t}$

$E = \frac{1}{2}mv^2$ $\frac{\Delta E}{\Delta t} = \frac{\frac{1}{2}mv^2}{t}$

D ✓

$0 \rightarrow mv$

$F = Ma = \frac{Mv}{t}$

$P = \frac{\Delta E}{\Delta t}$

$m = \frac{M}{t}$

$W = Fd$ $P = \frac{W}{t} = \frac{Fd}{t} = Fv = \frac{Mv^2}{t} = mv^2$

---

(20)

$1 \rightarrow$ copper?   A

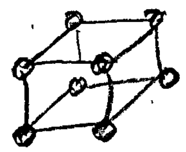
AV $2 \rightarrow$ glass

$3 \rightarrow$ nylon

---

(21)

$\rho = \frac{m}{V}$



cube has 8 atoms at corners, but each atom is shared with 8 other cubes

$\rightarrow$ 1 atom per cube

C ✓

$V = \frac{M}{\rho} = \frac{8.5 \times 10^{-25}}{9.2 \times 10^{3}} = 3.804 \times 10^{-29}$

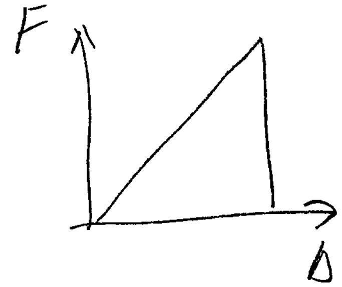
347826

$d = \sqrt[3]{V} = 3.3622 \times 10^{-10}$

$= 3.4 \times 10^{-10}$ m

---

(22)



$E = \frac{1}{2}kx^2$ strain $= \frac{\Delta x}{l}$

$E = \frac{1}{2}Fx$ stress $= \frac{F}{A}$

A ✓

y = force $x = \Delta l$

x = extension $F = kx$

---

(23)

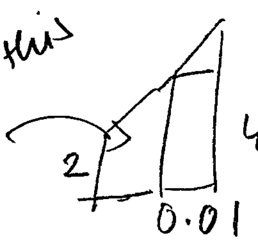
$\Delta l = 1.0$ cm $l_0 = 1.0$ cm $E = \frac{1}{2}$ $F = k\Delta l$

B ✓

$k = \frac{F}{\Delta l} = \frac{8}{0.04} = 200$

$E = \frac{1}{2}kx^2 = \frac{1}{2} \cdot 200 \times (0.01)^2$

use this



$\frac{1}{2} \times 0.01 \times 2$

extension from $1.0 \rightarrow 2.0$ cm

$0.01 + 0.01 = 0.030$ J $\rightarrow$ B

(24) $v = f\lambda$ $v = 320\ ms^{-1}$ $T = ~~8~~\ 4 \times 10^{-3}$ s

$f =$ ~~500 Hz~~ ✓ 250 Hz $f = \frac{1}{T} =$ ~~8000~~   250

~~#~~ Sound wave → longitudinal ✗   ~~$\lambda = \frac{v}{f} = \frac{320}{500}$~~ 250 ~~= 0.625~~

D ✓   intensity $\propto \frac{1}{r^2}$

intensity $\propto A^2$ ✗   A = amplitude m

D → false ✗

$\lambda = \frac{v}{f} = \frac{320}{250} = 1.28\ ms^{-1}$ ✓

---

(25) $f = 15$ $v = 24$

$\lambda = \frac{v}{f} = \frac{24}{15} = 1.6$ m

B ✓ phase dif = 0.4 m   (2 − 1.6)

$\frac{0.4}{1.6} = \frac{1}{4}$ quarter of a cycle

---

(26) $I \propto A^2$ $A' \Rightarrow$ ~~4A~~ 2A

✓ D $I' \rightarrow 4A^2 \rightarrow$ ~~3 × 4.0~~ $3.0 \times 4 = 12\ Wm^{-2}$

---

(27) A ✓   A must be gamma.

---

(28) 90 cm = 0.9 m → 1.5 λ   f = 12 Hz

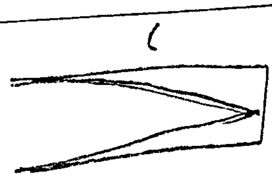
$\lambda = \frac{0.9}{1.5} = 0.6$ m.

B ✓ $v = f\lambda = 12 \times 0.6$

$= 7.2\ ms^{-1}$

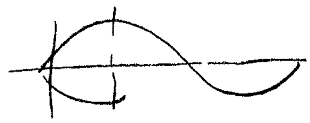
---

(29) ✓ D

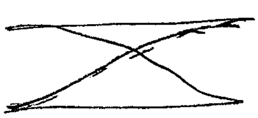


$\lambda = 4l$

closed



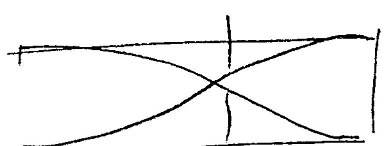
A



$\lambda = 2l$ → NO

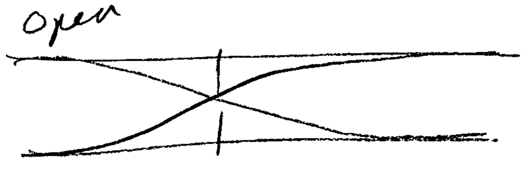
B is also open

C is closed   ~~overtone at~~ → NO



x | $\frac{\lambda}{2}$ $\frac{3\lambda}{2}$

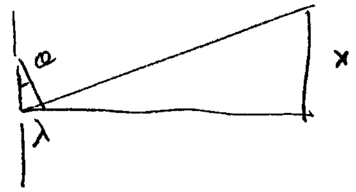
D open



fund at 2λ ✓✓

(30)

(B)



$v = f\lambda =$

$c = f\lambda = \frac{\lambda}{T}$ $f\uparrow$ $\lambda\downarrow$

---

(31) D

$E = \frac{V}{d} = \frac{1000}{0.002} = 500{,}000\ NC^{-1}$ $\rightarrow D$

---

(32) B ✓

$\uparrow F = EQ = V\frac{Q}{d}$ $F = \frac{Qq}{r^2}$ $E = \frac{V}{d}$

$\downarrow W = mg$

here

$W = mg = \frac{2VQ}{d}$ $m =$

---

(33) B ✓

$P = V \cdot I$

$= \frac{V^2}{R}$

$V = IR$ $I = \frac{V}{R}$

$R \rightarrow 2R$

$P' = \frac{V^2}{R'} = \frac{1}{2}\frac{V^2}{R} = \frac{1}{2}P \rightarrow B$

---

(34) D✓

C → false $\frac{VI}{P} = \frac{P}{P} = 1$

A → false $P = VI = I^2R$

$= \frac{Q^2}{t^2}R$

B → $P = \frac{V^2}{R}$ $\frac{E}{t} = \frac{V^2}{R}$

$ER = V^2t \rightarrow$ false

$P = VI$ $PQ = VIQ$ $V = \frac{E}{Q}$

$\frac{E}{t} = V$ $= VI\frac{E}{V} \rightarrow$ true $Q = \frac{E}{V}$

---

(35) 40 ampere-hour → 0.2 × 200 × 60 × 60

$Q = It$

$I = \frac{Q}{t}$ $Q = \frac{E}{V}$

$V = \frac{E}{Q}$

C

$E = QV = I \cdot V \cdot t$

$= 12 \times 0.2 \times 200 \times 60 \times 60$

$= 1{,}728{,}000 = 1.7$ MJ (2 s.f.)

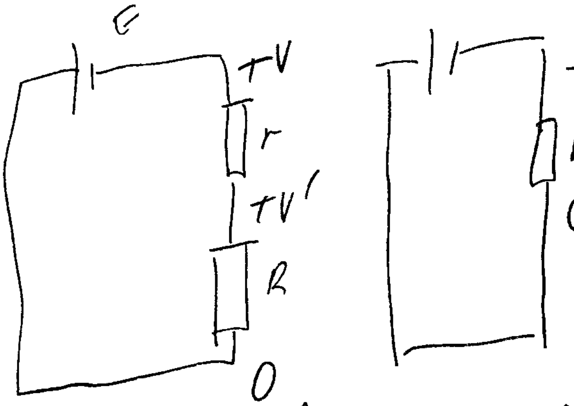
$I = \frac{Q}{t}$

→ C

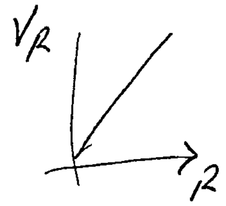
---

(36)

(D)



$P = \frac{V^2}{R}$ $V = IR$



pd across R increase → A false

pd across r decrease → B false

pd across R increase but as I ↓ the decreases

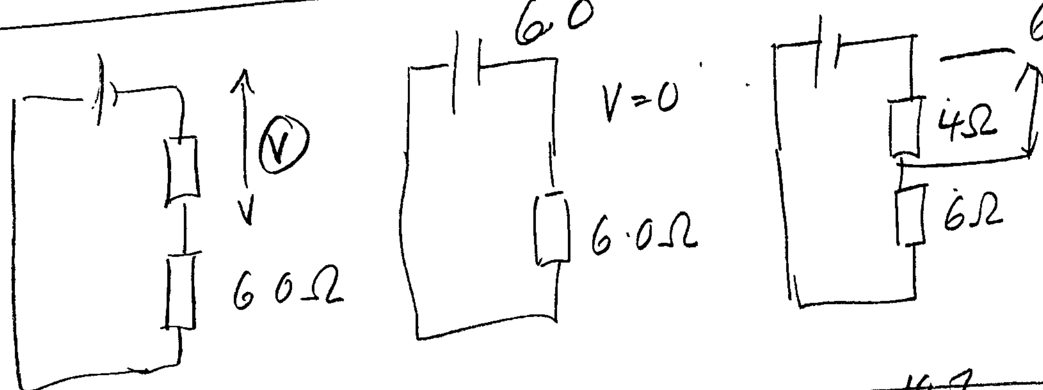
→ D ✓

C ✗

---

(37)

(A) ✓



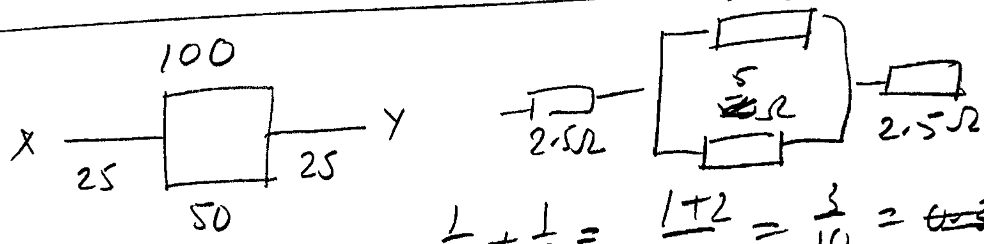
6 in ratio 4 : 6

= 2.4 V

---

(38) 10 Ω m⁻¹

C



$\frac{1}{10} + \frac{1}{5} = \frac{1+2}{10} = \frac{3}{10} =$ ~~0.3 Ω~~

$\frac{1}{R} = \frac{3}{10}$ $\Rightarrow \frac{10}{3}\ \Omega$

$\frac{10}{3} + 2.5 + 2.5 = 8.3$ → C

(3.3)

(39) C

(40) $^{222}_{86}Rn - ^{4}He \xrightarrow{-\alpha} ^{218}_{84} \xrightarrow{-\alpha} ^{214}_{82} \rightarrow ^{206}_{82}$

-8β

check

nucleid decay → DO

(41) B