① A ④ B ⑦ C

② B ⑤ E

③ D ⑥ B

8 a). Let trolley roll down slope so card cuts light beam.

Measure width of card – ruler

Measure time card cuts beam – electronic timer

calculate inst. speed = $\frac{\text{card width}}{\text{time beam cut}}$.

b). $a = \frac{v-u}{t}$

$a = \frac{0.8-0}{2}$ ← important to have both values in equation even if 0.8–0 = 0.8!

$a = 0.4\ ms^{-2}$

c). Wrong.

Human reaction time will have a greater effect upon the stopwatch time

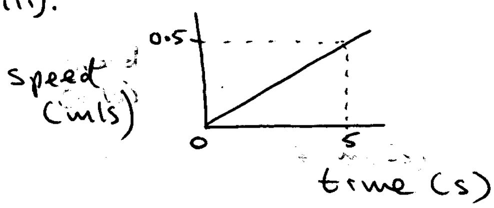
9 a i). $s = \frac{\text{width}}{t_{LG}} = \frac{0.1}{0.2} = 0.5 \text{ m/s}.$

a ii). $a = \frac{v-u}{t}$

$a = \frac{0.5-0}{5}$

$a = 0.1 \text{ ms}^{-2}$

a iii).



b i). LESS b ii) THE SAME.

10 a) $d = s.t$

$24 = 40.t$

$t = \frac{24}{40} = 0.6 \text{ s}$

b). $a = \frac{v-u}{t} = \frac{50-0}{0.004} = 12500 \text{ ms}^{-2}$

c). slower speed.

11 a). FORCE 10N.

b) i P scale too small (only goes up to 2N)

bii). Scale is too large.
Hard to read 10N on 200N scale.

12 ai). Width of ball
Time ball passed through light gate.

aii). inst speed = $\frac{\text{width}}{\text{time through Light Gate}}$

bi). FRICTION

bii). $a = \frac{v-u}{t} = \frac{6-8}{4} = \frac{-2}{4} = -0.5\ ms^{-2}$

biii) $F_{un} = ma = 5 \times (-0.5) = -2.5\ N$

13 a). SHAPE, SIZE, SPEED.

b). $F_{un} = m \cdot a$

$27 = 0.6 \cdot a$

$a = \frac{27}{0.6}$

$a = 45\ ms^{-2}$

14 a i). 1·2 N (const. speed ⇔ balanced forces)

a ii) $E_W = F \cdot d$

$E_W = 1{\cdot}2 \times 25$

$E_W = \underline{30\,J}$

b i). $E_p = mgh$

$E_p = 0{\cdot}8 \times 10 \times 2$

$E_p = \underline{\underline{16\,J}}$

✓ $h = 2$
✓ $g = 10$
✓ $m = 0{\cdot}8$
✗ $d = 25$
✓ $E_p = ?$

b ii). $E_{TOTAL} = E_W + E_p$

$E_T = 30 + 16$

$E_T = \underline{\underline{46\,J}}$

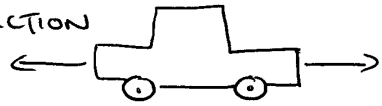
TOTAL E_W!

b iii) $P = \frac{E_W}{t}$

$P = \frac{46}{5}$

$P = \underline{\underline{9{\cdot}2}}\,W$

15 a)



b i).

brake force not applied to passenger
passenger keeps moving at original speed
until stopped by

b ii). (A)

$F_{un} = m \cdot a$

$8000 = 1000 \cdot a$

$a = \frac{8000}{1000}$

$a = 8 \, ms^{-2}$

F = 8000
m = 1000
d = 23 m
a = ?

(B)

$E_w = F \cdot d$

$E_w = 8000 \times 23$

$E_w = 184{,}000 \, J$

b iii)

Kinetic energy → Heat energy.

16 a). Measure total distance from start to finish.
Time how long boat took to travel the distance.
calculate ave speed = $\frac{\text{total distance}}{\text{total time}}$.

b). $\bar{s} = \frac{d}{t} = \frac{2000}{465}$ $t = (7 \times 60) + 45$
$t = 420 + 45$

$\bar{s} = \underline{\underline{4.30}}$ m/s

ci). FRICTION
cii) Boat ACCELERATES
ciii) forces will be BALANCED.

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17) a). Wax skis.
Skin tight clothing (↓ air drag)
Crouched body position

b). SAME size (balanced forces ⟷ constant speed)

c). $E_w = F.d$
$E_w = 346 \times 500$
$E_w = \underline{\underline{173{,}000}}$ J

18 a). $F = mg$

$W = 20{,}000 \times 10$

$W = \underline{200{,}000\ N}$

b). CONSTANT SPEED

c i) $E_p = mgh$

$E_p = 20\,000 \times 10 \times 300$

$E_p = \underline{60 \times 10^6}\ J$ [60 MJ]

c ii). $P = \frac{E}{t}$

$P = \frac{60 \times 10^6}{(8 \times 60)}$

$P = \underline{125{,}000}\ W$ (125 kW)

c iii). Some energy lost as heat due to friction.

19 a) $W = m.g$

$W = 40 \times 10$

$W = \underline{400 N}$

b). steady speed ⇔ balanced forces ∴ $\underline{400}$ N

c). $E_w = F.d$

$E_w = 400 \times 7.5$

$E_w = \underline{3000}\ J$

d). $P = \frac{E_w}{t}$

$P = \frac{3000}{120}$

$P = \underline{25}\ W$

20 a) $W = m \cdot g$

$W = 1200 \times 10$

$W = 12000 \text{ N}$

b). $E_p = mgh$

$E_p = 1200 \times 10 \times 1.5$

$E_p = 18{,}000 \text{ J}$

c). $P = \frac{E_p}{t}$

$P = \frac{18000}{12}$

$P = 1500 \text{ W}$

cii). Some energy is lost as heat due to friction.

2 1 a). $s = \frac{d}{t} = \frac{90\ km}{1\ hr} = \frac{90{,}000\ m}{(1 \times 60 \times 60)\ s} = \frac{90{,}000}{3600} = 25\ m/s$

b). $s_{CAR} = \frac{d}{t} = \frac{(9-2) \times 2m}{0.4} = \frac{14}{0.2} = 70\ m/s$

$\Delta S = 70 - 25 = 45\ m/s$

c) i). 5 s

ii). $a = \frac{v-u}{t} = \frac{50-0}{10} = 5\ m\,s^{-2}$

iii). calc. dist travelled by car @ 50s

$d = s.t$

$d = 40 \times 50$

$d = 2000\ m$

iv). Calc areas ~~under~~ UNDER both lines to calc. distance.

Polis

$d = \frac{1}{2} b.h$

$d = 0.5 \times 20 \times 50$

$d = 500m$

Sports

$d = \frac{1}{2} b h$

$d = 0.5 \times 24 \times 40$

$d = 480m$

Police car by 20 m

22 a) 0·55

b). $a = \frac{v-u}{t} = \frac{13-0}{6.5} = 2\,ms^{-2}$

ci). d = s.t

d = 12×20

d = 240 m

cii). d = AREA under v.t graph.

$d = \frac{1}{2}b.h + b.h$

d = (0.5×6.5×13) + (13×13)

d = 42.25 + 169

d = 211.25 m

Δd = 240 − 211.25

Δd = 28.75 m

23 a i). 1st (steepest slope o → p)

a ii). 2nd

b). d = AREA under vt graph

$d = \frac{1}{2} b.h + b.h$

$d = (0.5 \times 2 \times 2) + (2 \times 6)$

$d = 2 + 12$

$d = \underline{13 m}$

c). $a = \frac{v-u}{t} = \frac{(0-9)}{2} = -4.5 \ ms^{-2}$

24 a). i). $a = \frac{v-u}{t}$

$a = \frac{6.5-0}{200}$

$a = 0.0325 \ ms^{-2}$

NB you must show 6.5 − 0 even if it does equal 6.5!

$a = \frac{6.5}{200} \Rightarrow a = \frac{v}{t}$ which is WRONG PHYSICS — SORRY! :(

a ii). d = AREA under vt graph

$d = (\frac{1}{2} b.h) + (b.h) + (\frac{1}{2} b h)$

$d = (0.5 \times 200 \times 6.5) + (6.5 \times 200) + (0.5 \times 200 \times 6.5)$

$d = 650 + 1300 + 650$

$d = \underline{\underline{2600 m}}$

25 a i) 9 m

a ii). $d = v \cdot t$

$9 = 13.4 \times t$

$t = \frac{9}{13.4} = 0.67\ s$

b).i 0.4 s

b ii). d = Area under v/t graph

$d = (b \times h) + (\frac{1}{2} b.h)$

$d = (0.4 \times 18) + (0.5 \times 2.8 \times 18)$

$d = 7.2 + 25.2$

$d = 32.4\ m$

b iii) $a = \frac{v-u}{t}$

$a = \frac{0-18}{2.8}$

$a = -6.43\ ms^{-2}$

26a) $\bar{v} = \frac{d}{t} = \frac{5}{0.0417} = \underline{120} \text{ km/h.}$ $t = \frac{2.5}{60}$

Answer! No

b). Speedometer reading will increase/decrease depending upon road conditions and the driver.

Average speed = total distance ÷ total time.

27 a). Force (weight) per unit mass (or on 1 kg of mass)

b).

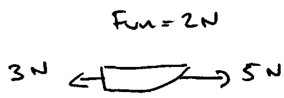
–	–	33.6
–	21	0
–	21	210

28 ai). 3 N

aii) $a = \frac{F_{un}}{m}$

$a = \frac{2}{4}$

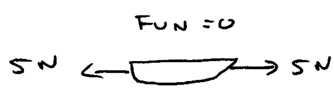
$a = 0.5 \text{ ms}^{-2}$



b) After the 7s Friction = 5N

Forces are balanced

Boat moves at constant speed



29 a). Average speed as it uses Total Distance (2.0 km) and total time.

b). $d = v \cdot t$

$2000 = 220 \cdot t$

$t = \frac{2000}{220} = 9.09\,s$

c) i Increases air resistance / friction

c ii). Distance = AREA under v/t graph

$d = \frac{1}{2} b \cdot h$

$d = 0.5 \times 150 \times 220$

$d = 16{,}500\ m$

c iii). $a = \frac{v - u}{t}$

$a = \frac{0 - 220}{150}$

$a = -1.47\ ms^{-2}$

c iv). $F_{un} = m \cdot a$

$F_{un} = 3000 \times (-1.47)$

$F_{un} = -4400\ N$

30 a). $a = \frac{v-u}{t}$

$a = \frac{11-0}{3.2}$

$a = 3.44 \ ms^{-2}$

b). $\bar{v} = \frac{d}{t}$

$\bar{v} = \frac{1200}{42}$

$\bar{v} = 28.57 \ ms^{-1}$

c). Light gate at finish line + electronic timer
Measure width of bob sleigh
Inst. speed = $\frac{\text{bob sleigh WIDTH}}{\text{time through light Gate}}$

d).
- All people crouch down as much as possible.
- Bob sleigh has rounded edges + shape
- Bob sleigh + crew have very smooth surfaces

31 a i) $a = \frac{v-u}{t}$

$a = \frac{70-0}{2}$

$a = 35\ ms^{-2}$

a ii). $F_{un} = m \cdot a$

$F_{un} = 28000 \times 35$

$F_{un} = 980,000\ N$

a iii). Catapult force = 980 kN − 240 kN

= 740 kN

b i). $E_k = \frac{1}{2} m v^2$

$E_k = 0.5 \times 28000 \times (65^2)$

$E_k = 59150000\ J$

$E_k = 59.15 \times 10^6\ J$

b ii). Distance = AREA under v/t graph.

$d = (\frac{1}{2} b.h) + (b.h) + (\frac{1}{2} b.h)$

$d = (0.5 \times 1 \times 10) + (1 \times 55) + (0.5 \times 2.5 \times 55)$

$d = 5 + 55 + 68.75$

$d = 128.75\ m$

32 a i) $\bar{v} = \frac{d}{t} = \frac{320}{21} = 15.24$ m/s

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33 a i) $a = \frac{v-u}{t}$

$a = \frac{15-0}{10}$

$a = 1.5 \ ms^{-2}$

a ii) Fun = m.a

Fun = 268 000 × 1.5

Fun = 402,000 N

a iii). • Greater during 10–40 s period.

• graph slope is steeper

(Calc a: $a = \frac{v-u}{t} = \frac{80-15}{30}$

$a = 2.17 \ ms^{-2}$)

a iv). Length = AREA under v/t graph

$L = (\frac{1}{2} b.h) + (b.h) + (\frac{1}{2} b.h)$

$L = (0.5 \times 10 \times 15) + (30 \times 15) + (0.5 \times 30 \times 65)$

$L = 75 + 450 + 975$

$L = 1500$ m

b). i greater than

b ii) equal to.

34a). $E_p = mgh$

$E_p = 60 \times 10 \times 7$

$E_p = 4200\ J$

b).i Q

ii). $E_k = \frac{1}{2} mv^2$

$E_k = 0.5 \times 60 \times (6^2)$

$E_k = 1080 J.$

$E_p = mgh$

$1080 = 60 \times 10 \cdot h$

$1080 = 600 \cdot h$

$h = \frac{1080}{600} = 1.8 m$

iii) Some energy lost as heat due to friction.

35ai). $d = v.t$

$d = 2 \times 0.3$

$d = 0.6 m$

a ii). $v = u + at$

$v = 0 + (10 \times 0.3)$

$v = 3 m/s$

b). Same time.

Runner is at same height.

(time depends on gravity + height)

c). $E_p = mgh$

$E_p = 50 \times 10 \times 5$

$E_p = 2500 J$

cii). $E_p = E_k = \frac{1}{2} mv^2$

$2500 = \frac{1}{2} \cdot 60 \times v^2$

$2500 = 30 v^2$

$v^2 = 2500/30$

$v = 9.13 ms^{-1}$