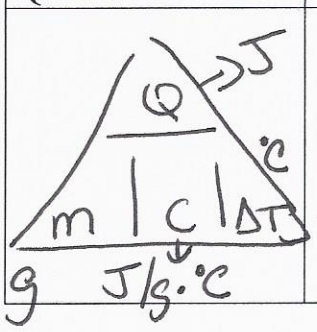
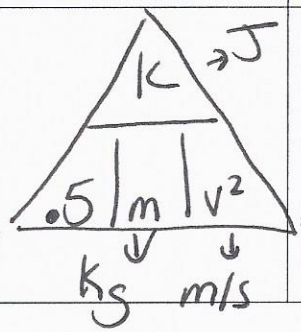
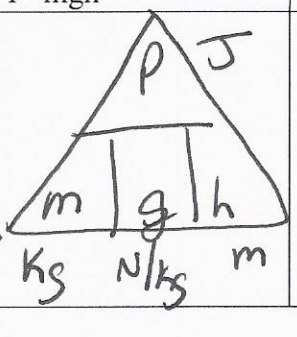
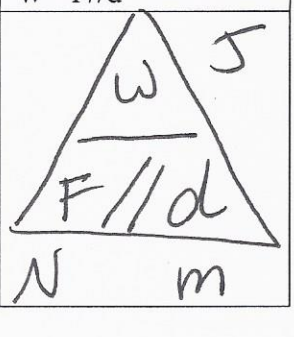
Test review for energies, forces and work

1. For each formula, make the triangle and give the unit for each variable.

Q=mcΔT	K= .5mv²	P=mgh	W= F//d
			
Q J m | c | ΔT °C g J/g·°C	K J .5 | m | v² kg m/s	P J m | g | h kg N/kg m	W J F//d N m

2. What are the formulas for final and initial temperatures?

IT = FT - ΔT FT = IT + ΔT

3. Conversions: convert the first box to the box below it.

700 km	6 000 g	45 kg	15 km/h	17 cm
m ×1000 700000 m	kg ÷1000 6kg	N ×9.8 N/kg 440 N	m/s 15×1000/3600 4.2m/s	m ÷100 0.17cm

4. Calculate the gravitational pull of a fictional planet if a 510 g golf ball was hit 35 meters high with 42 000 J of energy.

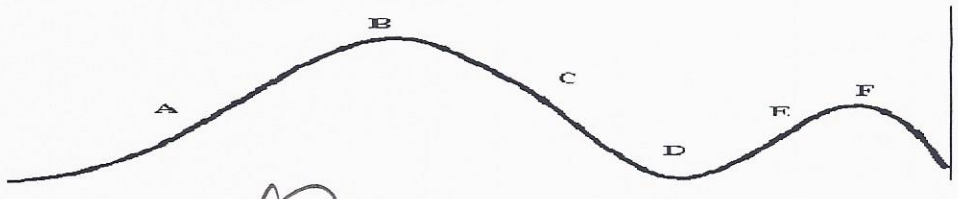
A) 2.4 N/kg B) 240 N/kg (C) 2.4 x 10^3 N/kg D) 2.9 x 10^4 N/kg

$g = \frac{P}{mh}$ $\frac{42000}{(.51 \times 35)} =$

5. Substance A has a higher specific heat than substance B. Which requires the most energy to heat equal masses of A and B to the same temperature?

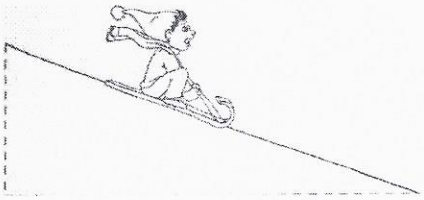
(A) Substance A C) Both require the same amount of heat.
B) Substance B. D) Answer depends on the density of each substance.

6. Which letter on the diagram represents the place where the cars on the roller coaster would have the most potential energy?



A) A (B) B C) D D) F

7. Nathan is sitting on his sled, sliding down a snowy hill. The hill is angled at 20° from the ground. Nathan and the sled weigh 350°N. Which of the arrows best represents the direction of the effective force acting on Nathan and the sled?



A) B) C) D)

8. If 59.1 g of pure metal uses 890.9 J of energy to heat it from 26.1°C to 59.6°C, identify the metal.

Specific heat capacities of some metals

Metal	Specific heat capacity (J/g·C)
Aluminum	**0.897**
Chromium	**0.45**
Cobalt	**0.64**
Copper	**0.385**

$C = \frac{Q}{m\Delta T}$ $\frac{890.6}{(59.1 \times (59.6-26.1))}$

Chromium

9. Two students were performing an experiment on heat energy. They poured 125 g of water into a calorimeter. The temperature of the water was 22.0°C. The students then placed a small electric heating element into the water. The heating element transferred 7 120 J of energy to the water.

What was the final temperature of the water?

A) 8.4°C B) 13.6°C C) 35.6°C D) 79.0°C

$\Delta T = \frac{Q}{mc}$ $\frac{7120}{(125 \times 4.19)} = 13.6°C$

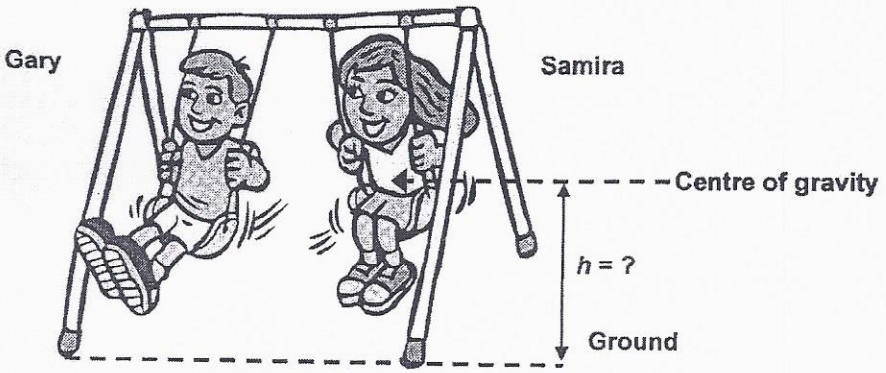
$FT = IT + \Delta T$
$13.6 + 22.0$
$= 35.6°C$

10. Karina decided to make herself some French fries as a snack. In order to cook her French fries, the temperature of the oil must be 190°C. Karina pours 1.4 kg of oil, that is originally at a temperature of 23°C, into a deep fryer. It takes 390 446 J of energy to heat the oil. What is the specific heat of the oil used?

A) 1.67 J/(g•°C) B) 12.12 J/(g•°C) C) 1 670 J/(g•°C) D) 12 120 J/(g•°C)

$C = \frac{Q}{m\Delta T}$ $\frac{390\ 446}{(1400 \times (190-23))} = 1.67$

11. Gary and Samira are swinging on separate swings, as illustrated below.



Gary has a mass of 28 kg and Samira has a mass of 23 kg. At a certain moment in time, Gary's kinetic energy is 126 J while Samira's gravitational potential energy is 180 J.

a) What is Gary's speed at this moment in time?

b) How high above the ground is Samira's center of gravity at this moment in time?

a) $v^2 = \frac{K}{.5m} = \frac{126}{(.5 \times 28)} = 3\ m/s$

b) $h = \frac{P}{mg}$

$\frac{180}{(23 \times 9.8)} = .80\ m$

12. Brad is pulling his daughter Ashley on a sleigh. The rope is at an angle of 47° with the horizontal. Brad has a mass of 67 kg and exerts a force equal to his weight and pulls his daughter for 3.0 km. How much work is done by brad?

~~67~~ $\times 9.8 = 660\ N$

$W = F \parallel d$

$\left(\cos 47 = \frac{x}{660}\right) \times 3000 =$

1 400 000 or 1.4×10^6 J

~~9.8×10^5 J~~

13. Carl is pulling his younger sister on a sled with a force of 60.0 N at a 75° angle.

a- What is the effective force used when pulling the sled?

b- If the sled's mass is 3.0 kg when his sister is in it, could they be lifted off the ground?

a) $\cos 75 = \frac{x}{60.0} = 16\ N$

b) $\sin 75 = \frac{x}{60.0} = 58\ N$

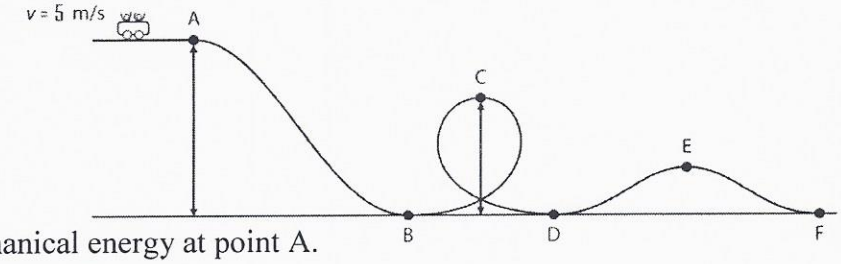
$3.0 \times 9.8 = 29\ N$

yes he can lift 58 N greater than 29 N

14. What is vinegar's specific heat if 40.0 g was heated for 8 minutes and had a temperature change of 24.0°C to produce 500.0 J of heat?

$C = \frac{Q}{m \Delta T}$ $\frac{500.0}{(40.0 \times 24.0)} = 0.521\ J/g \cdot °C$

15. Roger gave the following account of a roller-coaster ride:
"I tried a brand-new ride at a science centre. There's a computer screen that tells you how much the car and the people in it weigh and how high and fast you travel. You get into the car and they strap you in. The car has a mass of 555 kg. At the top, it moves horizontally at a speed of 5.00 m/s. Then you drop 30.0 m, make a loop 20.0 m into the air and finish by riding over an 8.0-m hill. I don't remember our maximum speed or our speed at the top of the loop, but the ride was fantastic!"



Calculate the mechanical energy at point A.

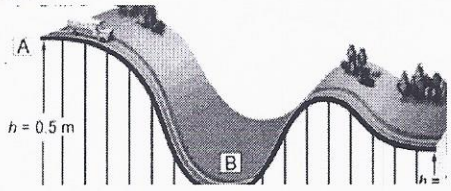
M = P P = mgh

K = 0 now

555 x 9.8 x 30.0

E = 163000 J or 1.63×10^5 J

16. Jessica builds a model track for her little brother.
She places a toy bus weighing 0.5 kg at point A . The b travels the entire route with no further addition of energy.



a- What is the potential energy of point A?

P = mgh .5 x 9.8 x .5 = 2J

b- If the velocity of the bus at point B is 3.13 m/s, calculate its kinetic energy.

$K = .5mv^2$ $.5 \times .5 \times 3.13^2 = 2J$

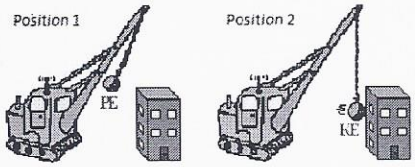
c- What is the relationship between the energy values calculated in A and B? Explain.

When at rest PE = KE at full speed.

Full PE = 0 KE = Full ME Full KE = 0 PE = Full ME

As PE ↓ KE ↑, but ME never changes.

17. A bulldozer will be used to bulldoze a building. In Position 1, the bulldozer has a height of 2 500 cm and weighs 125 kg. What is the speed that the bulldozer will hit the building as seen in position 2?



$K = P = mgh$

$v^2 = \frac{K(mgh)}{.5m}$

$\sqrt{\frac{125 \times 9.8 \times 25}{(.5 \times 125)}}$

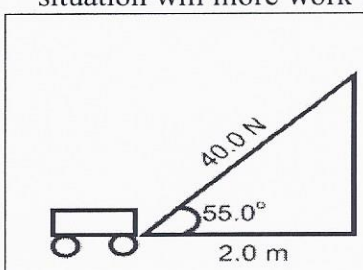
22 m/s

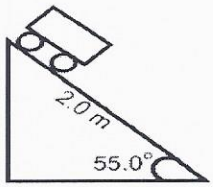
18. A van travels at a speed of 30.0 km/h with a kinetic energy of 7 700 J. What is the van's mass?

$m = \frac{K}{.5v^2} = \frac{7700}{(.5 \times 8.33^2)} = 220\text{kg}$

$\frac{30.0 \times 1000}{3600} = 8.33\text{ m/s}$

19. If each of the carts illustrated weighs 60.0 N and travels a distance of 2.0 m, in which situation will more work be done?





$W = F \parallel d$

$(\cos 55.0 = \frac{40.0}{x}) \times 2.0$

40.0 46J

~~80 J~~

$(\sin 55.0 = \frac{x}{60.0}) \times 2.0$

98J

more work

20. A crane carries a metal tube weighing 70.5 kg 110.5 m above ground at a speed of 7.5 km/h. What is the metal tube's mechanical energy?

$K = .5mv^2$

$.5 \times 70.5 \times 2.1^2$

160 J

$P = mgh$

$70.5 \times 9.8 \times 110.5$

76 300 J

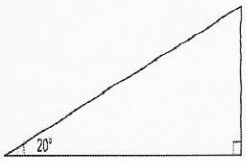
$\frac{7.5 \times 1000}{3600}$

2.1 m/s

$+$

$= 76500\text{J}$

21. What is the effective force of a boy weighing 170 N going down a hill at a 20° angle?



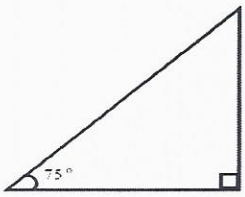
$\sin 20 = \frac{x}{170} = 60\,N$

22. How much work was done when a boy pulled a sled for 60.0 m with a force of 10.0 N at a 10.0° angle?

$W = F//d \quad \left(\cos 10.0 = \frac{x}{10.0}\right) \times 60.0 = 591\,J$

23. Fred is pulling his younger sister on a sled with a force of 90.0 N at a 75° angle.
   a- What is the effective force used when pulling the sled?

$\cos 75 = \frac{x}{90.0} = 23\,N$



   b- If the sled's mass is 8.0 kg, will it be lifted off the ground?

$8.0 \times 9.8 = 78\,N \quad \sin 75 = \frac{x}{90.0} = 87\,N$

yes can lift 87 N greater than 78 N.

24. A truck weighing 12 000 kg has 85 000 J of kinetic energy. What is the speed it is travelling at?

$V^2 = \frac{K}{.5m} \quad \sqrt{\left(\frac{85000}{.5 \times 12000}\right)} = 3.8\,m/s$

25. How much work does the gravitational force acting on a skier represent if the skier weighs 55 kg and travels 4.0 km down a hill with a 10.0° angle?

$W = F//d$

$55 \times 9.8 = 540\,N$

$\left(\sin 10.0 = \frac{x}{5400}\right) \times 4000$

$= 3.8 \times 10^5\,J$