Unstructured Question Practice

1. Potential to kinetic energy (1&2)
2. Specific Heat Capacity and Specific Latent heat (3-5)
3. Specific Heat capacity and Kinetic energy (6)
4. Power and Specific heat capacity (7)
5. Power and latent heat (8)
6. Power and GPE (motor lifting a load) (9)
7. Kinetic energy and Work done (a slow moving football being 'stopped' by the frictional force of the grass) (10)
8. Elastic energy and kinetic energy (pinball machine – velocity of pinball) (11)
9. Elastic energy and acceleration (fairground attraction – running against bungee cord – acceleration on 'spring back')(12)
10. Transformer equations (like paper 2, 2018) (13)
11. Wave equation and ultrasound detection (give f and λ then ask to calculate a depth etc) (14)
12. Floating (15)
13. Moments & springs (like in paper 2, 2019) (16)
14. Volume flow rate - filling up a container to provide a force and moment to release a load (something along the lines of the Britain's Got Talent stunt act this year where cross bows were released when water containers filled). (17)
15. Boyle's and Hooke's law (18)
16. F=ma and $v^2-u^2 = 2as$ braking force on a train. (19)

Unstructured Question Practice

1. A ball of mass 50g is thrown into the air with an initial speed of 14m/s using the idea of energy transfers calculate the maximum height the ball reaches. Take g=9.8m/s^2

2. A rollercoaster train with mass of 500kg starts 25m above the ground. If the maximum speed it reaches at the bottom of the first dip is 20m/s calculate the height of the lowest point of the dip above the ground. Take g=9.8m/s^2

3. How much energy is required to bring 100g of ice at 0 °C to room temp (20 °C)? Specific heat capacity of water = 4200 J/kg/°C , Specific latent heat of fusion of ice = 335 000 J/ °C

4. 10,000kg of Aluminium is heated from 20°C to its melting point and then fully melted. If the Specific heat capacity of Aluminium = 910 J/(kg°C) and Specific latent heat of fusion of Aluminium = 3.21×10^5J/kg calculate the melting point of Aluminium if the energy required is 9.034GJ.

5. In another furnace Gold is being melted. Using the information given calculate the mass of Gold in the crucible if 20kJ of energy are required to heat it from room temperature and melt it completely. Melting point of gold = 1063°C, Specific heat capacity of gold = 130 J/(kg°C), Specific Latent Heat of gold = 6.7×10^4 J/kg.

6. A car and its driver of total mass 1500Kg travelling at 31m/s (about 70mph) is brought to rest by applying the brakes. The brakes comprise a steel disc brake on each wheel, each with a mass of 1.5Kg. If the initial temperature of the discs is 20°C, how hot do they get to bring the car to a stop? Specific heat capacity of steel = 490 J/kg/°C

7. A Kettle rated 3kW is used to heat 1kg water from room temperature to boiling point. Calculate how long it will take for the water to boil.

8. In a polypropylene injection moulding machine (to make the caps for plastic bottles) the polymer must be melted gently so the material properties are not destroyed. The PP chips at room temperature (20°) are put into a long heater and are moved slowly through using and Archimedes screw. A t the other end of the heater all the polymer must be completely melted. If the power of the heater is stated to be 2.5kW and we assume no energy loss to the surroundings calculate the time the PP will need to be inside the heater.
   Specific Heat Capacity PP = 1920 J/(kg°C), Specific Latent Heat PP = 2.93×10^5 J/kg, Mass of PP = 500g, melting point of PP = 160°C

9. A restaurant has a small lift between the kitchen in the basement and the restaurant on the ground floor to transfer the food. The motor on the lift states that it uses 10W power and is 90% efficient in converting that energy. The restaurant regularly lift a load of 15kg the 3m between the floors and it takes 1 minute. Is the manufacturer's claim correct?

10. A footballer kicks a football with a mass of 450g at 10m/s along the ground. The ball comes to a stop 25m away. Calculate the force of friction provided by the grass which has slowed the ball.

11. In a pinball machine a spring is used to propel a ball-bearing along a track. The spring obeys 'Hooke's Law' and requires a force of 0.20N to compress it 1.00mm. Calculate the energy stored in the spring when it is compressed by 30mm and the speed the ball bearing leaves the spring (the ball bearing has a mass of 0.025kg).

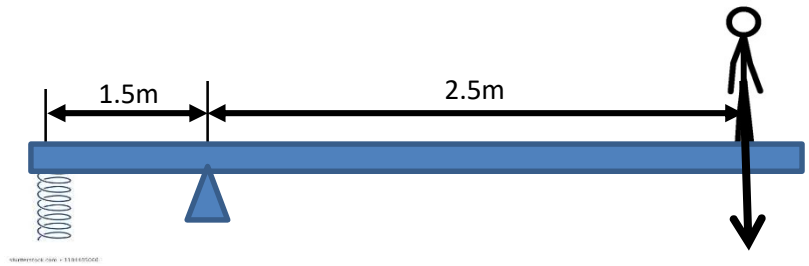
12. A man of mass 65kg is at the fair and takes part in a bungee challenge. The bungee is tied to his waist and he runs against the bungee as far as he can along an inflatable track. When the man can run no further, the bungee accelerates him back towards the start. The initial length of the bungee cord is 10m and it obeys Hooke's law having a spring constant of 500N/m. The man manages to run a total distance of 11.5m before being 'flung' back. Calculate the initial acceleration of the man when the bungee pulls him back and his velocity

13. A step up transformer has 10 turns on the primary coil, and 1000 turns on the secondary coil. The secondary p.d. is 200V and the secondary current is 0.5A. Calculate the current in the primary coil.

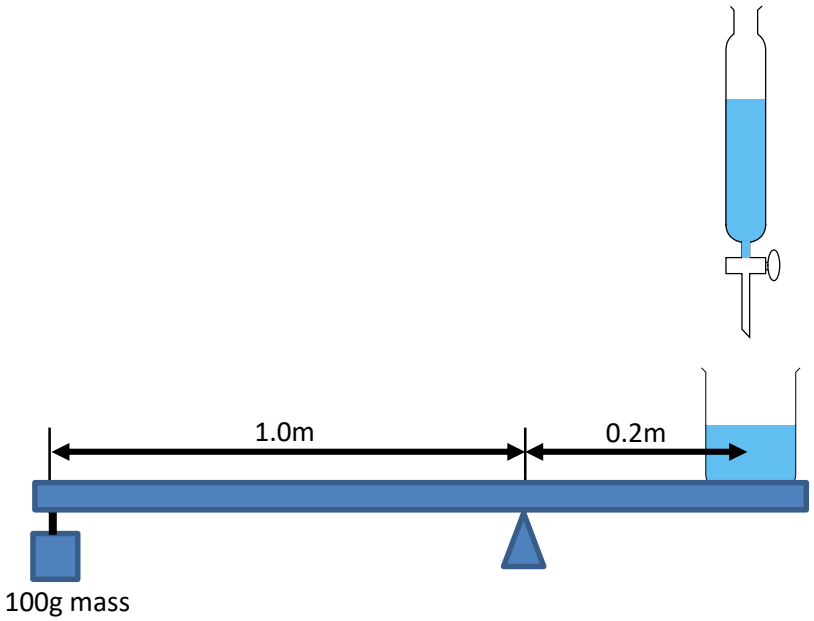
14. A fishing trawler is using ultrasound of frequency 150kHz and wavelength 1cm to detect shoals of fish. A shoal is detected when the ultrasound is reflected back to the boat and returns in a time of 0.03s. Calculate the depth of the shoal underneath the base of the trawler.

15. A buoy has a volume of 100cm^3. When it floats 40% of the buoy is submerged. If the weight of the water displaced by the buoy is equal to the upthrust force keeping the buoy floating, calculate the weight and density of the buoy. Take the density of water as 1g/cm^3 and g=9.8N/kg.

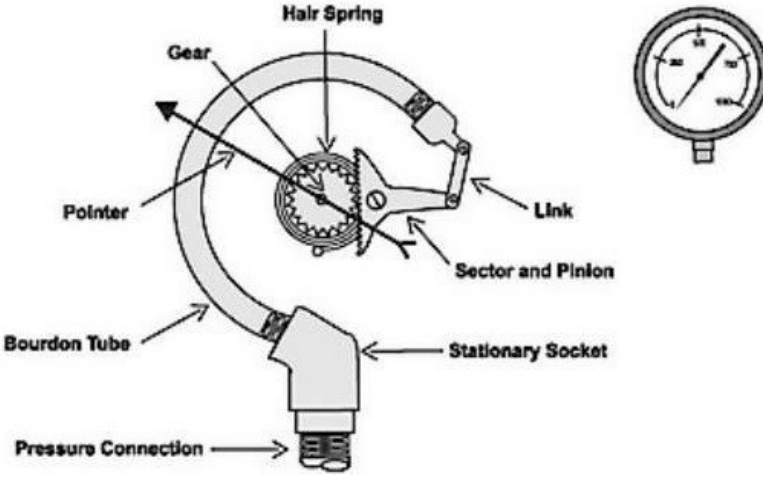
16. A diver of mass 65kg stands on the end of the diving board as shown. If the extension in the spring is 10cm for the situation shown, calculate the spring constant of the spring.



17. On Britain's Got Talent 2019 a stunt act used the flow of water into a vessel to trigger the release of a crossbow. The trigger releases when the beam is horizontal as shown. There is a 100g mass 1.0 m from the pivot and the beaker which is originally empty has a mass of 100g. When the tap is opened on the funnel the water flows into the beaker at a constant rate of 15cm^3 per second. Calculate the time from the tap opening to the point where the trigger is released. Give your answer to two significant figures.



18. In a bourdon pressure gauge the extension of a spring is used to move a pointer and show the pressure in the system. The gauge will be calibrated carefully. The spring constant of the hair spring is 1.82kN/m. The area of the pressure connection into the spring system is $2cm^2$. A gas syringe is attached to the pressure gauge. The initial pressure in the syringe is 100kPa and the volume is $10cm^3$. If the volume is reduced to $7.25cm^3$ the pressure will increase and the spring in the gauge will extend moving the pointer. Assuming the spring obeys Hooke's law; calculate the extension of the spring when the new pressure is applied. Give your answer to 2 significant figures.



19. A train is moving at 120km/h when the driver spots an emergency red light. The mass of the train is 100 tonnes. What force must be applied to the brakes if the train must stop in 100m?