Sem2 Exam Practise 3

Short Answers

Q1

A boat is motoring north with a velocity of 20 km h^{-1} across a river flowing east with velocity 15 km h^{-1}. Find the resultant velocity of the boat. **(2 marks)**

Q2

A cannonball is fired at 150 $m\,s^{-1}$ at an angle of 30° to the horizontal.

(a) How high does it reach above the ground? (Acceleration due to gravity $g = 9.81\,m\,s^{-2}$.)

(3 marks)

(b) How far does it travel and how long is it in flight?

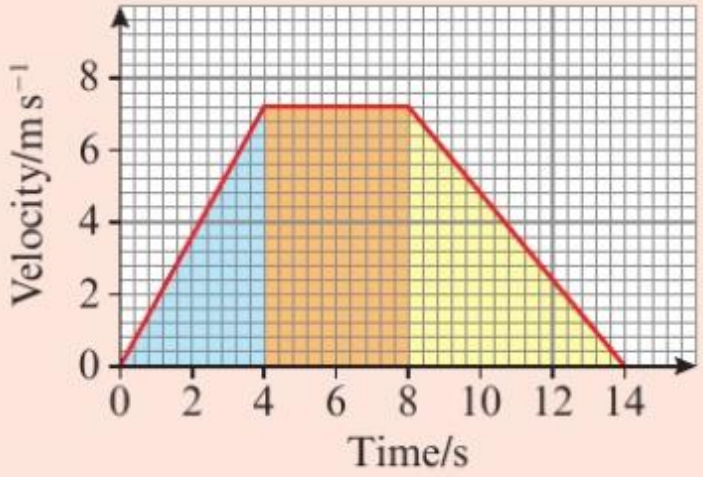
(2 marks)

Q3

A stone is released from rest at the top of a well. It hits the surface of the water after exactly 3.00 seconds. Calculate the distance between the top of the well and the surface of the water.
($g = 9.81\ \text{m s}^{-2}$) **(3 marks)**

Q4

(a) Describe the motion of the object in the velocity–time graph shown below. **(6 marks)**



(b) How far does the object travel? **(4 marks)**

Q5

Ignoring air resistance and upthrust, describe the action-reaction pair for a ball in free-fall. **(2 marks)**

Q6

A book is resting on a level table. Describe the action-reaction pair **(4 marks)**

Q7

A block of ice of mass 1.0 kg slides across a frozen pond at 6.0 m s^{-1} and collides with a stationary block of ice of mass 2.0 kg. After the collision the 2.0 kg block moves off with a velocity of 4.0 m s^{-1} in the same direction. Assuming that friction is negligible, calculate the velocity of the 1.0 kg block after the collision. **(3 marks)**

Q8

A bullet with a mass of 20 g is fired from a rifle with a barrel 80 cm long with a velocity of 500 $m\,s^{-1}$.

(a) What is the kinetic energy of the bullet? **(2 marks)**

(b) What is the average force on the bullet whilst it is accelerating along the barrel? **(2 marks)**

Q9

A student of mass 50 kg climbs 25 steps up a tall ladder. The rungs on the ladder are 30 cm apart. What is the increase in the student's gravitational potential energy when at the top of the ladder? **(2 marks)**

Q10

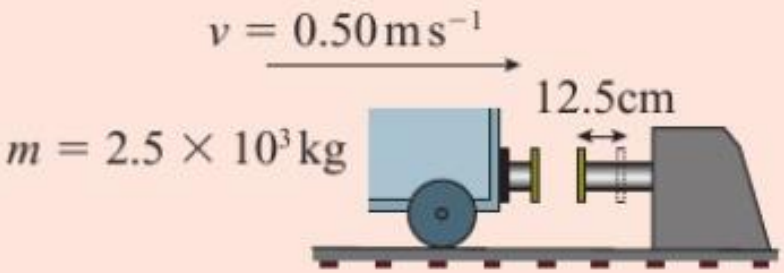
An object of mass 2.0 kg is raised to a height of 30 m above the ground and then dropped.

(a) Describe the energy changes that take place from the moment the object is released until after it has come to rest on the ground. **(4 marks)**

(b) Use the principle of conservation of energy to calculate the speed with which it hits the ground. **(3 marks)**

Q11

The diagram shows a railway truck hitting a buffer. The buffer spring is compressed by 12.5 cm when the truck is brought to rest.



(a) What is the kinetic energy of the moving truck? **(3 marks)**

(b) What is the average force F exerted by the buffer, assuming all the truck's kinetic energy is converted to stored energy in the buffer spring? **(3 marks)**

Q12

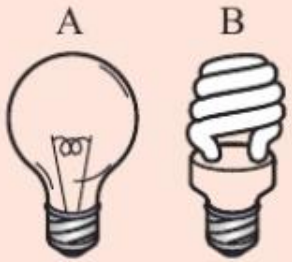
1 A man pushes a box at a steady rate of 2.5 m s^{-1} for 12 seconds by applying a force of 80 N. Calculate the work he does and his power output. **(3 marks)**

2 A forklift truck lifts a 250 kg pallet and load through 180 cm in 1.2 s. Calculate the work done and the power of the forklift. **(3 marks)**

3 An electric motor raises a 600 kg lift at 3.0 m s^{-1}. Assuming no energy is wasted, calculate the power of the electric motor. **(3 marks)**

Q13

Lamp A is a tungsten filament lamp. These are only 5% efficient. Lamp B is a compact fluorescent lamp. These are claimed to use 75% less energy than filament bulbs. Lamp A is rated at 60 W.



Lamps A and B are both in use for 2.0 hours.

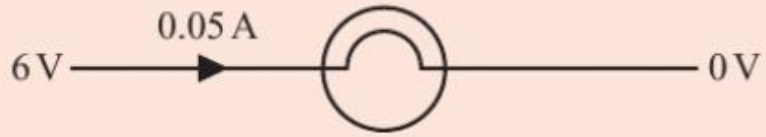
(a) Find the total electrical energy input to lamp A in joules. Calculate the useful light output of lamp A in joules and say how the remaining amount is 'wasted'. **(4 marks)**

(b) Assuming that both lamps have the same useful light output and the maker's claim for B is accurate, calculate how much electrical energy lamp B uses in 2.0 h, and the efficiency of lamp B. **(4 marks)**

Q14

A lamp has a current of 50 mA through it. Calculate the electric charge that passes through it in 1 minute. **(1 mark)**

The lamp in the example on the left was connected to a 6 V supply:



How much energy is transferred into heat and light in the lamp if the lamp is on for 1 minute? **(2 marks)**

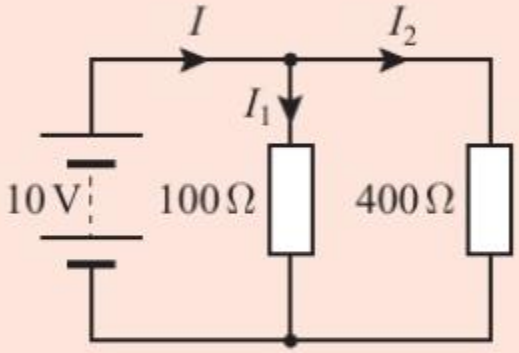
An electric heater operates from a 230 V supply and draws a current of 12.5 A.

(a) Calculate the power of this heater. **(1 mark)**

(b) Calculate how much energy is transferred into heat in 1 hour and 40 minutes by the heater. **(2 marks)**

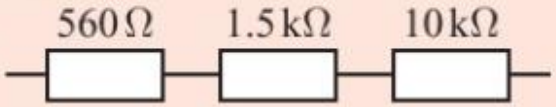
Q15

1 Calculate the current through the two resistors. Hence state the current, I, supplied by the battery. **(3 marks)**

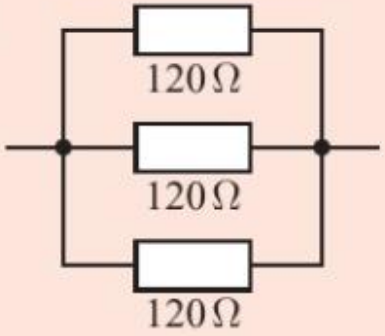


Q16

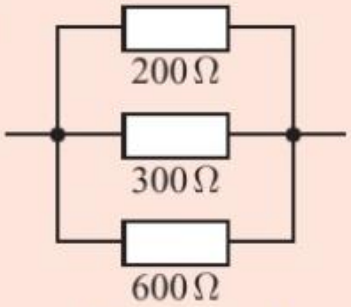
Find the total resistance of the following resistor networks.

(a) 

(1 mark)

(b) 

(2 marks)

(c) 

(2 marks)

Q17

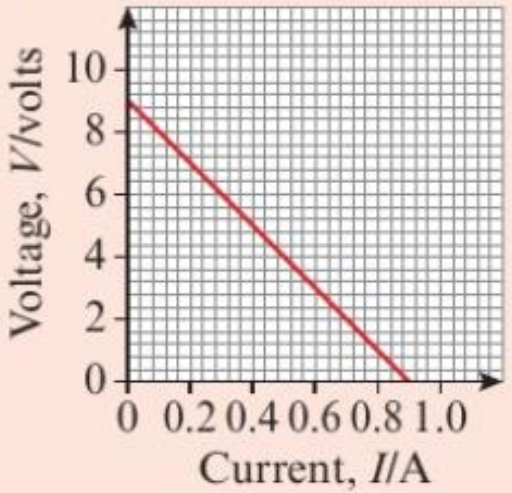
Find the resistance of a 1.5 m length of wire of diameter 0.50 mm and resistivity $5.0 \times 10^{-7}\ \Omega\,\text{m}$. **(3 marks)**

Q18

The resistance of a 1.30 m length of wire is 0.8 Ω.
The average diameter is 0.40 mm.
Calculate the resistivity of the material the wire is made from. **(3 marks)**

Q19

The graph shows how the terminal p.d. of a battery of six cells varies with the current drawn from the battery.



(a) Determine the e.m.f. of one of the cells in the battery. **(2 marks)**

(b) Determine the internal resistance of one of the cells in the battery. **(2 marks)**

Q20

The circuit of fig. 1 consists of a direct current supply of e.m.f. 24 V, negligible internal resistance and three resistors.

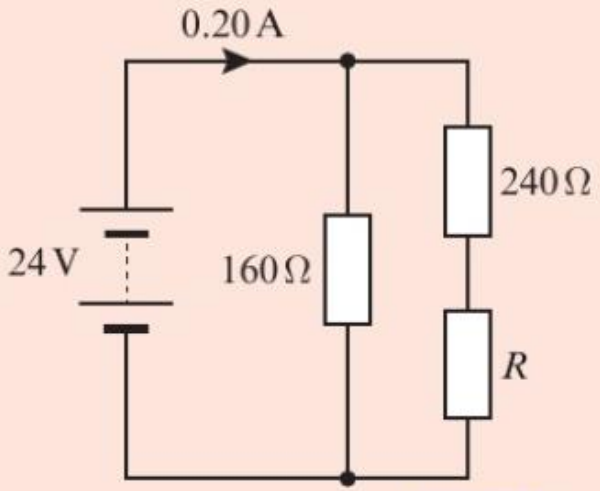


fig. 1

Two of the resistors have resistances 160 Ω and 240 Ω as shown.

The current drawn from the supply is 0.20 A.

(a) Calculate the resistance of R. **(3 marks)**

(b) Resistor R is now short-circuited by connecting a wire of negligible resistance in parallel with it.

State and explain what happens to the currents in each arm of the circuit when R is short-circuited. **(3 marks)**

Q21

(a) Sketch the next simplest standing wave that can be set up in a pipe closed at one end. What is the wavelength of the sound in terms of the length, l, of the pipe? **(3 marks)**

(b) State what happens to the frequency of the sound wave produced. **(1 mark)**

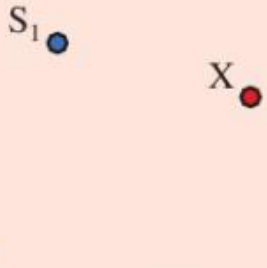
Q22

(a) Ripples travel across the surface of a pond at $15\,\text{cm}\,\text{s}^{-1}$. If the frequency of the ripples is 6.0 Hz find their wavelength. **(2 marks)**

(b) State what happens to the wavelength if the frequency is doubled. **(1 mark)**

Q23

Two similar sets of circular ripples are made at S_1 and S_2 with a frequency of 5.0 Hz and travel at 16 cm s^{-1} across the surface of a ripple tank. X is a point on the water surface 8 cm away from the source S_1.



(a) What is the path length S_1X in terms of the wavelength, λ, of the ripples? **(3 marks)**

(b) Suggest a value of S_2X such that the two sets of waves arrive at X in phase (i) in terms of λ, (ii) in cm. **(2 marks)**

Q24

On a standard guitar, the lowest-pitch string has a frequency of $f_1 = 82.4$ Hz and the highest has a frequency of $f_2 = 329.6$ Hz. The strings have the same tension and the same length. Find the ratio of their masses m_1 and m_2. **(2 marks)**

Q25

An ultrasound scanner produces sound waves with a wavelength of 0.50 mm. The waves travel through soft body tissue at 1540 $m\,s^{-1}$. An echo is detected from the fetus at a distance of 8.0 cm. (a) Find the frequency of the ultrasound transmitted. **(2 marks)**

(b) Find the time interval between pulse and echo. **(3 marks)**

Q26

A sonar pulse–echo detection system uses sound with a frequency of 2.5 kHz. Sound travels at 1500 m s^{-1} in sea water.

(a) Find the wavelength of sound waves in sea water. **(2 marks)**

(b) An echo is detected 2.4 s after the pulse is transmitted. Find the distance to the detected object. **(3 marks)**