Paper 1 [40 marks]

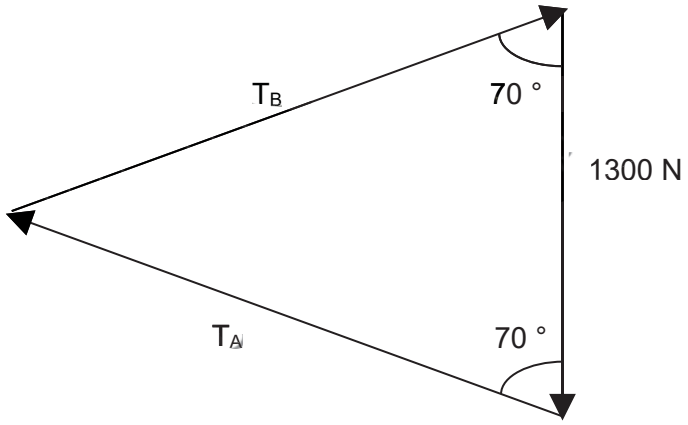
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
B	B	A	D	C	C	D	B	B	C
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
B	C	C	B	B	C	B	B	D	D
Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
C	C	C	A	B	B	A	A	A	C
Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40
C	C	D	B	D	A	C	A	B	D

Paper 2 Section A [50 marks]

1)(a) Weight of cargo = 130 x 10 = 1 300 N A1

(b) Using a **min. scale** of 1 cm: 200 N B1

Diagram correctly drawn (either parallelogram method or tip-to-tail method) B1



Allow ECF for weight of cargo from (a)

T_A = T_B = 1 900 N (accept values from 1 800 to 2 000 N) A1

2(a) For any system to be in equilibrium, B½

total clockwise moments is equal to total anticlockwise moments B1

about the same pivot B½

(b)(i) $F = P \times A$

$= 20000 \times 4.0 \times 10^{-2}\ m^2$ C1

$= 800\ N$ A1

(b)(ii) By Principle of Moments, Clockwise moments = anticlockwise moments

$800 \times 5 = 100 \times 10 + W \times 15$ Allow ECF from **(b)(i)** C1

$W = 200\ N$ A1

(b)(iii) Mass M should be moved further from the pivot. B1

With a larger release pressure, a larger force is produced at the valve, which means the clockwise moment is increased. Hence a larger anticlockwise moment is needed to balance this increased clockwise moment. B1

3(a) As the volume of the ball decreases, the number of air particles per unit volume increases. B1

Air particles in the ball collide more frequently with the inner walls of the ball. B1

The air particles then exert a larger force on the inner walls of the ball. Since pressure is the force per unit area, the pressure exerted increases. B1

(b) P_{atm} = 810 – 50 = 760 mm Hg C1

= 0.76 x 10 x 13 600

= 103 360 Pa ≈ 103 000 PA (3 s.f.) A1

4(a) They are poor heat conductors / poor emitter of radiation / poor absorber of radiation hence heat transfer into and out of igloo is slower. B1

(b) Any one of the following sets of answers:

- The Eskimos can curl their legs close to the body to reduce their surface area B1
  exposed to the surroundings, so heat loss by radiation from their bodies is slower. B1
- The Eskimos can wear silver / white coloured clothes, as such clothes are B1
  poorer emitters of radiation so that heat loss from their bodies is slower B1

(c) When air around the eskimos is warmed, it becomes less dense and rises B½

Hot air is trapped at the top of the igloo. B½

The cold air which is denser sinks into the cold sink and flows out of the igloo. B1

5(a) Specific heat capacity is the amount of thermal energy required to raise the temperature of 1.0 kg of water by 1.0 °C. B1

Specific latent heat of vaporisation is the amount of thermal energy required to change 1.0 kg of water into steam without a change of temperature. B1

(b) Heat needed = $mc\Delta T$

= 1 200 x 4200 x (100 – 25) C1

= 3.78×10^8 J A1

(c) Heat needed = ml_v

= $450 \times 2.3 \times 10^6$ C1

= 1.04×10^9 J A1

6(a) Critical angle is the angle of incidence in the optically denser medium for which the angle of refraction in the optically less dense medium is 90°. B1

(b)(i) In order for total internal reflection to occur, light ray must travel from an optically denser medium to an optically less dense medium. B1

Therefore, glass core has a higher refractive index than plastic cladding. B1

(b)(ii) $\frac{\sin 45^\circ}{\sin r} = 1.65$ C1

$r = 25.4°$ A1

(b)(iii) $\frac{1}{\sin c} = 1.65$ M1

$c = 37.3°$ A1

7(a) voltmeter reading $= \frac{6}{7} \times 12$ C1

$= 10.3$ V (3 s.f.) A1

(b) The **potential difference across the 6.0 kΩ resistor is given by** $\frac{6}{6 + R_{TH}} \times 12$ where

R_{TH} is the resistance of the thermistor. B1

As the resistance of the thermistor increases, the potential difference across the 6.0 kΩ resistor will decrease and voltmeter shows a smaller reading. B1

Alternative explanation

As the resistance of the thermistor increases, the total resistance of the circuit increases and the current in the circuit decreases. B1

Since potential difference across the 6.0 kΩ resistor is given by V = IR, if current decreases, potential difference decreases and voltmeter shows a smaller reading. B1

8(a) Wire X: Live wire
Wire Y: Neutral wire
Wire Z: Earth wire
Device W: fuse

B2 (1 mark for every two correct answers)

(b)(i) The large current flows through the earth wire to the ground. B½

The fuse will melt (or circuit breaker will trip) and break the circuit. B½

Thus the high voltage source is disconnected from the water heater and the water inside will no longer be live, preventing electric shock. B1

(b)(ii) green and yellow B1

(c) Total kWh used per month = 3.0 x 0.5 x 30

= 45 C1

Total cost = 45 x \$0.30

= \$13.50 A1

9(a) When the switch is closed, current flows through the coil and the iron core becomes an electromagnet. B1

The electromagnet attracts the iron bolt, causing it to move to the left, allowing the door to be opened. B1

(b) Any two of the following answers: B2

- Increase the number of turns of the coil of wire
- Increase the current flowing through the coil of wire.
- Move the iron core closer to the iron bolt.

10(a)(i) $\lambda = \frac{v}{f}$

$= \frac{6\,100}{4.0 \times 10^6}$ C1

= 0.00153 m (3 s.f.) or 1.53 mm A1

(a)(ii) distance = 3 x 0.01525 = 0.00458 m (3 s.f.) A1

(b)(i) $s = \frac{2d}{t}$

$6100 = \frac{2 \times 0.004}{t}$ C1

t = 0.000001311

= 1.31 μs A1

(b)(ii) A **shorter pulse 13 spaces after the reflected pulse**. B1

(c) Either the emitted and transmitted pulses will be closer

OR the time interval between emitted and refelcted pulses will be shorter B1

The ultrasound travels a shorter distance at the same speed before it is reflected. B1

(d) The chemical solution will always be in contact with the bottom wall. B1

Any corrosion of the wall will be detected at the bottom wall first. B1

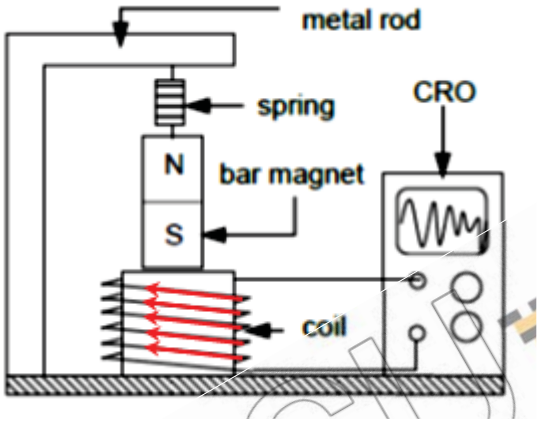
11 (a)(i) During an earthquake, the magnet moves in and out of coil, producing a change in magnetic flux linking (in) the coil, thus inducing an electromotive force (e.m.f.) at the solenoid. B1

The direction of the e.m.f. changes when the magnet moves in and out of the coil, hence an alternating trace is produced. B1

The magnitude of the induced emf is proportional to the rate of change of magnetic flux linkage, B1

hence a larger tremor will produce a trace with a higher amplitude. B1

(a)(ii)



(b)(i) Soft iron B1

(ii) $V_s = 50 \times 2.0 = 100\ V$

$0.75 \times V_p I_p = V_s I_s$

$0.75 \times 2.0 \times I_p = 100 \times 0.0024$ C1

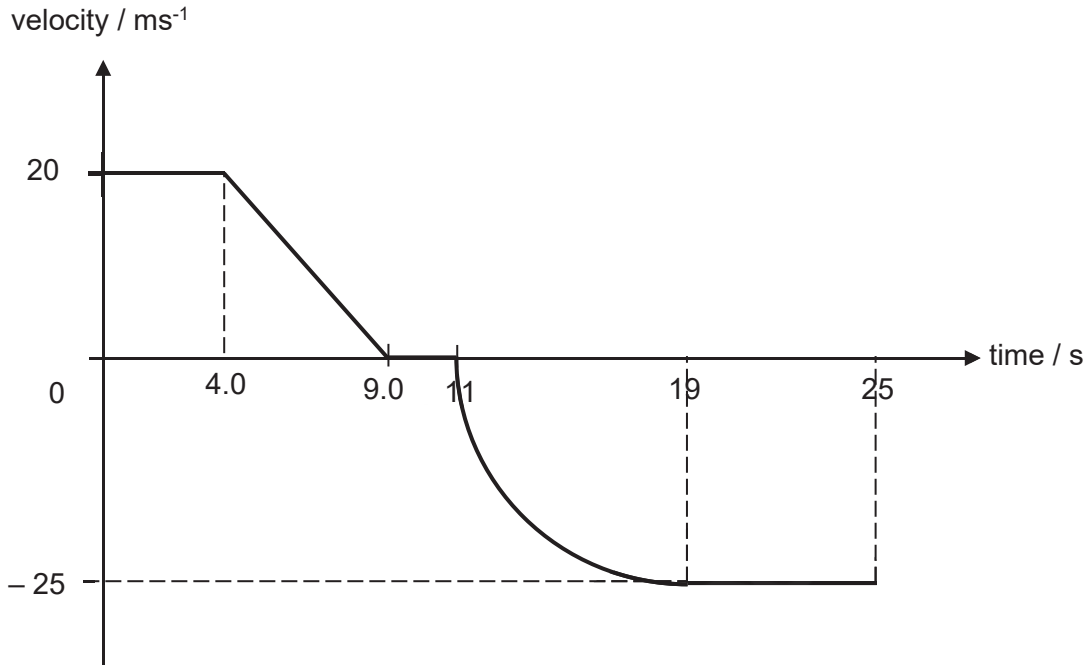
$I_p = 0.16\ A$ A1

(iii) Any two answers from the following: B2

- There is energy loss due to eddy currents formed in the core of the transformer.
- There is heat loss due to the resistance in the primary / secondary coils.
- There is magnetic flux leakage between the primary and secondary coil.

12 EITHER

(a)(i)



- B1 mark for correct timings
- B1 mark for all correct shapes
- B1 mark for axes correctly labelled.

(a)(ii) The velocity of the car decreases at a constant rate. B1

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

$= \frac{0 - 20}{5.0}$ C1

$= -4.0$

deceleration = $4.0\ m/s^2$ A1

(b) $F = ma$

$= 1\,500 \times 4.0$ Allow ECF from **(a)(iii)** C1

$= 6\,000$ N **Do not accept – 6 000 N** A1

(c) The opposing force such as air resistance acting on the car increases as velocity of the car increases. B1

This causes the resultant force acting on the car to decrease, resulting in a decrease in its acceleration. B1

12 OR

(a) During impact, part of the kinetic energy of the golf club is converted into kinetic energy of the ball and sound and thermal energy as the club hits the ball. B1

The golf club continues moving with a smaller amount of kinetic energy. B1

The amount of total energy remains constant before and during impact. B1

(b) As the golf ball travels, its gravitational potential energy is changed into kinetic energy and vice-versa. B1

This means that $mgh = \frac{1}{2}mv^2$ or $v^2 = 2gh$ or speed is independent of mass. B1

(c)(i) Increase in GPE = mgh

= 0.045 x 10 x 16 C1

= 7.2 J A1

(ii) KE at A + GPE at A = KE at B and GPE at B

= 2.5 + 7.2 **Allow ECF from (c)(i)**

= 9.7 J A1

(iii) KE at C = KE at B and GPE at B

$\frac{1}{2} \times 0.045 \times v^2$ = 9.7 **Allow ECF from (c)(ii)** C1

v = 20.8 m/s A1