



Complete, fold and seal
(see note 2 below)

SURNAME: white

FORENAME(S): Kai

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

[illegible]
$$\frac{60}{90} = 66\%$$

1a. $4 \frac{dy}{dx} = 8x^2 + 2$ $y_0 = 2$

$$\frac{dy}{dx} = 2x^2 + 0.5 \quad \checkmark \quad 2$$

$$y = \frac{2x^3}{3} + 0.5x + c \quad \checkmark \quad 4$$

~~at x=0~~ $y=2$

u

$$2 = \frac{2 \times 0^3}{3} + (0.5 \times 0) + c$$

$$c = 2 \quad \checkmark \quad 2$$

$$y = \frac{2x^3}{3} + 0.5x + 2 \quad \checkmark \quad 2$$

(10)

$$16 \quad x^2 \frac{dy}{dx} + xy = x^3$$

$$\div x^2 \quad \checkmark$$

$$\frac{dy}{dx} + \frac{y}{x} = x \quad \checkmark$$

$$y + \boxed{\frac{dy}{dx} + py = Q}$$

$$p = x^{-1}$$

$$c = y(0) \\ c = 2$$

$$y \rightarrow \int p = \int x^{-1} = \ln x \quad \int p dx = \frac{x^3}{3}$$

$$\int p = \int x^{-1} = \ln x$$

$$\int p dx = x$$

RHS correct

$$yx^2 = \frac{x^3}{3} + c \quad \checkmark$$

$$yx^2 = \frac{x^3}{3} + 2x$$

$$ye^{\int p dx} = \int e^{\int p dx} Q dx \quad \checkmark$$

$$ye^{x^2} = \frac{x^3}{3} + 2x$$

Method correct
Integrating factor incorrect

Q1 10+3

13

$$y = 3 \quad \frac{dy}{dx} = 3 \quad x = 0$$

Question No.

Examiner Only

2a $2 \frac{d^2 y}{dx^2} + 7 \frac{dy}{dx} + 6y = 0$

Ass Eq. $2m^2 + 7m + 6 = 0$

$$a = 2$$

$$b = 7$$

$$c = 6$$

$$M = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$M = \frac{-7 \pm \sqrt{7^2 - (4 \times 2 \times 6)}}{2 \times 2}$$

$$m = -1.5 \text{ or } -2 \quad \checkmark$$

$$y = A + B \quad \bigg|_3 = A + B \quad 3 - B = A \quad \checkmark$$

$$Ae^{mx} + Be^{mx} = y \quad \checkmark$$

$$Ae^{-1.5} + Be^{-2} = y \quad \checkmark$$

$$-1.5 Ae^{-1.5} + B(-2)Be^{-2} = \frac{dy}{dx} \quad \checkmark$$

$$-1.5A - 2B = 3 \quad \checkmark$$

$$-1.5(3 - B) - 2B = 3$$

$$-4.5 + 1.5B - 2B = 3$$

$$-0.5B = 7.5$$

$$B = -15$$

$$B = \frac{3}{-0.5} = -6$$

$$-1.5A - 2(-0.375) = 3$$

$$-1.5A + 0.75 = 3$$

$$-1.5A = 2.25$$

$$A = \frac{2.25}{-1.5} = -1.5 \quad \checkmark$$

Method correct

$$-1.5e^{-1.5} - 0.375e^{-2} = y$$

14/20

Q 2

14

Q3

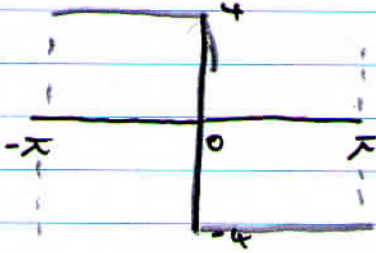
x	F	xF	$f(x - \bar{x})^2$
7	5	35	35.113
8	21	168	57.173
9	25	225	10.563
10	20	200	2.45
11	16	176	29.16
12	8	96	44.18
13	5	65	56.113
Σ	100	965	234.753 ✓ 5

$$\bar{x} = \frac{\Sigma xf}{\Sigma f} = \frac{965}{100} = 9.65 \quad \checkmark \quad 2$$

$$\sigma = \sqrt{\frac{\Sigma f(x - \bar{x})^2}{\Sigma f}} = \sqrt{\frac{234.753}{100}} = \sqrt{2.34753} = 1.533 \quad 3$$

Q3 10

Q4

period = 2π 

5 OPP ✓

$$a_0 = 0 \quad a_n = 0 \quad \checkmark$$

$$b_n = \frac{2}{\pi} \int_0^{\pi} f(x) \sin(nx) dx \quad \checkmark$$

$$= \frac{2}{\pi} \left[\frac{4 \cos nx}{n} - \frac{4 \cos n0}{n} \right] \quad \checkmark$$

$$= \frac{2}{\pi} \left[\frac{4}{n} \cos nx - \frac{4}{n} \cos n0 \right] \quad ?$$

$$f(x) = 0 - \frac{8}{\pi} \sin x - \frac{4}{\pi} \sin 3x - \frac{8}{\pi} \sin 5x - \frac{4}{\pi} \sin 7x$$

Q4

10

Q5)

a) i)

$$\frac{2}{s} + \frac{2}{s^3} + \frac{1}{s-3}$$

x

0

ii)

$$\frac{4}{(s+2)^2 + 4^2}$$

2

iii)

$$2e^{3t}$$

✓

1

iv)

$$\frac{b}{(s+a)^2 + b^2} \rightarrow e^{-at} \sin bt$$

x 0

$$= e^{-8t} \sin 1t$$

Q5pta 3



$$\frac{dy}{dt} + 12y = 8$$

$$y(0) = 2 \quad t=0$$

56)

$$s\bar{X} - X_0 + 12\bar{X} = \frac{8}{s} \quad \checkmark$$

$$s\bar{X} - 2 + 12\bar{X} = \frac{8}{s}$$

$$s\bar{X} + 12\bar{X} = \frac{8+2s}{s}$$

$$\bar{X}(s+12) = \frac{8+2s}{s} \quad \checkmark$$

2

$$\bar{X} = \frac{8+2s}{s(s+12)} \quad \checkmark$$

$$\frac{8+2s}{s(s+12)} = \frac{A}{s} + \frac{B}{s+12} \quad \checkmark$$

3

$$8+2s = A(s+12) + Bs$$

$$8+2s \uparrow$$

$$\text{let } s=0$$

$$8+2(0) = A(0+12)$$

$$8 = 12A$$

$$\frac{8}{12} = A = 0.667 \quad \checkmark$$

$$\text{let } s = -12 \quad \checkmark$$

$$8+2s = A(s+12) + Bs$$

$$8+2s = A(s+12) + Bs \quad \text{let } s = -12$$

$$8 - 1.334 = -0.667A + 12A \quad \checkmark$$

$$8 - 1.334 = 0.667(-0.667 + 12) + B(-0.667)$$

$$6.666 = -0.445 + 8.004 - 0.667B$$

$$6.666 = 6.882B$$

$$\frac{6.666}{6.882} = B = 0.969 \quad \checkmark$$

$$6.882$$

$$\bar{X} = \frac{0.667}{s} + \frac{0.969}{s+12}$$

$$y = 0.667 + 0.969 e^{-12t}$$

$$y = 0.667 + 0.969 e^{-12t}$$

Correct method
evaluation of constant B incorrect

Q5 pt b

10

Q5

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